From: Johnson, Bruce
To: Dell, David
Cc: Cassler, Constance
Subject: [EXTERNAL] Data request
Date: Tuesday, April 16, 2019 4:07:06 PM
Importance: High

David,

Per our conversation this morning, we are requesting the input data and assumptions that were used by AECOM to run the FDOT District One Regional Planning Model (D1RPM). In essence, we request everything that would be needed to reconstruct/deconstruct what was modeled, in order to achieve (validate) the model output results:

- All D1RPM model files for the baseline conditions and the two alternatives (No Action and Issuance of ITPs)
- Any spreadsheet files developed to interpolate/extrapolate TAZ socioeconomic (SE) land use data for the two alternatives
- Any GIS files used/developed that may have been used to quantify the SE data into the appropriate TAZs
- Any written documentation as to what modifications, if any were made to the TAZs, centroid connectors, network files, etc.
- Any supporting materials (input or output figures or tables) that clarify modeling approaches, inputs, and/or outputs

Given the timeline for the section 7 process, we request that the contractor deliver the necessary information to the Service ASAP. If they are unclear about any aspect of this request, we can promptly arrange a conference call between the Service, AECOM, and our transportation planner.

Thanks,

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

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From:	Clements, E. Carter Chandler
To:	Dell, David
Cc:	Tawes, Robert; Cassler, Constance; "CSpilker" (cspilker@collierenterprises.com); Turner, Andrew; Johnson, Bruce (Bruce.Johnson@stantec.com)
Subject:	[EXTERNAL] ECPO Responses to USFWS Recommendations for HCP Revisions
Date:	Friday, February 22, 2019 5:59:41 PM
Attachments:	image001.png ECPO Responses to USFWS Recommendations_72622952_9.PDF
Importance:	High

David,

As we discussed on Wednesday, attached are ECPO's written responses to the recommendations that you send to us in late December. We are in the process of revising the August 2018 version of the HCP to reflect the revisions described in our responses, and will forward the revised HCP to you when we have completed that work.

Best regards.

HUNTON ANDREWS KURTH

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FWS Recommended Revisions to HCP

This document outlines David Dell's suggested revisions to the HCP, and ECPO's corresponding responses.

HCP Revisions most highly recommended to support positive issuance criteria findings

- Tighten up description of uses and operations of Marinelli Fund.
    - The Service needs to have a role in overseeing Marinelli funds expenditures.

See revisions in Chapter 9 which clarify that the Service will have oversight through direct advice and technical assistance to the Marinelli Fund Board regarding expenditures from the Marinelli Fund and, will be able to attend Board meetings when conservation priorities and conservation activities will be determined. See also revisions to Chapter 7 at Section 7.7.3, which clarify that the annual report prepared on behalf of the permittees and submitted to the Service will provide an accounting of the year-end balance of the Marinelli Fund, along with a summary of all accruals to the Fund and all expenditures from the Fund for (i) HCP monitoring and reporting that is required by the overall HCP and ITPs, and which goes beyond the monitoring and reporting obligations associated with individual projects and paid for by individual permittees, and (ii) discretionary expenditures to initiate and support conservation activities that go beyond the requirements of the HCP and ITPs.

    - Clarify that expenditures toward projects, like an environmental education center, would not serve as mitigation.

The permanent preservation and maintenance of approximately 107,000 acres of land is the mitigation provided by the HCP and fully offsets the impacts of authorized incidental take. The establishment and use of the Fund to implement conservation activities, such as the establishment of an education center, is not mitigation; it is an additional conservation benefit provided by the HCP through contributions to the Marinelli Fund. See revisions in Chapter 9.

    - Project-specific conservation measures should be borne by the individual landowner, rather than the Marinelli Fund.

Preservation of land by individual landowners will occur as Covered Activities are undertaken by those landowners through placement of conservation easements on lands that correspond to and fully offset impacts from Covered Activities. All costs associated with establishing conservation easements on preservation lands will be borne by the individual landowner and will be proportional to the Covered Activities being initiated. Individual landowners will be responsible for arranging and paying for all costs associated with project-level permitting and associated mitigation requirements and conservation measures, as well as project-specific monitoring that would occur in the absence of the HCP. See clarifying revisions in Chapter 9.

- Our understanding is that the Marinelli Fund is intended as mitigation for effects not directly assignable to any one project, such as locating and constructing highway wildlife crossings.

As noted above, the conservation activities that will be financially supported by the Fund, such as the construction of highway wildlife crossings, are not mitigation; they are additional conservation benefits provided by the HCP. See clarifying revisions in Chapter 9.

- Several commenters are confused whether project-specific monitoring will be funded by individual project proponents or by the Marinelli Fund and they want clarification in the HCP.

As noted above, individual landowners will each be responsible for arranging and paying for all costs associated with project-specific monitoring that would be associated with residential and commercial development and/or earth mining in the absence of the HCP. Monitoring that is required for implementation of the HCP through the ITPs—including compliance monitoring and effectiveness monitoring for the HCP as a whole—will be arranged by the landowners, following consultation with FWS, FWC, and the Marinelli Fund Board, and will be paid for through the Marinelli Fund. The cost of annual reporting requirements of the HCP and ITPs will also be paid through the Marinelli Fund. The permittees will each deposit $2,000 into the Fund within 90 days following the issuance of the ITPs to cover the costs of monitoring and reporting that may be incurred prior to the initiation of Covered Activities. The landowners will pay the same amount into the Fund in subsequent years in the event that there has been no contribution to the Fund based on Covered Activities, in order to ensure that adequate funding will be available to pay for monitoring and reporting required under the HCP and ITPs. These initial contributions will be available for use only to pay for monitoring and reporting required under the HCP and ITPs, and will not be available for support of conservation activities at the discretion of the Board. All initial contributions made by each permittee will be credited against that permittee's the per-acre contribution requirements of the Fund. See clarifying revisions in Chapter 9.

- Clarify the intent of the conservation measures presented in the HCP (section 7.6).
  - Specifically link potential conservation actions as options for specific projects (authorized activity):
    - developer responsible for project-specific conservation at interfaces with preserve lands
    - Funding assurances for on-going project-site management (cost borne by landowner/developer/HOAs, etc?)
    - Describe how the BMPs fit in.

See revisions in Section 7.6. See also explanation above and revisions to Chapter 9, clarifying the scope of costs borne by permittees versus the Marinelli Fund.

- The example of the reforestation and hydrologic restoration at Rural Lands West could be presented as an example of the intention for project/site-specific conservation.

Section 7.6 describes measures that the Plan will implement to avoid, minimize, or mitigate impacts to Covered Species. As described in that section, habitat restoration is not a requirement of the Plan, with the exception of restoration of degraded habitat for caracara (section 7.2.1.1, Objective 2), but the preservation of land will make it possible for the Marinelli Fund, a permittee, a government entity, or some other third-party to support and/or perform restoration in these areas. See clarifying revisions in Section 7.6.

- Provide a framework for decisions on conservation actions (Defenders comments, p. 8).

As noted above, decisions regarding conservation activities funded by the Marinelli Fund, such as the location and number of wildlife crossings, will be made by the Marinelli Fund Board—which will be comprised of two representatives of the landowner-permittees, one representative of each of the permittees' four conservation partners, and one at-large member who will serve at the invitation of the other six members of the Board—with technical assistance from the Service. The principles that will guide the allocation of funds, and categories of conservation activities that will receive priority, are described in Section 9.5.

- Clarify that project-specific conservation actions should be considered in addition to the RLSA easements.

The Collier County Rural Lands Stewardship Program (RLSP) provides a purely voluntary framework, whereas the HCP and ITPs establish permanent preservation and maintenance of 107,000 acres is a mandatory condition of conducting the Covered Activities under the HCP/ITPs that will fully offset the impacts of authorized incidental take. The reginal, landscape-level planning that resulted in the land designations within the HCP area represents another benefit that is in addition to the voluntary RLSP, which does not require coordination among participants. Although the applicants are committed to working with developers and homeowners associations to employ the project-level planning measures described at subsection 7.6.1.2 and the best management practices described at subsection 7.6.1.3, these are not requirements of the HCP or ITPs. See revisions to sections 4.4 and 7.6, which specify certain project-level planning measures and best management practices that the landowners will commit to following—and which will be required under the HCP and ITPs—in order to further enhance the conservation value of the HCP, including the northern and southern wildlife corridors. The contributions to the Marinelli Fund required by the HCP will also facilitate support for conservation activities at the discretion of the Marinelli Fund Board (with input from the Service) that will serve as an additional conservation benefit. See clarifying edits in Section 7.6.

- Emphasize planning to minimize or avoid mortality of panthers within developments.

No panther mortalities are expected as a result of the Covered Activities. The land designations established within the HCP area represent regional, landscape-level planning that will minimize and avoid take, including mortality, of panthers and other Covered Species by consolidating and directing development away from more ecologically valuable areas of interconnected native habitats and toward previously cleared areas with lower habitat support functions, preserving wildlife dispersal corridors that provide crucial linkages between existing public conservation lands. At the project level, the applicants are committed to working with developers and homeowners associations to employ a number of avoidance strategies to minimize impacts of the Covered Activities, including the minimization measures described in Chapter 4 of the HCP at subsection 4.4.1.2. See clarifying edits in subsection 4.4.1.2.

- Wetland mitigation for individual projects could build on covered species mitigation plan -- would this be a component of the project-specific conservation measures.

As noted above, the 107,000-acre preservation area will serve as mitigation and will fully offset authorized incidental take. Within the preservation areas, approximately 54,007 acres are classified as native wetlands. Wetland mitigation for individual projects will be handled at the project level and is not addressed specifically in the HCP, although the applicants intend to work with FWS and the Corps to address in advance how wetland mitigation will be coordinated with preservation under the HCP. We note that, although the landowners are willing to coordinate wetland mitigation with HCP conservation activities, the determination regarding wetland mitigation required for each individual project belongs to the Corps under the CWA 404 program. As noted above, the applicants are committed to working with developers and homeowners associations to employ the project-level planning measures described in Chapter 7 of the HCP at subsection 7.6.1.2 and the best management practices described at subsection 7.6.1.3.

- Florida Wildlife Federation proposes the applicants include graded densities within the HCP (higher densities toward the center of proposed development nodes and lower densities along the perimeter of proposed developments, with a maximum allowable density of 1 unit per 50 acres along the perimeter of developments to minimize impacts on adjacent preservation areas).

As noted above, the applicants are committed to working with developers and homeowners associations to employ the project-level planning measures described at subsection 7.6.1.2 and the best management practices described at subsection 7.6.1.3, although these are not requirements of the HCP or ITPs. The project-level planning measures include a number of avoidance strategies to minimize impacts of the Covered Activities, including designing master plans that concentrate more intensive land uses within the center of mixed-use residential/commercial developments (town centers), and diminish land use intensities adjacent to panther habitat preservation

areas (e.g., providing "graded densities" that decrease the density of development outward from the center by providing transitions from mixed-use town centers, to residential neighborhoods, to community open space areas, to project boundaries, thereby providing two outer rings with no development). Given the spatial configuration of specific properties relative to preservation areas, and the 50-year timeframe of the ITPs, the applicants cannot commit to a specific density for all residential and/or commercial development over the course of the ITPs. See revisions to sections 4.4 and 7.6, however, which specify certain project-level planning measures and best management practices that the landowners will commit to following—and which will be required under the HCP and ITPs—in order to further enhance the conservation value of the HCP, including the northern and southern wildlife corridors.

- Articulate goals for project-specific conservation measures.
    - There needs to be a conservation "lift" above the RLSA preserve, per Audubon, there needs to be restoration (example of restoration at Rural Lands West).

As noted above, the HCP provides a number of conservation benefits that extend beyond those provided by the voluntary RLSP. Chiefly, whereas the RLSP provides a voluntary framework that does not mandate interconnection of preservation lands (SSAs), the HCP will create a binding mechanism that will permanently preserve and maintain approximately 107,000 acres of privately held land which could otherwise be developed. Moreover, the landscape-level planning provided by the HCP will result in greater conservation benefits than would exist under uncoordinated participation in the RLSP. The HCP also facilitates direct federal involvement in and oversight of its provisions; establishes federal, third-party enforcement mechanisms; includes state government coordination on the development and implementation of the HCP; incorporates and implements the Florida Panther Protection Program; creates and funds the Marinelli Fund, which will be used for conservation activities that go beyond the requirements of the HCP and ITPs and that will benefit the Florida panther, as well as other wildlife; and imposes additional monitoring that is not required under the RLSP. Although habitat restoration is not a mandatory requirement of the HCP, the preservation of land makes it possible for the Marinelli Fund, a permittee, a government entity, or some other third-party to support and/or perform restoration in these areas. See clarifying revisions in Section 1.7.3.

    - Given that conservation credits (sending-receiving units) could be traded among ECPO members, a restoration target would help ensure against a cumulative shortfall of project-specific conservation.

The permanent preservation of approximately 107,000 acres of land will serve as mitigation that fully offsets the impacts of authorized incidental take under the HCP and ITPs. The conditions and requirements of the HCP and ITPs are independent from the RLSP, and whether or not the permittees trade stewardship (i.e., conservation) credits under the RLSP, they will remain subject to the requirements of the HCP and ITPs. The HCP is designed so that conservation easements will be

placed on preservation lands prior to the initiation of Covered Activities and will be proportional to the amount of residential/commercial development. Although habitat restoration is not a requirement of the Plan (with the exception of restoration of degraded habitat for caracara; section 7.2.1.1) the preservation of land under the HCP and ITPs will make it possible for the Marinelli Fund, a permittee, a government entity, or some other third-party to support and/or perform restoration in these areas.

- Are there particular segments of habitat corridors or road crossings where we should specify certain management prescriptions? See Defenders comments (p. 5).

See revisions to sections 4.4 and 7.6, which specify certain project-level planning measures and best management practices that the landowners will commit to following—and which will be required under the HCP and ITPs—in order to further enhance the conservation value of the HCP, including the northern and southern wildlife corridors. Both wildlife passage corridors (northern and southern) will include core areas of native vegetation that are buffered by a combination of surface water management lakes (to avoid human-panther interactions), berms, landscaping, and low-intensity land uses near the corridors. Although the specific corridor designs will not be established until projects within the surrounding areas designated for Covered Activities are designed and permitted, the proposed southern corridor configuration will maintain a minimum width of 500 meters (1,640 feet or 0.3 mile) over the 3.2-km distance between the vast habitat area south of Oil Well Road and the 1,900-acre habitat block (stopover habitat) that includes Summerland Swamp and surrounding citrus groves. Draft HCP at 102. The proposed northern corridor configuration will maintain a minimum width of 400 meters (1,300 feet or 0.25 mile) over the 2-4 km distance between the northern limits of the Corkscrew Regional Ecosystem Watershed (CREW) lands and the northern boundary of the HCP. Draft HCP at 102. The applicants reconfigured the northern corridor to intersect a future wildlife crossing and allow for two connections into Hendry County that will feed into preservation and agricultural areas planned for the Southwest Hendry Sector Plan. Specifically, the applicants have agreed to put conservation easements on private land to accommodate Florida Department of Transportation plans to construct a wildlife crossing to provide for safe passage of panthers and other wildlife during a widening project of SR-82 at Gator Slough. This change will help ensure the benefit of the wildlife crossing.

- Commenters would like to see explicit, measurable biological goals and objectives for covered species relative to baseline condition.

The key biological characteristic that will be used to measure the performance of the HCP will be the quantity and quality of suitable habitat preserved for the Covered Species. The habitat requirements for the Covered Species are well established by the scientific literature, and the documented habitat characteristics and acreage within the preservation areas under the HCP will serve as a sound basis for effective monitoring under the Plan. Use of habitat-based monitoring for the Covered Species is

appropriate because the availability of suitable habitat is cited as a primary threat to recovery for each species, as well as a primary conservation priority for each of the species. Within the preservation areas, habitat assessments will be conducted for areas to be placed under perpetual conservation easements to document baseline conditions at the time of easement recording. Habitat assessments will be conducted on an annual basis to document the current habitat quality of the preserved areas relative to baseline conditions to ensure that biological goals are being met and the results of these assessment will be documented in the annual report prepared on behalf of the permittees and submitted to the Service. See clarifying edits in Section 7.7.3.

- The draft section 7/404 MOU contemplates a "concurrence" check as individual projects are proposed. Having defined goals would facilitate ECPO's concurrence coordination with the Service as we implement the MOU.

ECPO members have started working with FWS and the Corps on the draft MOU.

- Discussion of red knot, consideration/decision not to cover

The applicants considered including the red knot among the Covered Species under the HCP but have decided not to seek take coverage for this species because it is a shorebird that does not typically occur in the HCP area (away from the coast and saltwater environments). No take of the red knot is expected and thus no take coverage is requested or will be authorized.

- Commenters concerned the adaptive management plan isn't actionable (no defined protocols, metrics, or decision points). An oversight panel, as suggested by Defenders, p. 11, would strengthen this.

As explained in the HCP at Sections 4.6 and 7.8, and in Chapter 8, if the current environmental circumstances change substantially during the course of the ITPs, the permittees will coordinate with FWS to determine how to respond to a changed circumstance based on the degree of impact to Covered Species and, together with the Service, will determine whether and what adaptive management is necessary. Chapter 8 of the HCP provides information on thresholds to be used to determine when it is necessary for the permittees to initiate communication with FWS regarding specific potential events and provides a framework for how to respond to significant events. It is difficult to provide more specificity regarding adaptive management than is already provided in the HCP, given the 50-year term of the ITPs In addition, we note that many of the commenters' concerns would be addressed by the Service's regulatory requirement to reinitiate formal consultation under certain circumstances. The Service's implementing regulations specify that "Reinitiation of formal consultation is required and shall be requested by . . . the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (a) [i]f the amount or extent of taking specified in the incidental take statement is exceeded; (b) *[i]f new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered*; (c) [i]f the identified action is subsequently modified in a manner that

causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or (d) [i]f a new species is listed or critical habitat designated that may be affected by the identified action." 50 C.F.R. § 402.16 (emphasis added). ECPO supports the formation of an oversight panel comprised of scientific experts who have published research on one or more of the Covered Species in peer-reviewed publication that would meet every three years during the 50-year term of the ITPs to assess the performance of the HCP and provide recommendations to the permittees and the Service regarding when adaptive management may be needed. See revisions in Sections 4.6 and 7.8.

HCP Revisions recommended to strengthen the document

- Does the HCP account for preserve areas already obligated for other section 10 or 7 conservation measures?

  There are no preservation lands within the HCP area that are currently obligated for section 10 conservation measures; the only preservation lands already obligated for section 7 conservation measures are those set aside for impacts to Ave Maria. The HCP explains at section 4.2.2.2.1 that the PHUs provided by SSAs within these lands were removed from the PHU analysis in the HCP. We note that, under the HCP, the conservation value of these lands will be enhanced by the permanent preservation and management of lands adjoining these parcels. See clarifying edits in Sections 4.2.2.1.1 and 4.2.2.2.1.

- The HCP nominates FWC to monitor Florida panther in the HCP area. We need assurances that FWC is willing and resourced to do this, and will have full access to conduct monitoring. Need to guarantee the monitoring is sufficient to document the achievement of biological goals and objectives

  FWC maintains a longstanding panther research and management program funded through appropriations and the Florida Panther Research and Management Trust Fund.[1] If the panther monitoring conducted by FWC within the HCP area requires additional monetary support, the Marinelli Fund may provide required funds. The applicants will work with FWC and FWS to determine whether additional monitoring protocols and/or studies may be required to effectively monitor the panther within the HCP area. In the unlikely event that FWC significantly changes or discontinues its panther research and monitoring program, the permittees will coordinate with FWS under the "Changed Circumstances" procedures.

- More explanation of RLSA, we have several comments about what is already protected, i.e., sending areas already being under protection. Several comments complain about the history of RLSA program versus its description in the HCP. [Note that "protections"

[1] *See* Annual Report on the Research and Management of Florida Panthers: 2017-2018 (Oct. 18, 2018), available at https://myfwc.com/media/17636/pantherannualreport2017-18.pdf. The last page of this report includes funding information as of June 30, 2018.

under the RLSA and other local authorities do not preclude their use in the HCP (we will explain in findings), we suggest clearer accounting of the local authorities.]

> See revisions in Section 1.7. As noted above, the HCP provides a number of conservation benefits that extend beyond those provided by the voluntary RLSP.

- Clarify or tighten up accounting of allowable land uses in the preserve areas

> See clarifying revisions in Section 2.2.

- Clarify and tighten up what and where historic low-intensity land uses

> See clarifying revisions in Section 2.2.

- Clarify cumulative impacts: RLSA allows about 43,000 acres, and the HCP is more. Also, many commenters point to known, additional projects that occur outside of the HCP covered activity (only consider within the ECPO plan area).

> The RLSP is currently undergoing a county amendment process which may stipulate a development cap of 45,000 acres. If there is any difference in acreage between the RLSP and the HCP, the lower cap will govern the extent of development. FWS should consider whether to add any of the 25 projects listed by CBD on pages 92-98 its comments to the cumulative effects analysis in the EIS.

- Fire management and smoke on developed areas?

> Controlled burns and mechanical vegetation control, including reducing the amount or height of vegetation, are the most effective measures to minimize the destructive effects of wildfires.[2] The applicants will continue to implement land management practices to prevent impacts due to fire and will work with developers and homeowners' associations to educate new residents within the HCP area regarding wildfire risk and prevention. *See* Draft HCP at 272. Permittees will include provisions in contracts with developers for lands within the Covered Activities areas that require developers to provide notice to residents that smoke from controlled burns may drift into residential areas. See revisions in Section 7.6.

- Bolster the changed and unforeseen circumstances section (Defenders, pp. 8-9).

> See revisions in Chapter 8.

Summary of concerns raised by commenters that should be considered when revising the HCP

- Several commenters are concerned about the change in traffic volume attributable to covered activities and how this will affect Florida panther. The HCP confuses changes in

[2] *See* Florida Forest Service, Wildfire Mitigation in South Florida: Understanding the Work to Reduce Your Risk.

transportation volume incurred by development and changes in transportation infrastructure that comes about because of transportation planning by the county and state. The HCP claims the applicants should not be held liable for take of Florida panthers from vehicle collisions or barrier effects from changes in transportation infrastructure, but does not address take from changes in transportation volume.

- Most commenters want the issue of panther mortality caused by changes in transportation volume to be addressed in the HCP and the take inherent to this avoided, minimized, and mitigated by the applicants. Defenders of Wildlife also cite a case precedent which indicates the applicants could be held responsible for take of covered species caused by changes in transportation infrastructure - if it is shown the changes in transportation infrastructure will be in response to the applicants' proposed activities. Defenders of Wildlife argues that the impact of future changes in traffic infrastructure, taken in response to covered activities, be likewise be avoided, minimized, and mitigated by the applicants.

See Responses to Public Comments document sections II.A-B.

- Friends of FPNWR concerned development will impact management activities on the refuge, such as suppressing prescribed fire, introducing invasive species, and exposing FP to feline leukemia.

Permittees will include provisions in contracts with developers for lands within the Covered Activities areas that require developers to provide notice to residents that smoke from controlled burns may drift into residential areas. See revisions in Section 7.6. See Responses to Public Comments addressing invasive species and feline leukemia document section VII.H.

- Florida Wildlife Federation concerned the HCP doesn't quantify land use types in preserve areas (forest vs. agriculture etc) and establish explicit goals for habitat restoration within the preserve.

For a breakdown of land use types in the preservation areas, see the Draft HCP at Table 3-1 and the dEIS at page 32. As noted above, within the 107,000-acre preservation area, traditional, historic, and ongoing rural land uses – primarily agriculture and ranching – will continue as they have for many decades, as part of the landcover matrix that supports the Covered Species. *See* dEIS at 32, Tbl. 3.1-1 (improved pastures, cropland/pasture, citrus groves/other groves, and other agricultural rural open lands). Also, as noted above, although habitat restoration is not a requirement of the Plan, the preservation of land will make it possible for the Marinelli Fund, a permittee, a government entity, or some other third-party to support and/or perform restoration in these areas.

- Florida Wildlife Federation wants large-animal exclusionary fences to be banned from use within the very low density use areas to allow free movement of panthers through these areas.

  ECPO agrees with this recommendation and FWS should consider adding language to this effect. See clarifying revisions in Section 2.2.

- Florida Wildlife Federation thinks oil and gas exploration and production should be prohibited in preservation/plan-wide activities areas within the HCP area.

  The HCP provides that oil and gas exploration and production are among the activities that may occur within the lands designated for Preservation/Plan-Wide Activities and Very Low Density Use. As explained in the HCP at Section 2.2, active oil and gas production has occurred within the HCP area since the 1940s, and remains ongoing. Long-term radiotelemetry data and GPS data demonstrate that oil and gas production is compatible with utilization of the surrounding habitat by the Florida panther. No adverse effects of oil and/or gas exploration or production have been documented for the Covered Species within the HCP area, and no incidental take of Covered Species is expected based on these activities. The oil and gas activities conducted in the HCP area are subject to regulation and permitting by the State of Florida and Federal agencies. Under the Plan, oil and gas exploration and production are activities that may occur anywhere within the HCP area, as there are inherent uncertainties related to locating productive oil and gas reserves. See clarifying edits in Section 2.2 and Chapter 3.

- Florida Wildlife Federation is concerned that a block of Covered Activities areas near the intersection of Oil Well Road and SR-29 will impede the ability of panthers to utilize crossings on those roads. Telemetry data supports the concern that panthers use this area regularly, and that development in this particular location could impede the ability of panthers to disperse north along this corridor. They also point to a block of Covered Activities Areas on CR 858 that will have similar effects.

  Under current Collier County base zoning laws, all lands within the HCP area are zoned for and subject to development at a density of one dwelling unit per five acres, and in the absence of the HCP, applicants would be free to pursue development pursuant to local zoning regulations. The proposed southern corridor, which is located in this area, will permanently preserve areas of native vegetation and restored pine flatwoods to allow the panthers to disperse north or south between the vast habitat area south of Oil Well Road and the 1,900-acre habitat block (stopover habitat) that includes Summerland Swamp and surrounding citrus groves. A minimum width of 500 meters (1,640 feet or 0.3 mile) will be maintained over the approximately 2-mile length of the corridor. See revisions to sections 4.4 and 7.6, which specify certain project-level planning measures and best management practices that the landowners will commit to following—and which will be required under the HCP and ITPs—in order to further enhance the conservation value of the HCP, including the northern and southern wildlife corridors.

- Florida Wildlife Federation notes no budget has been drawn up for implementation expenditures and assurance of funding aren't apparent. FWF also notes the Marinelli Fund is filled by the sale of properties, meaning funds haven't been allocated for monitoring and other HCP needs prior to development and sales.

  See clarifying revisions in Chapter 9. As described above, the permittees will each deposit $2,000 into the Fund within 90 days following the issuance of the ITPs to cover the costs of monitoring and reporting that may be incurred prior to the initiation of Covered Activities. The landowners will pay the same amount into the Fund in subsequent years in the event that there has been no contribution to the Fund based on Covered Activities, in order to ensure that adequate funding will be available to pay for monitoring and reporting required under the HCP and ITPs. These initial contributions will be available for use only to pay for monitoring and reporting required under the HCP and ITPs, and will not be available for support of conservation activities at the discretion of the Board. All initial contributions made by each permittee will be credited against that permittee's the per-acre contribution requirements of the Fund.

- Some commenters are confused about the mechanism of habitat restoration.

  As noted above, habitat restoration is not a requirement of the Plan, but the preservation of land will make it possible for the Marinelli Fund, a permittee, a government entity, or some other third-party to support and/or perform restoration in these areas.

- Audubon of the Western Everglades wants this statement added to page. 52, Section 3.7 "A significant additional wildlife benefit of the HCP's proposed agricultural preservation is wading bird foraging habitat value found in wet season and early dry season flooded farm fields. These wet fields mimic the functions of vital and scarce short-hydroperiod wetlands."

  This statement will be incorporated into the final HCP.

- FWC states the form of take likely to come about from proposed activities will include harm as well as harassment.

  For most of the Covered Species, the only form of take anticipated to occur would be limited to harassment because most species will leave the area of the Covered Activities and will not be harmed, wounded, or killed. While unlikely, it is possible that certain ground-burrowing species – including gopher tortoise, gopher frog, eastern indigo snake, and eastern diamondback rattlesnake – as well as the Florida bonneted bat – may be "harmed" by the Covered Activities if death or injury occurs. Draft HCP at 98 n.16. No intentional take (such as purposeful hunting, capturing or killing) will occur, and no such take authorization is requested. See also Responses to Public Comments document sections I.A.1-3.

- Defenders of Wildlife notes the HCP doesn't make use of all relevant available data sources when looking at species' range, occurrence, and population. Examples provided include GBIF, iNaturalist, eBird, and Arctos. FWC also provides apps that enable users to report locations and post photos of wildlife of conservation concern, like the FWC Reporter and the Gopher Tortoise Smartphone App. These data sources and applications often contain records of species' occurrence that Service records don't. For example, eBird had two years of red knot records, multiple snail kite records, multiple Audubon's Crested Caracara records, and records of other species covered or addressed in the HCP - including site information, age, sex, breeding status, and photos- from within the HCP footprint that weren't considered in the HCP. The HCP would be strengthened by review of all available sources of information about species range, occurrence, and population trends, disclosure of these records of species occurrence in the HCP footprint, and consideration of HCP implementation on Covered Species that may be more abundant and reliant on resources within the HCP area than the text of the HCP implies.

  See Responses to Public Comments document section I.B.

- Defenders of Wildlife complains the Deconstructed Activities doesn't seem to inform effects, avoidance measures, minimization, or mitigation measures cited elsewhere in the HCP.

  The applicants created the spreadsheets of deconstructed activities provided in Appendix A to the HCP at the request of the Service to assist in explaining the stages of Covered Activities and anticipated impacts of those activities on the Covered Species. Section 4.2.1 of the HCP analyzes the potential direct and indirect impacts to the panther from (i) habitat loss, (ii) construction disturbance and related stressors, (iii) earth mining, and (iv) land management. Draft HCP at 74-82. Potential direct and indirect impacts on other Covered Species are analyzed in Section 6.2. Draft HCP at 211- 224. During Section 7 consultation, FWS will use this information to complete the assessment framework in full.

- Defenders of Wildlife states it would benefit covered species to place caps on the acreage of land cover/land use classes that diminish the ecological value of preserve lands, and that the HCP should explicitly limit the intensity of activities currently allowed on preservation lands.

  As noted above, within the 107,000-acre preservation area, traditional, historic, and ongoing rural land uses – primarily agriculture and ranching – will continue as they have for many decades, as part of the landcover matrix that supports the Covered Species. *See* dEIS at 32, Tbl. 3.1-1 (improved pastures, cropland/pasture, citrus groves/other groves, and other agricultural rural open lands). The ability to continue these traditional rural land uses is important to obtaining the landowners' agreement to participate in the HCP. These lands will be managed to preserve their existing ecological functions and will provide the basis for long-term sustainable activities

compatible with conserving protected species. In other words, the Plan will prevent impacts that would result from more intensive uses of these lands, including development. Over the course of the 50-year term of the ITPs, the permittees need to retain the flexibility to conduct certain activities within the preservation lands to maintain agricultural production. However, the permittees will commit to maintaining the same proportion of native land cover within the preservation lands that exists at the time the ITPs are issues. Maintenance of these proportions of native land cover will be demonstrated in the annual report to FWS. See revisions in Sections 2.2 and 7.7.3.

- The Center for Biological Diversity, Conservancy of Southwest Florida, and Sierra Club note the HCP does not detail the impact of changes in transportation volume and infrastructure on listed species such as Florida panther and Eastern indigo snake, and that vehicle collisions and barrier effects incurred by these can have population-level effects on species. They state these effects are not analyzed by the applicants in the HCP, and that the HCP does not provide avoidance, minimization, or mitigation for these effects.

  See Responses to Public Comments document sections II.A-B.

- The Center for Biological Diversity, Conservancy of Southwest Florida, and Sierra Club complain that preserving 32,260 acres of land in agricultural use that is of low use to covered species, in the preserve areas, does not benefit covered species in the HCP nor minimize or mitigate for impacts to covered species in covered activities areas.

  As noted above, under current Collier County base zoning laws, all lands within the HCP area are zoned for and subject to development at a density of one dwelling unit per five acres, and in the absence of the HCP, applicants would be free to pursue development pursuant to local zoning regulations. Certain of the Covered Species—including Florida sandhill crane and Northern crested caracara—have been documented to use agricultural lands, including fields and pastures. These agricultural lands also support prey base for other Covered Species, including Florida panther, and provide ecologically valuable edge conditions at the interface of agricultural fields and native habitats within the HCP preservation areas. The majority of the preservation lands consist of native habitats, however, and as noted above, the permittees will commit to maintaining the same proportion of native land cover within the preservation lands that exists at the time the ITPs are issues. Maintenance of these proportions of native land cover will be demonstrated in the annual report to FWS. See revisions in Sections 2.2 and 7.7.3.

- The Center for Biological Diversity, Conservancy of Southwest Florida, and Sierra Club challenge the Panther Habitat Assessment Methodology as insufficient for the purpose of accounting for all impacts to Florida panther from covered activities, or to provide meaningful avoidance, minimization, and mitigation of those effects. Like other

commenters, they are concerned failure to account for all types, duration, and magnitudes of take will reduce the likelihood of survival and recovery of the species.

See Responses to Public Comments document section III.J.

From:	Johnson, Bruce
To:	Cassler, Constance
Subject:	[EXTERNAL] FW: Data request
Date:	Thursday, February 28, 2019 3:14:38 PM
Attachments:	Pages from 20180831_Letter_ServicetoCorps_AveMaria.pdf
Importance:	High

Connie,

When I sent the GIS file of the HCP without Ave Maria on 2/19, I assumed that the Service already had the GIS files for the associated mitigation in SSAs 1, 2, 3, 4, and 6.

I still think that is correct, but I wanted to make sure that when we removed Ave Maria for your Biological Opinion analyses, the Service is only removing SSAs 1-4 and the 1,656 acres within SSA 6 that were used as mitigation for Ave Maria (see 20180831 Ave Maria Biological Opinion, page 8). Only 1,656 acres of SSA 6 were used as federal mitigation, not the entire 9,911 acres that were set aside for the local RLSP entitlement process. Please make sure that the Biological Opinion analyses are consistent with this. I'm attaching Figure 5 from the 20180831 Bi-Op as an illustration.

If you have any questions, please call me at your convenience.

Thanks,

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

Stantec Consulting Services Inc.
300 Primera Blvd., Suite 300
Lake Mary, FL 32746-2145 US

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From: Johnson, Bruce
Sent: Tuesday, February 19, 2019 6:55 PM
To: 'constance_cassler@fws.gov' <constance_cassler@fws.gov>
Subject: Data request

Hi Connie,

Per our phone discussion, please find attached two files for use by FWS staff:

1. A GIS geodatabase file of the HCP Area, with the 5,027-acre Ave Maria DRI removed; and
2. A spreadsheet breaking down the CLC land cover within that area (146,752 acres).

Please let us know if you require anything else to continue with the analyses.

Best Regards,

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

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300 Primera Blvd., Suite 300
Lake Mary, FL 32746-2145 US

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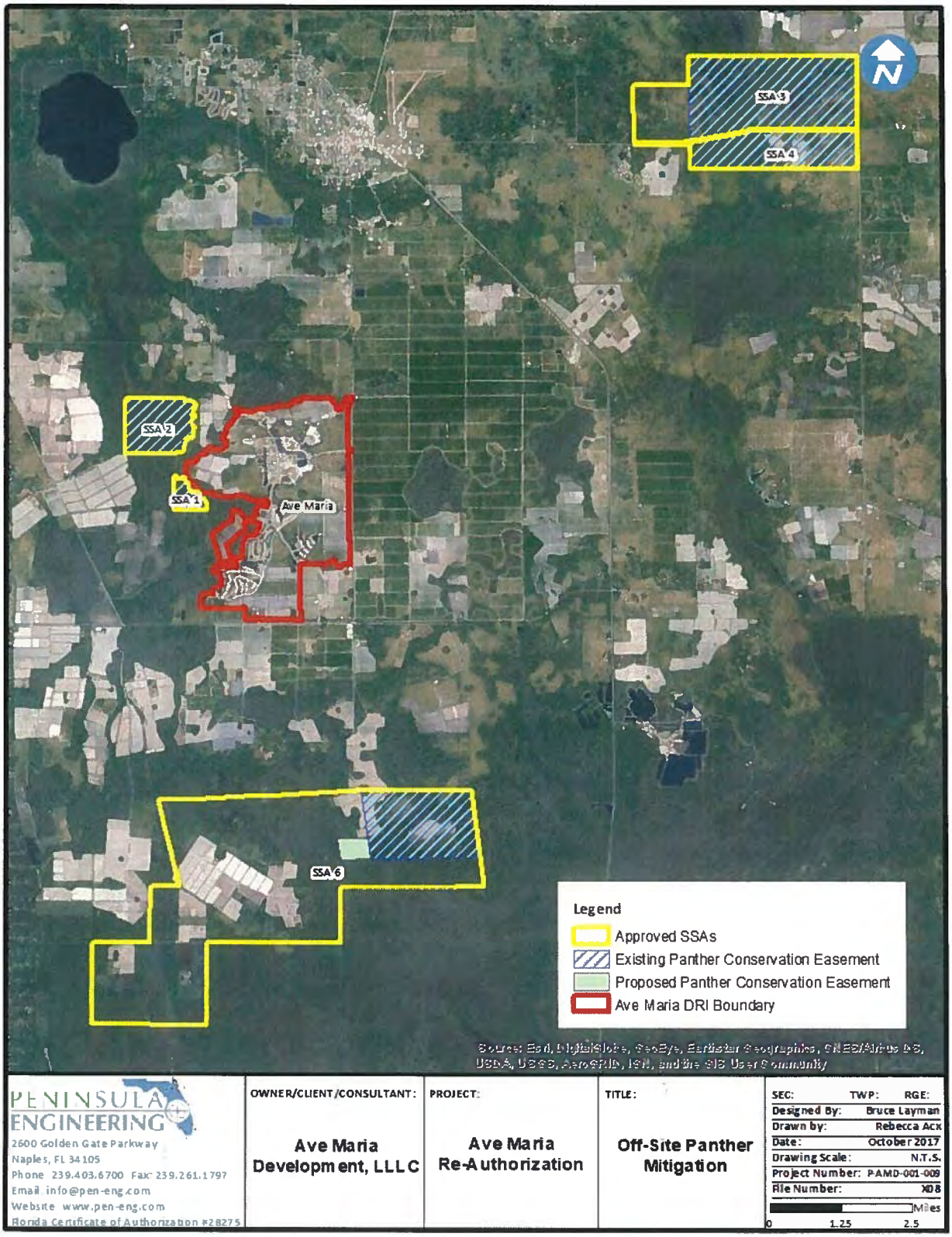

Figure 5. Locations of off-site panther compensation parcels for the Project.

From: Johnson, Bruce
To: Cassler, Constance; Dell, David; Kelso, Charles
Subject: [EXTERNAL] HCP files
Date: Monday, March 25, 2019 9:11:19 AM
Importance: High

All,

Thanks to Chuck's assistance with the file transfers, all of the updated HCP document files were uploaded a few moments ago. The upload contains the following files:

- A fully revised HCP document in PDF format
- The HCP document in Word format (without most table/figures); for Service use with commenting
- Appendix A to the HCP
- Appendix B to the HCP

Please check the TOC functionality in the Word document. Some members of our team could use the TOC links by using the Ctrl-Click command, while for others the links were not active. If the links are not working properly, please advise us and we will resubmit.

Thanks,

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

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From:	Johnson, Bruce
To:	Dell, David; Ziewitz, Jerry
Cc:	Tawes, Robert; Cassler, Constance; Christian Spilker (CSpilker@collierenterprises.com); Andrew Turner (aturner@hunton.com); Clements, E. Carter Chandler (eclements@hunton.com)
Subject:	[EXTERNAL] Outline of proposed traffic approach
Date:	Wednesday, May 8, 2019 2:06:51 PM
Attachments:	Outline of Proposed Traffic Approach to Section 7 Analysis (May 8 19).pdf
Importance:	High

David and Jerry,

Please find attached ECPO's outline of a proposed traffic approach to the section 7 analysis. We look forward to discussing the outline with you after you have reviewed it.

Regards,

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

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ECPO Perspective on Causation Related to
ESA Section 7 Consultation on ECMSHCP and Traffic Impacts

The following outline provides ECPO's perspective on causation principles related to ESA section 7 consultation on the HCP and ITPs, and traffic impacts in particular.

ECPO has consistently maintained that proximate cause is the appropriate standard for determining direct or indirect effects that may attributed to the ITPs, HCP or activities covered by the HCP, and that third party vehicle strikes of panthers or other species on external roadways cannot be deemed direct or indirect effects under the proximate cause standard. But even if the section 7 consultation applies a broader "but for" causation standard, third party vehicle strikes of panthers cannot be deemed direct or indirect effects of the ITPs, HCP or activities covered by the HCP. There are simply too many other, separate causal factors that determine when, where or how many future roadway strikes occur, including: panther access to roadways; the presence of wildlife fencing and underpasses along roadways; road design; speed limits and other traffic controls; driver behavior and skill; and panther behavior.

Finally, even though third party vehicle strikes of panthers cannot be deemed direct or indirect effects of the action under consultation, the HCP will provide significant mitigation benefits that will help offset those impacts.

I. **Proximate Cause**: Proximate cause is the appropriate standard for attributing direct and indirect effects to agency actions under ESA section 7.

   a. Consistency with NEPA causation standard

      i. Recognized by Service in HCP Handbook. *See e.g.* Handbook at 13-4:

         > "[W]e must consider whether the federal action, in this case the ITP, is the legally relevant cause of the effects which must be analyzed. Simple "but for" causation is not enough. There must be a reasonably close causal relationship between issuance of the ITP and the effects under consideration to require analysis under NEPA." (Emphasis added.)

      ii. Established by the Supreme Court in *Dep't of Transp. v. Pub. Citizen*, 541 U.S. 752, 754 (2004):

         > "'[B]ut for' causation is insufficient to make an agency responsible for a 'particular effect under NEPA and the relevant regulations…. NEPA requires a 'reasonably close causal relationship'" akin to "proximate cause….") (citations omitted).

   b. Consistency with ESA take standard

      i. Under applicable legal principles, a person may be held liable for take if he undertakes the precise activity that results in take, or controls the manner in which the taking activity is conducted. *Aransas Project v.*

Shaw, 775 F.3d 641, 657-59 (5th Cir. 2014) (rejecting causation standard urged by plaintiffs that could imply "issuing drivers' licenses will 'cause the take' of endangered species run over by cars", and explaining that "[a]pplying a proximate cause limit to the ESA must therefore mean that liability may be based neither on the 'butterfly effect' nor on remote actors in a vast and complex ecosystem."); *Strahan v. Linnon*, 187 F.3d 623 (1st Cir. 1998) (unpublished op.);

ii. The Supreme Court has recognized that the ESA take prohibition is subject to "ordinary requirements of proximate causation." *Babbitt v. Sweet Home Chapter of Communities for a Great Oregon*, 515 U.S. 687, 700 n.13 (1995).

c. There is no proper basis for applying inconsistent standards of causation between ESA sections 7 and 9, or between ESA section 7 consultation and NEPA.

d. Environmental effects (such as offsite, third party vehicle strikes of panthers) that are not proximately caused by the agency action (ITP issuance) should be analyzed in the baseline or cumulative effects section of the biological opinion, not attributed to the agency action as direct or indirect effects.

II. **But For Causation**: Even if "but for" causation is applied in the consultation section 7, the HCP and ITPs are not the "but for" cause of future offsite roadway panther strikes.

a. It is important to begin with an understanding of the action under consultation. The ITP does not authorize the covered activities. The ITP authorizes only incidental take that is caused by activities covered in the HCP. The covered activities will be authorized by various local, county, state and federal permits, and could (as with virtually all other development in the region) proceed without the ITP. *See* Revised Handbook at 4-14:

> A basic tenet underlying [ITP] applications is that the Services are not authorizing the applicant's activities that are causing the take. Instead, the Services are authorizing the incidental take that results from the applicant's covered activities.

b. As a general matter, private land developers do not control and are not responsible for the actions of the residents who live in their communities or the individuals who frequent their commercial establishments, much less the driving behavior of those or other individuals on public roadways.

c. Vehicle strikes of panthers generally result from a confluence of different factors, including panther access to roadways; the presence of wildlife fencing and underpasses along roadways; road design; speed limits and other traffic controls; driver behavior and skill; and panther behavior.

d. FWS issuance of ITPs will not authorize or control the activities that directly cause panther vehicle strikes – the confluence of vehicle operations and panthers

– or determine whether such strikes occur. Moreover, the factors that actually do determine whether such strikes occur (primarily panther access to roadways and vehicle operations) are outside the scope of FWS authority and control.

e. Vehicle traffic levels and speed do not determine whether panther strikes will occur, even within important panther habitat. For example, even with high speeds and heavy increasing traffic volume, the Alligator Alley portion of I-75 has experienced a sharp reduction in (nearing a virtual elimination of) panther strikes where wildlife fencing and underpasses are located,.

f. For all of these reasons, issuance of the ITPs is not a but for cause of future vehicle strikes of panthers. Any future level of future vehicle strikes of panthers could occur with or without the ITPs, and the occurrence or level of such strikes largely depends on vehicle operations (e.g., speed limits and driver behavior) and panther access to roadways (e.g., fencing and underpasses) that neither the applicants nor the FWS control.

III. **Future Roadway Impacts will be Mitigated in Any Event**. Even if some level of third-party roadway mortality could be deemed an effect of the ITPs and Covered Activities (which it cannot under any legal causation standard), it would not cause jeopardy because of the value of landscape-level planning and mitigation provided under HCP will avoid and offset such impacts.

a. Fencing and Underpasses. The construction of fencing and underpasses has been directed to areas of greatest value (panther "hot spots"), the result of which is often a substantial reduction if not elimination of vehicle strikes within those "hot spot" road segments. To the extent future roadway mortalities appear to be a concern in the vicinity of the HCP area, it can be reasonably expected that fencing and underpasses will be constructed. In fact, the Florida Department of Transportation (FDOT) and county governments (e.g., Collier County) have generally sought to ensure that lands on either side of wildlife underpasses will remain available for use as habitat by species in the future. The HCP will provide extensive areas of habitat with the mechanisms necessary to assure FDOT and county governments that wildlife crossings can be constructed and remain viable in perpetuity. Additionally, the HCP establishes the Marinelli Fund, which will be available to pay for or supplement the cost of construction of future wildlife fencing and underpasses, allowing more underpasses to be constructed than typically proposed by FDOT and/or county governments.

b. Projection of Future Vehicle Strikes. While there are established models that can be used to estimate future traffic levels under certain scenarios, it is not possible to scientifically estimate with reasonable confidence future vehicle strikes – when or where strikes will occur, at what levels, or (critically) the cause of such future strikes. It is not known what actions may be taken in the future by appropriate government officials to regulate vehicle operations (such as speed limits) or limit panther access to roadways (such as through wildlife fencing and underpasses). In addition, future technology (such as collision avoidance) may reduce the

likelihood of vehicle strikes over the 50-year period of the HCP. Indeed, the HCP's location and clustering of Covered Activities will simultaneously discourage panther movements toward Covered Activities areas while encouraging panther movement toward and within preservation areas that have higher habitat values and extensive interconnected native land cover. This beneficial influence on panther movement can be expected to reduce the total length of road segments where panthers would be likely to attempt a crossing in the vicinity of the Covered Activities, and the frequency of such crossings, and allow panther biologists and transportation planners to focus conservation measures (like wildlife fencing and underpasses) to areas with the highest probability of and benefit to panther movement. Thus, while commenters have argued that, e.g., a projected 10% increase in traffic in an area can be assumed to result in a 10% increase in vehicle mortalities in that area, such projections are not grounded in fact or science and ignore the variables that actually determine whether panther vehicle strikes are likely. Basic causation and foreseeability principles prevent treating the ITPs, HCP or covered activities as the cause of an assumed level of future vehicle strikes. Accordingly, there is no valid basis for assuming a level of future vehicle strikes, attributing that level to the HCP, and requiring the HCP to offset that level of strikes. Nonetheless, as described below, the HCP does provide substantial offsetting mitigation.

c. Habitat Value. The value of the habitat preserved by the HCP is substantial, comprising over 100,000 acres of interconnected habitats with an economic value estimated to be over $1 billion. The preservation of these lands, which include two existing regional wildlife corridors – the Camp Keais Strand and Okaloacoochee Slough flowways – has been a goal of conservationists dating back several decades, and a goal identified specifically with respect to the panther since the 1980s (Belden et al. 1988; Maehr 1990; Logan et al. 1993). The Plan will permanently preserve these large, interconnected blocks of panther habitat, and will minimize potential impacts of future development by concentrating and directing that development toward existing development and previously cleared areas in the western portions of the HCP Area, in the areas designated for Covered Activities. In contrast, the piecemeal development patterns that have occurred in the past and would otherwise occur under existing zoning (without the Plan) would be expected to result in larger total development acreages, higher risks of habitat fragmentation, and less predictable cumulative impacts.

d. Offset Determination. While future vehicle strikes cannot be attributed to the ITPs under proximate or but for causation, even if an assumed level of future vehicle strikes could be attributed to the ITPs (which it cannot under any legal causation standard), that portion would necessarily be low to account for the points above, including the far greater role of other factors outside of the control of the FWS and the applicants – such as speed limits, driver behavior and wildlife fencing and underpasses. On the other hand, the benefits of the HCP to conservation of the panther are substantial, including the preservation of valuable habitat and critical linkages that will allow the panther population to expand.

From: Johnson, Bruce
To: Cassler, Constance
Cc: Dell, David; Tawes, Robert
Subject: [EXTERNAL] RE: Ave Maria
Date: Wednesday, February 13, 2019 8:55:00 PM
Importance: High

Connie,

Thank you for your response. As you note, the Applicants are not seeking incidental take coverage through the HCP for Ave Maria, since incidental take coverage has already been provided by the 2018 Biological Opinion for Ave Maria.

Ave Maria remains part of the HCP for purposes of calculating the 45,000 acre cap on Covered Activities (thereby effectively lowering the Covered Activities cap to 39,973 acres, since Ave Maria is already partially developed and already has incidental take coverage), for purposes of contributing 17,000 acres to the overall 107,000 acres of preservation, and for purposes of overall conservation planning.

All of the federally listed covered species that were not addressed in the 2018 Biological Opinion for Ave Maria are either in the "not likely to adversely affect" or "no effect" categories. No incidental take of state-listed covered species is expected to occur as a result of the buildout of Ave Maria (especially in light of minimization measures), and a final federal listing decision for any state listed species is unlikely to occur prior to completion of the Ave Maria buildout.

Bruce

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

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From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Wednesday, February 13, 2019 1:40 PM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>
Cc: David Dell <david_dell@fws.gov>; Robert Tawes <Robert_Tawes@fws.gov>
Subject: Ave Maria

Hi Bruce,

I just missed grabbing the phone, but I did get your message about Ave Maria. I understand the Applicants don't need additional take coverage through the HCP for Ave Maria. This will make it the BO cleaner. I'll let the biologists working on the HCP know.

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
office: 772-469-4243
fax: 772-562-4288
email: constance_cassler@fws.gov

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From:	Johnson, Bruce
To:	Dell, David
Cc:	Kelso, Charles; Cassler, Constance; Tawes, Robert
Subject:	[EXTERNAL] RE: East Collier Applications and the HCP
Date:	Friday, August 31, 2018 3:17:09 PM
Attachments:	ITP_application_Pacific_Land_20180831.pdf
Importance:	High

David,

Understood, and we are on it. The ITP application for Pacific Land is attached. That should make nine applications submitted, with 1 or 2 more to go.

Thanks,
Bruce

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

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From: Dell, David <david_dell@fws.gov>
Sent: Friday, August 31, 2018 1:03 PM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>
Cc: Charles Kelso <charles_kelso@fws.gov>; Constance Cassler <Constance_Cassler@fws.gov>; Robert Tawes <Robert_Tawes@fws.gov>
Subject: Re: East Collier Applications and the HCP

Bruce: By the way, if we get an eleventh applicant, the HCP will need to be revised everywhere affected by the addition: add applicant name, acres owned by applicant (151,779 + ?), "eleven" vs. "ten," etc.

We will need this mid-week to submit to the Department with our briefing request.

David Dell
Southeast Region
HCP and Safe Harbors Coordinator
404/679-7313
fax: 7081
david_dell@fws.gov

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On Fri, Aug 31, 2018 at 12:53 PM, Dell, David <david_dell@fws.gov> wrote:

> Bruce: Among the applications sent here in 2010, I do not find one for: Heller Bros. Packing Corp.
>
> This is also among the ones you are still digging for. If we don't receive an application from them, there will be no fallback alternative, 2010 application. I note that the principal officer for Pacific Land, Ltd is Billy Heller. If they want each entity to receive a permit, I will need separate applications. Thanks.
>
> David Dell
> Southeast Region
> HCP and Safe Harbors Coordinator
> 404/679-7313
> fax: 7081
> david_dell@fws.gov
>
> NOTE: All email correspondence and attachments received from or sent to me are subject to the Freedom of Information Act (FOIA) and may be disclosed to third parties.

Form 3-200-56 (Rev. 10-2017)
U.S. Fish and Wildlife Service

OMB Control No. 1018-0094
Expires 03/31/2021

FEDERAL FISH AND WILDLIFE PERMIT APPLICATION FORM

Native Endangered and Threatened Species - Incidental Take Permits Associated with a Habitat Conservation Plan (HCP)

Return to: U.S. Fish and Wildlife Service (USFWS)
click here for return addresses

Complete Sections A or B, and C, D, and E of this application. U.S. address may be required in Section C, see instructions for details.

See attached instruction pages for information on how to make your application complete and help avoid unnecessary delays.

A. Complete if applying as an individual

1.a. Last name	1.b. First name	1.c. Middle name or initial	1.d. Suffix

2. Date of birth (mm/dd/yyyy)	3. Occupation	4.a. Affiliation/Doing business as (see instructions)	4.b. Website URL (if applicable)

5.a. Telephone number	5.b. Alternate telephone number	6. E-mail address

B. Complete if applying on behalf of a business, corporation, public agency, Tribe, or institution

1.a. Name of business, agency, Tribe, or institution	1.b. Doing business as (dba)
Pacific Land, Ltd.	

2. Tax identification no.	3.a. Description of business, agency, Tribe, or institution	3.b. Website URL (if applicable)
59-2490438	Agricultural Farm Land	

4.a. Principal officer (P.O.) last name	4.b. P.O. first name	4.c. P.O. middle initial	4.d. P.O. e-mail address
Heller	Billy	L	bheller@sunripecertified.com

5. P.O. title	6. Primary contact name
Co-Chief Executive Officer/ COO	Billy L. Heller, Jr.

7.a. P.O. telephone number	7.b. Alternate phone no.	8.a. Primary contact telephone no.	8.b. Primary contact e-mail address
941-722-3291	941-704-6636	941-722-3291	bheller@sunripecertified.com

C. All applicants complete address information

1.a. Physical address (Street address; Apartment #, Suite #, or Room #; no P.O. Boxes)
503 10th Street

1.b. City	1.c. State	1.d. Zip code/Postal code	1.e. County/Province	1.f. Country
Palmetto	FL	34221	Manatee	USA

2.a. Mailing address (include if different than physical address; include name of contact person if applicable)
P.O. Box 866

2.b. City	2.c. State	2.d. Zip code/Postal code	2.e. County/Province	2.f. Country
Palmetto	FL	34220	Manatee	USA

D. All applicants MUST complete

1. Check or money order payable to the U.S. FISH AND WILDLIFE SERVICE **in the amount indicated on pages 2-3 (nonrefundable processing fee).** Federal, Tribal, State, and local government agencies, and those acting on behalf of such agencies, are exempt from the processing fee – ***attach documentation of fee exempt status as outlined in instructions.*** (50 CFR 13.11(d))

2. Do you currently have or have you ever had any Federal Fish and Wildlife permits?
   ☐ Yes If yes, list the number of the most current permit you have held or that you are applying to renew or amend: _____
   ☒ No

3. Certification: I hereby certify that I have read and am familiar with the regulations contained in ***Title 50, Part 13 of the Code of Federal Regulations*** and the other ***applicable parts in subchapter B of Chapter I of Title 50***, and I certify that the information submitted in this application for a permit is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to the criminal penalties of 18 U.S.C. 1001.

Signature of applicant/person responsible for permit (No photocopied or stamped signatures) — Date (mm/dd/yyyy): 08/31/2018

** See page 15 for additional instructions on completing the above form. See page 16 for information on the Paperwork Reduction Act, Privacy Act, and Freedom of Information Act aspects of this application form.

If a biological survey is required, you will need to send us your complete Recovery permit application package and have it accepted at least 3 months prior to commencement of survey activities to facilitate processing of your Recovery permit application. The Recovery permit application is designated as U.S. Fish and Wildlife Service form # 3-200-55 and can be found on our Endangered Species permit web page at http://www.fws.gov/forms/3-200-55.pdf.

Option B: You may hire biological consultants who already hold Recovery Permits to conduct biological surveys on your behalf. We maintain a list of Recovery permittees who have authorized the release of their contact information to third parties for conducting biological surveys on a contract basis. This list is provided to the public at the discretion of each U.S. Fish and Wildlife Service Regional Office as time and workload allow. Please be aware that this list does not represent an endorsement by us of any particular permittee.

****

If you are not applying as an individual but as a business, corporation, tribe, institution, or non-Federal public agency (block B. on page 1 of the application), the person to whom the permit will be issued (e.g., the landowner, president, director, executive director, or executive officer) is legally responsible for implementing the permit. Although other people under the direct control of the permittee (e.g., employees, contractors, consultants) receive third party take authorization in their capacity as designees of the permittee, the individual named as the permittee ultimately is legally responsible for the permit and any activities carried out under the permit except as otherwise limited in the case of permits issued to State or local government entities under 50 CFR 13.25(e).

****

If you wish to coordinate the processing of this permit application through an **authorized agent**, and to have that agent represent you as the primary contact with us, check the box below. Sign (in blue ink) and date the authorization statement, and provide contact information for your authorized agent.

☑ I hereby authorize the following person to act as an authorized agent on my behalf in the processing of this permit application and to furnish, upon request, supplemental information in support of this permit application.

Signature

Billy L. Heller, Jr.
Please print name legibly

08/31/2018
Date

Your Authorized Agent's Contact Information (please print legibly)

Name: Mr. Tom Jones

Address: 2600 Golden Gate Parkway, Second Floor

City: Naples State: FL Zip Code: 34105

Telephone: 239-262-2600 Cell Phone: 239-842-0025

E-mail: tjones@barroncollier.com Fax: 239-263-3339

INCIDENTAL TAKE PERMIT APPLICATION
CERTIFICATION NOTICE

The same person who signs in box D. on page 1 of the application must sign (in blue ink) the following certification.

By submitting this application and receiving an Incidental Take permit pursuant to Section 10(a)(1)(B) of the Endangered Species Act, I Pacific Land, Ltd. (print name(s)) attest that I/we own the lands indicated in this application, or have sufficient authority or rights over these lands to implement the measures of the Habitat Conservation Plan (and Implementing Agreement, if applicable) covered by the Incidental Take permit. Further, upon receipt of the Incidental Take permit, I/we agree to conduct the activities as specified in the Habitat Conservation Plan (and Implementing Agreement, if applicable) according to the terms and conditions of the Incidental Take permit and its supporting documents.

Signature (in blue ink) — date: 08/31/2018

Billy L. Heller Jr

Please print name legibly

Signature (in blue ink) — date

Please print name legibly

From:	Johnson, Bruce
To:	Dell, David
Cc:	Kelso, Charles; Cassler, Constance; Tawes, Robert
Subject:	[EXTERNAL] RE: East Collier Applications
Date:	Friday, August 31, 2018 1:00:27 PM
Attachments:	ITP_application_Heller_Bros_20180831.pdf
Importance:	High

David,

Thank you for being on top of this. I spoke with Heller Bros. legal counsel this morning, and just received their application 10 minutes before your email. Please see attached.

They are working on getting Pacific's paperwork done today. I will forward it to you as soon as I have it.

Thanks,
Bruce

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

Stantec Consulting Services Inc.
300 Primera Blvd., Suite 300
Lake Mary, FL 32746-2145 US

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From: Dell, David <david_dell@fws.gov>
Sent: Friday, August 31, 2018 12:54 PM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>
Cc: Charles Kelso <charles_kelso@fws.gov>; Constance Cassler <Constance_Cassler@fws.gov>; Robert Tawes <Robert_Tawes@fws.gov>
Subject: East Collier Applications

Bruce: Among the applications sent here in 2010, I do not find one for: Heller Bros. Packing Corp.

This is also among the ones you are still digging for. If we don't receive an application from them, there will be no fallback alternative, 2010 application. I note that the principal officer for Pacific Land, Ltd is Billy Heller. If they want each entity to receive a permit, I will need separate applications. Thanks.

David Dell
Southeast Region
HCP and Safe Harbors Coordinator
404/679-7313

fax: 7081
david_dell@fws.gov

NOTE: All email correspondence and attachments received from or sent to me are subject to the Freedom of Information Act (FOIA) and may be disclosed to third parties.

Form 3-200-56 (Rev. 10-2017)
U.S. Fish and Wildlife Service

OMB Control No. 1018-0094
Expires 03/31/2021

FEDERAL FISH AND WILDLIFE PERMIT APPLICATION FORM

Native Endangered and Threatened Species - Incidental Take Permits Associated with a Habitat Conservation Plan (HCP)

Return to: U.S. Fish and Wildlife Service (USFWS)
click here for return addresses

Complete Sections A or B, and C, D, and E of this application. U.S. address may be required in Section C, see instructions for details.

See attached instruction pages for information on how to make your application complete and help avoid unnecessary delays.

A. Complete if applying as an individual

1.a. Last name	1.b. First name	1.c. Middle name or initial	1.d. Suffix

2. Date of birth (mm/dd/yyyy)	3. Occupation	4.a. Affiliation/Doing business as (see instructions)	4.b. Website URL (if applicable)

5.a. Telephone number	5.b. Alternate telephone number	6. E-mail address

B. Complete if applying on behalf of a business, corporation, public agency, Tribe, or institution

1.a. Name of business, agency, Tribe, or institution	1.b. Doing business as (dba)
Heller Bros. Packing Corp.	

2. Tax identification no.	3.a. Description of business, agency, Tribe, or institution	3.b. Website URL (if applicable)
59-1859302	Citrus	www.hellerbros.com

4.a. Principal officer (P.O.) last name	4.b. P.O. first name	4.c. P.O. middle initial	4.d. P.O. e-mail address
Heller	Harvey	R	harvey@hellerbros.com

5. P.O. title	6. Primary contact name
President	Harry Heller Falk

7.a. P.O. telephone number	7.b. Alternate phone no.	8.a. Primary contact telephone no.	8.b. Primary contact e-mail address
407-656-2125		407-656-2124	harry_falk@hellerbros.com

C. All applicants complete address information

1.a. Physical address (Street address; Apartment #, Suite #, or Room #; no P.O. Boxes)
288 9th Street

1.b. City	1.c. State	1.d. Zip code/Postal code	1.e. County/Province	1.f. Country
Winter Garden	FL	34787	Orange	USA

2.a. Mailing address (include if different than physical address; include name of contact person if applicable)
P.O. Box 770249

2.b. City	2.c. State	2.d. Zip code/Postal code	2.e. County/Province	2.f. Country
Winter Garden	FL	34777-0249	Orange	USA

D. All applicants MUST complete

1. Check or money order payable to the U.S. FISH AND WILDLIFE SERVICE **in the amount indicated on pages 2-3 (nonrefundable processing fee).** Federal, Tribal, State, and local government agencies, and those acting on behalf of such agencies, are exempt from the processing fee – ***attach documentation of fee exempt status as outlined in instructions.*** (50 CFR 13.11(d))

2. Do you currently have or have you ever had any Federal Fish and Wildlife permits?
   ☐ Yes If yes, list the number of the most current permit you have held or that you are applying to renew or amend: _____
   ☒ No

3. Certification: I hereby certify that I have read and am familiar with the regulations contained in ***Title 50, Part 13 of the Code of Federal Regulations*** and the other ***applicable parts in subchapter B of Chapter I of Title 50***, and I certify that the information submitted in this application for a permit is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to the criminal penalties of 18 U.S.C. 1001.

Harvey R Heller — Signature of applicant/person responsible for permit (No photocopied or stamped signatures)

08/31/2018 — Date (mm/dd/yyyy)

** See page 15 for additional instructions on completing the above form. See page 16 for information on the Paperwork Reduction Act, Privacy Act, and Freedom of Information Act aspects of this application form.

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****

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****

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☑ I hereby authorize the following person to act as an authorized agent on my behalf in the processing of this permit application and to furnish, upon request, supplemental information in support of this permit application.

Signature

Harvey R. Heller
Please print name legibly

08/31/2018
Date

Your Authorized Agent's Contact Information (please print legibly)

Name: Mr. Tom Jones

Address: 2600 Golden Gate Parkway, Second Floor

City: Naples State: FL Zip Code: 34105

Telephone: 239-262-2600 Cell Phone: 239-842-0025

E-mail: tjones@barroncollier.com Fax: 239-263-3339

INCIDENTAL TAKE PERMIT APPLICATION CERTIFICATION NOTICE

The same person who signs in box D. on page 1 of the application must sign (in blue ink) the following certification.

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Signature (in blue ink) — date: 08/31/2018

Please print name legibly: HARVEY R. HELLER

Signature (in blue ink) — date

Please print name legibly

From:	Turner, Andrew
To:	Dell, David
Cc:	Mott, Vicki V; Cassler, Constance; Christian Spilker; Clements, E. Carter Chandler; tjones@barroncollier.com; Johnson, Bruce
Subject:	[EXTERNAL] RE: East Collier HCP: Update Meeting, March 29
Date:	Thursday, March 28, 2019 2:54:58 PM
Importance:	High

Thank you, David. Just to clarify, as to the comment matrix the applicants would welcome the opportunity to provide input for the Service's consideration on responses related to facts or details on the HCP (e.g., with respect to the covered activities or preserved lands), to the extent that would be helpful to the Service. We look forward to speaking with you tomorrow.

Andrew

From: Dell, David [mailto:david_dell@fws.gov]
Sent: Thursday, March 28, 2019 1:44 PM
To: Turner, Andrew; Charles Kelso; Constance Cassler; Christian Spilker; dksutton@alicoinc.com; Clements, E. Carter Chandler; Jerry Ziewitz; Mcdonald, Kenneth; Kristen Peters; Mitch Hutchcraft (mhutchcraft@cclpcitrus.com); Robert Tawes; tjones@barroncollier.com; Jack Arnold; Tewis, Robert M CIV USARMY CESAJ (US); Johnson, Bruce; Chris Guy; Joshua.R.Holmes@usace.army.mil; Roxanna Hinzman; Mott, Vicki
Subject: East Collier HCP: Update Meeting, March 29

Everyone: Please see the attached draft agenda for our call tomorrow. Talk to you then!

David Dell
US Fish and Wildlife Service
Southeast Region
HCP and Safe Harbors Coordinator
404/679-7313
david_dell@fws.gov

NOTE: All email correspondence and attachments received from or sent to me are subject to the Freedom of Information Act (FOIA) and may be disclosed to third parties.

From: Mitch Hutchcraft
To: Cassler, Constance
Subject: [EXTERNAL] Re: ECMSHCP dEIS Federal Register Notice
Date: Thursday, October 25, 2018 4:30:33 PM
Importance: High

Thank you.

My correct contact information is included, below.

Mitch Hutchcraft
King Ranch Florida
3602 Colonial Court
Fort Myers, FL 33913
mhutchcraft@cclpcitrus.com

Direct line: 239-210-9040
Cell: 239-405-1694

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On Oct 25, 2018, at 4:29 PM, Cassler, Constance <constance_cassler@fws.gov> wrote:

> Hi Mitch,
>
> As part of out outreach for the dEIS and public comment period we sent letters to everyone we sent letters to during the 2016 scoping period. We must have the wrong address for you because the letter was returned to us. Since I have your email, I thought I would email you the same information that was in the letter.
>
> Connie
>
> Constance L. Cassler, Ph.D.
> Supervisory Fish and Wildlife Biologist
> U.S. Fish and Wildlife Service
> 1339 20th Street
> Vero Beach, Florida 32960
> office: 772-469-4243
> fax: 772-562-4288
> email: constance_cassler@fws.gov

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Follow us on InstaGram @usfws_south_florida
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<20181015 ECHCP News Release (1).docx>

From: Johnson, Bruce
To: Cassler, Constance
Subject: [EXTERNAL] RE: GIS layer for Lands Eligible for Inclusion in HCP
Date: Monday, February 25, 2019 4:23:52 PM
Importance: High

Hi Connie,

I'll forward your request to James Hale, our GIS Manager. I suspect that our analysts could pull from property appraiser parcel boundaries or some other data to clip the roads off those properties.

We'll get back with you ASAP. I'll be seeing James on Wednesday, and we should be able to kick something out within 48 hours. Will that timeframe be OK?

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

Stantec Consulting Services Inc.
300 Primera Blvd., Suite 300
Lake Mary, FL 32746-2145 US

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From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Monday, February 25, 2019 4:17 PM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>
Subject: GIS layer for Lands Eligible for Inclusion in HCP

Hi Bruce,

For the BO we had promised to consider Lands Eligible for Inclusion in HCP in our analysis so that it would be easy to include them if landowners chose to join the HCP at a later date. I'm hoping you have a GIS layer you can send us so we get the property boundaries right. We have an old one that has a lot of roads attached to the properties. It would take us a long time to clean that up.

Please let me know,

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist

U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
office: 772-469-4243
fax: 772-562-4288
email: constance_cassler@fws.gov

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Follow us on InstaGram @usfws_south_florida
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From: Johnson, Bruce
To: Cassler, Constance
Cc: Kelso, Charles; Dell, David
Subject: [EXTERNAL] RE: Hogan Island Quarry off-site mitigation
Date: Friday, March 15, 2019 10:54:08 AM
Importance: High

Hi Connie,

Thanks for the screenshot; I will track that down as well. Can you tell me what the colors indicate (orange fill versus light green fill)?

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

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300 Primera Blvd., Suite 300
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From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Friday, March 15, 2019 10:45 AM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>
Cc: Charles Kelso <charles_kelso@fws.gov>; David Dell <david_dell@fws.gov>
Subject: Hogan Island Quarry off-site mitigation

Hi Bruce,

I'm attaching a GIS map of the other project. It appears to be off-site mitigation for the Hogan Island Quarry.

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
office: 772-469-4243
fax: 772-562-4288

email: constance_cassler@fws.gov

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From:	Johnson, Bruce
To:	Dell, David
Cc:	Cassler, Constance
Subject:	[EXTERNAL] RE: JB Ranch Agricultural and Conservation Easement
Date:	Thursday, March 7, 2019 5:28:28 PM
Attachments:	image003.png JB Ranch 1 Deed of Easement RFLPP.PDF Recorded Conservation Easement2.pdf
Importance:	High

David,

An easement was recorded on JB Ranch lands under the Florida Rural and Family Lands Protection Program (RFLPP) on June 23, 2016 for the purpose of preserving the agricultural character of those lands as a working landscape. Concurrently with the recordation of the RFLPP easement, a conservation easement was recorded on the same lands for the purpose of preserving the lands as habitat for the Florida panther and other species covered by the HCP – that is, specifically so that the preservation of those lands could be used for purposes of this HCP. Copies of both easements are attached for your reference.

The terms of the two easements clarify that the purposes of the easements, while complementary, are quite different. For example:

- The RFLPP easement focuses on preserving the agricultural character of the lands, whereas the conservation easement is designed to preserve the "ecological and habitat values that benefit endangered, endangered, or other species" covered by the HCP. See RFLPP easement at Recital B and Article II; conservation easement at third recital and paragraphs 1 and 2.

- The conservation easement also grants certain rights to the Service and the holder of the easement (Florida Forest Service, Florida Department of Agriculture and Consumer Services) that allow for oversight and enforcement of the terms of that easement, consistent with the HCP. See conservation easement at paragraph 3.

Accordingly, the conservation easement accomplishes and is enforceable for separate purposes specific to the preservation objectives of the HCP. I understand that Ernie Cox – the lawyer who represented JB Ranch in connection with the easements – met with several people in the USFWS Vero Beach Field Office to coordinate plans for recording the easements, including Larry Williams, Victoria Foster, and Connie Cassler, and that they indicated to Mr. Cox that recording the complimentary (but not duplicative) easement under the RFLPP would not preclude inclusion of those lands as preservation lands under the HCP.

Please let me know if you have questions or want to discuss.

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

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Lake Mary, FL 32746-2145 US

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From: Dell, David <david_dell@fws.gov>
Sent: Wednesday, March 06, 2019 12:23 PM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>
Cc: Constance Cassler <Constance_Cassler@fws.gov>
Subject: Fwd: JB Ranch Agricultural and Conservation Easement

Bruce: A question from David Shindler concerning the conservation status of JB Ranch property.

David Dell
US Fish and Wildlife Service
Southeast Region
HCP and Safe Harbors Coordinator
404/679-7313
david_dell@fws.gov

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---------- Forwarded message ---------
From: **Cassler, Constance** <constance_cassler@fws.gov>
Date: Wed, Mar 6, 2019 at 12:06 PM
Subject: Fwd: JB Ranch Agricultural and Conservation Easement
To: David Dell <david_dell@fws.gov>
Cc: Charles Kelso <charles_kelso@fws.gov>, Kenneth Mcdonald <kenneth_mcdonald@fws.gov>, Roxanna Hinzman <roxanna_hinzman@fws.gov>

Hi David,

I just sent David Shindle the updated map you sent us yesterday. See his email for a map he sent back to me with lands that are under an easement near Oil Well Road-SR29 intersection. It looks like the piece above Oil Well Road is listed as already in conservation, but the other pieces are listed as part of the preserve. I think we need to ask ECPO about this before we consider the maps they sent yesterday as final. Would you ask ECPO today? Or do you want us to ask Bruce Johnson? Please let us know the best way to make the ask.

Thank you,

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
office: 772-469-4243
fax: 772-562-4288
email: constance_cassler@fws.gov

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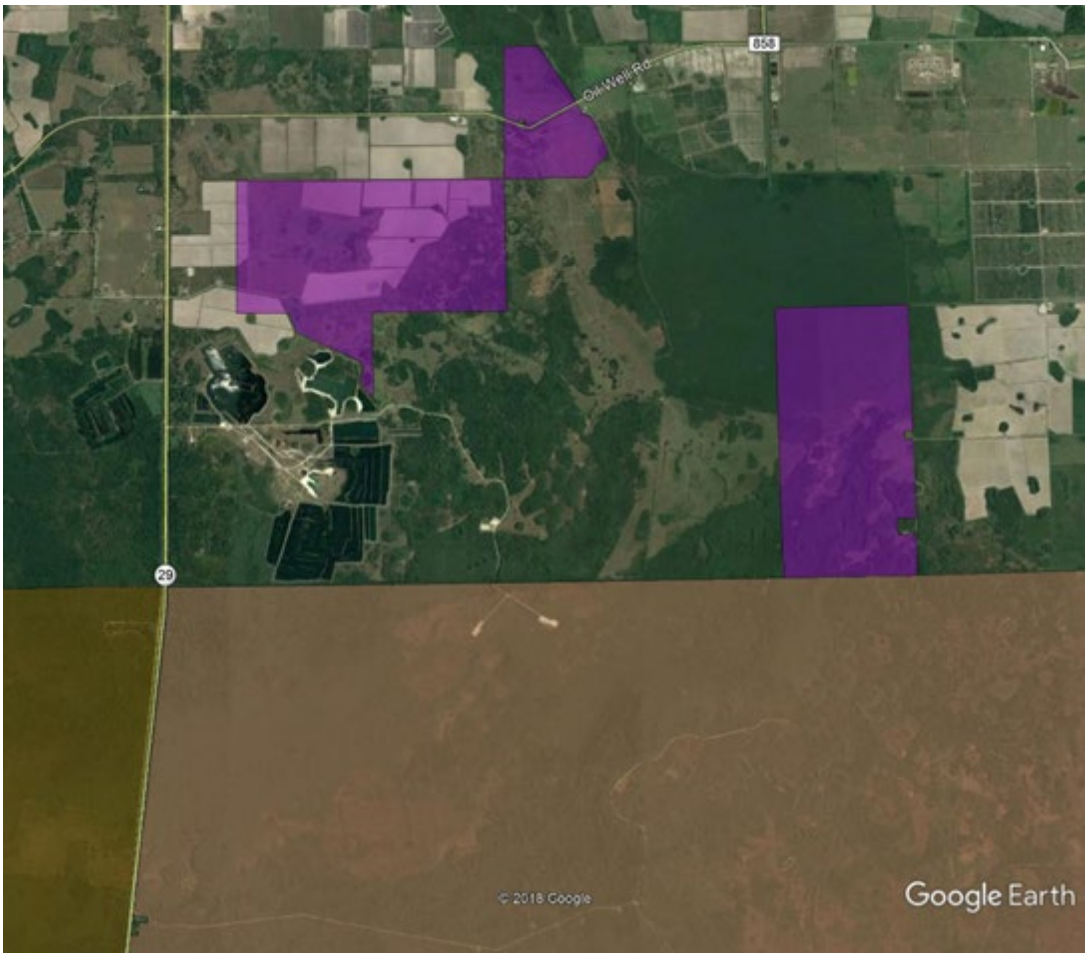
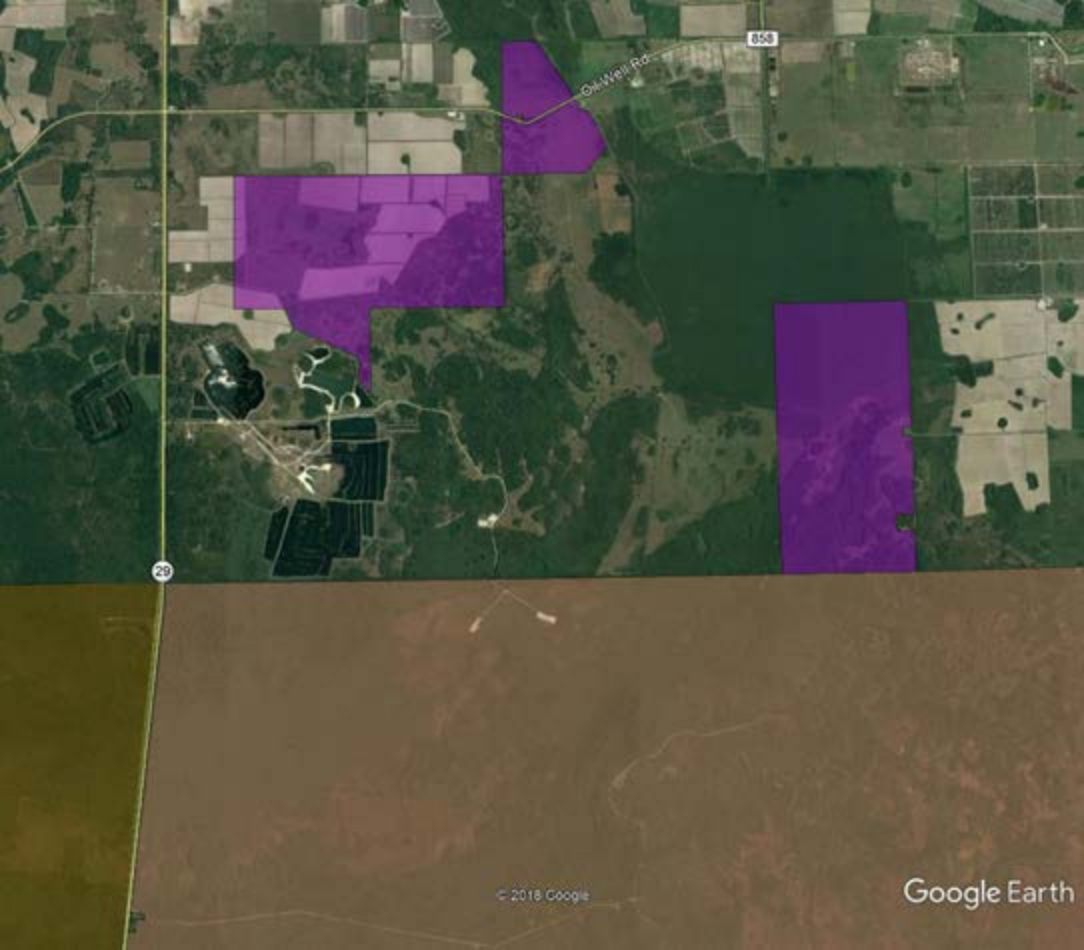
---------- Forwarded message ---------
From: **Shindle, David** <david_shindle@fws.gov>
Date: Wed, Mar 6, 2019 at 11:53 AM
Subject: JB Ranch Agricultural and Conservation Easement
To: Constance Cassler <Constance_Cassler@fws.gov>, Kelso, Charles <charles_kelso@fws.gov>, Mcdonald, Kenneth <kenneth_mcdonald@fws.gov>, Roxanna Hinzman <Roxanna_Hinzman@fws.gov>

The JB Ranch Agricultural and Conservation Easement 1617.46 acres) should be categorized as existing Conservation Lands on the HCP map and not credited as "Preserve Lands". And in doing so, I presume this would impact the overall ledger of habitat/development currency.



David Shindle, Florida Panther Coordinator
U.S. Fish and Wildlife Service South Florida Ecological Services Field Office
12085 State Road 29 S
Immokalee, FL 34142
Desk 239-657-8013
Cell 772-532-7293
david_shindle@fws.gov

Southeast Region Vision: Together, we will connect lands and waters to sustain fish, wildlife and plants by being visionary leaders, bold innovators and trusted partners, working with and for people.
NOTE: All email correspondence and attachments received from or sent to me are subject to the Freedom of Information Act (FOIA) and may be disclosed to third parties.


Old Well Rd
858
29
© 2018 Google
Google Earth

INSTR 5281789 OR 5286 PG 3920 RECORDED 6/23/2016 2:06 PM PAGES 23
DWIGHT E. BROCK, CLERK OF THE CIRCUIT COURT, COLLIER COUNTY FLORIDA
DOC@.70 $26,250.00 REC $197.00
CONS $3,750,000.00

FDACS CONTRACT #

Project Name: JB Ranch 022408

This instrument prepared by and returned to:
Jennifer Reed
Land Program Coordinator
Florida Forest Service
Florida Department of Agriculture and Consumer Services
The Conner Building
3125 Conner Boulevard - Room 237
Tallahassee, FL 32399-1650

DEED OF EASEMENT

THIS DEED OF EASEMENT is made this 20th day June, 2016, by JB Ranch I, LLC, a Florida Limited Liability Company, and Sunniland Family Limited Partnership, a Florida Limited Partnership, whose address is Post Office Box 930, Immokalee, Florida 34143 ("Grantor"), in favor of the BOARD OF TRUSTEES OF THE INTERNAL IMPROVEMENT TRUST FUND OF THE STATE OF FLORIDA whose address is Florida Department of Agriculture and Consumer Services, 3125 Conner Boulevard, Tallahassee, Florida 32399-1650 ("Grantee").

The terms "Grantor" and "Grantee" shall include the singular and the plural, and the heirs, successors and assigns of Grantor and Grantee, and the provisions of this Deed of Easement shall be binding upon and inure to the benefit of Grantor, Grantee and their heirs, successors and assigns.

NOTICES

All notices required to be given pursuant to this Deed of Easement shall be sent to the parties at the following addresses:

Grantor: JB Ranch I, LLC and Sunniland Family Limited Partnership, Post Office Box 930, Immokalee, Florida 34143

Grantee: Board of Trustees of the Internal Improvement Trust Fund, Florida Department of Agriculture and Consumer Services, Florida Forest Service, 3125 Conner Boulevard, Tallahassee, Florida 32399-1650

RECITALS

A. Grantor is the sole owner in fee simple of certain real property in Collier County, Florida, more particularly described and graphically depicted in Exhibit A attached hereto and incorporated by reference (hereinafter, the "Property").

B. Grantor and the Grantee mutually recognize the special character of the Property as a working landscape that has traditionally been used for agriculture, as

that term is defined in Section 570.02(1), Florida Statutes, and have the common purpose of conserving certain values and character of the Property by conveyance to the Grantee of a perpetual easement on, under, over, and across the Property, to conserve the agricultural use and character of the Property, continue certain land use patterns that do not significantly impair the character of the Property, and prohibit certain further development activities on the Property.

C. The existing agricultural uses and conservation values of the Property are documented in the "Baseline Documentation Report for the JB Ranch Easement Tract in Collier County, Florida", dated February 4, 2016 ("Baseline Documentation Report" or "BDR"), which consists of reports, maps, photographs, and other documentation that the parties agree provide, collectively, an accurate representation of the Property at the time of this Deed of Easement and which is intended to serve as an objective information baseline for monitoring compliance with the terms of this Deed of Easement. The BDR is maintained in the offices of the Florida Department of Agriculture and Consumer Services and is incorporated in this Deed of Easement by this reference. A copy of the BDR is available from the Department upon request.

D. Significant Natural Areas ("SNAs"). There are certain significant naturally occurring ecosystems within the boundaries of the Property, more particularly identified as Significant Natural Areas in the BDR. Notwithstanding any other provision to the contrary, there shall be no construction or improvements in any SNA, other than as it relates to maintenance of existing improvements and management of these lands, nor any use of the Property, which would impair or destroy the SNAs (recognizing that cattle grazing, management and the existing uses are the primary reason for their current condition). Prior to any timbering in an SNA, Grantor shall consult with Grantee concerning methods to minimize damage. The SNAs are identified in the map in Exhibit B attached hereto and incorporated by reference herein.

E. Grantee is an agency authorized under the provisions of Sections 570.71 and 704.06, Florida Statutes, to hold easements for the preservation and protection of agricultural lands threatened by conversion to other uses, as well as the promotion and improvement of wildlife habitat, protection and enhancement of water bodies, aquifer recharge areas, wetlands, and watersheds, and perpetuation of open space on lands with SNAs.

F. Grantee agrees by accepting this Deed of Easement to honor the intentions of Grantor stated herein and to preserve and protect in perpetuity the values of the Property for the benefit of this generation and the generations to come.

G. The fact that any use of the Property that is expressly prohibited by the terms of this Deed of Easement may become greatly more economically valuable than uses allowed by the terms of this Easement, or that neighboring properties may, in the

future, be put entirely to uses that are not allowed by this Deed of Easement has been considered by Grantor in executing and delivering this Deed of Easement and by Grantee in accepting it.

To achieve these purposes, and in consideration of $10.00 and other good and valuable consideration, including but not limited to the above, and the mutual covenants, terms, conditions, and restrictions contained herein, the receipt and sufficiency of which is acknowledged, and pursuant to the laws of Florida, and in particular Sections 570.71 and 704.06, Florida Statutes, but without intending the validity of the Easement (hereinafter defined) to be dependent on the continuing existence of such laws, Grantor hereby voluntarily grants and conveys to Grantee an easement in perpetuity over the Property of the nature and character and to the extent hereinafter set forth ("Easement").

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ARTICLE I. DURATION OF EASEMENT

This Easement shall be perpetual. It is an easement in gross, runs with the land, and is enforceable by Grantee against Grantor, Grantor's personal representatives, heirs, successors and assigns, lessees, agents, and licensees.

ARTICLE II. PURPOSE OF EASEMENT

It is the purpose of this Easement to assure that the Property will be retained forever in its condition as a working landscape, to preserve, conserve, and protect the Property as productive agricultural land that sustains for the long term both the economic and conservation values of the Property and its environs, and to provide a relatively natural habitat for fish, wildlife, plants or similar ecosystems, through management guided by the following principles:

- Maintenance of economically viable agricultural practices that protect the landscape as a working enterprise in harmony with the open space and scenic qualities of the Property.

- Maintenance of soil productivity and control of soil erosion.

- Maintenance or improvement of the overall quality of the timber resource.

- Consistent with the protection of the integrity and function of the working landscape, promotion of a more complete pattern of protection, including buffers to natural areas, ecological greenways and functioning ecosystems.

- Promotion of the restoration, enhancement or management of species habitat, consistent with the purposes for which the Easement is acquired.

- Protection, restoration or enhancement of water bodies and aquifer recharge areas, including uplands and springsheds, wetlands, flowways, water management features and structures, or watersheds.

- Protection of unique and fragile natural areas and rare species habitats.

- Perpetuation of open space on working lands that contain SNAs.

The above purposes are hereinafter referred to as "the Easement Purposes" or "Purposes." Grantor intends that this Easement will confine the use of the Property to such activities as are consistent with the Easement Purposes.

ARTICLE III. RIGHTS GRANTED TO THE GRANTEE

To accomplish the Easement Purposes, the following rights are conveyed to Grantee by this Easement:

A. The right to enforce protection of the values of the Property for which the Easement was acquired.

B. All future residential, commercial, industrial and incidental development rights that are now or hereafter allocated to, implied, reserved, or inherent in the Property except as may be specifically reserved to Grantor in this Easement. The parties agree that such rights are hereby terminated and extinguished and may not be used on or transferred to other property. Neither the Property nor any portion thereof may be included as part of the gross area of other property not subject to this Easement for the purposes of determining density, lot coverage, or open space requirements, under otherwise applicable laws, regulations or ordinances controlling land use and building density. No development rights that have been encumbered or extinguished by this Easement shall be transferred to any other lands pursuant to a transferable development rights scheme or cluster development arrangement or otherwise. Nor shall any development rights or density credits be transferred onto the Property from other property.

C. The right to enter upon the Property on an annual basis, and more often if Grantee determines that such entry is warranted, at reasonable times in order to inspect and monitor compliance with and otherwise enforce the terms of this Easement; provided that such entry shall be upon prior reasonable notice to Grantor, and Grantee shall not unreasonably interfere with Grantor's use and quiet enjoyment of the Property.

D. The right to prevent any activity on or use of the Property that is inconsistent with the Purposes or provisions of this Easement and to require the restoration of or

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to restore such areas or features of the Property that may be damaged by any inconsistent activity or use, at Grantor's cost.

E. The right to have the ad valorem taxes, assessments and any other charges on the Property paid by Grantor.

F. A right to prior notice of Grantor's intent to sell or transfer title as provided in Article VIII, Paragraph G. Except as otherwise provided herein, this right of notice shall be triggered by sales or transfers of title by Grantor, including gifts and bequests of title as well as transfers of title to entities in which Grantor owns a majority of the controlling interests. The right of notice applies to the original Grantor and to said original Grantor's heirs, successors and assigns.

G. The right to be indemnified by Grantor for any and all liability, loss, damage, expense, judgment or claim (including a claim for attorney fees) arising out of any allegation of negligent or willful action or activity resulting from the Grantor's use and ownership of or activities on the Property or the use of or activities of Grantor's agents, guests, lessees or invitees on the Property.

H. The right to be indemnified by Grantor for any liability for injury or property damage to persons on the Property arising out of any condition of the Property known to the Grantor to the best of Grantor's knowledge.

I. The right to have the Property maintained as reflected on the Baseline Documentation Report, as the Property may develop or change through the forces of nature or man-induced activities, including but not limited to impacts to water management offsite, fire, introduction of exotic species by means other than by Grantor or similar impacts hereafter, subject only to the exercise of Grantor's Reserved Rights, and the Rights Granted to the Grantee, as described in this Easement. Grantor will continue to use reasonable efforts to control the exotic species present on the Property. Exotic species which may be present in the future will be controlled with reasonable efforts according to Best Management Practices (BMPs) and in conjunction with Grantee.

J. If Grantor fails to cut and remove timber damaged by natural disaster, fire, infestation or the like, then the right, but not the duty, of Grantee, in its sole discretion, to cut and remove said timber. Any such cutting and removal by Grantee shall be at the expense of Grantee and all proceeds from the sale of any such timber shall inure to the benefit of Grantee.

ARTICLE IV. PROHIBITED USES

The Property shall be maintained to preserve the Easement Purposes. Without limiting the generality of the foregoing Grantor agrees that the following

uses and practices, though not an exhaustive recital of inconsistent uses and practices, are expressly prohibited or restricted on the Property, except for those rights and practices reserved by Grantor under Article V below, and as otherwise retained by Grantor herein:

A. Dumping of biodegradable or nonbiodegradable, toxic, unsightly, offensive or hazardous substances, trash or garbage, wastes, abandoned vehicles, appliances, machinery, toxic wastes or substances, pollutants or contaminants, or similar material including, but not limited to those defined by the Federal Solid Waste Disposal Act, the Federal Clean Air Act, the Federal Clean Water Act, the Federal Resource Conservation and Recovery Act of 1976, the Federal Comprehensive Environmental Response, Compensation and Liability Act of 1980, the Federal Superfund Amendments and Reauthorization Act of 1986, the Federal Emergency Planning and Community Right-To-Know Act, the Federal Insecticide, Fungicide and Rodenticide Act, the Toxic Substances Control Act, Chapters 161, 253, 373, 376, and 403, Florida Statutes, and the rules and regulations of the (i) United States Environmental Protection Agency, (ii) the Florida Department of Environmental Protection, and (iii) the South Florida Water Management District, now or at any time hereafter in effect, or any Florida Statute defining hazardous materials, wastes or substances, toxic wastes or substances, pollutants or contaminants on the Property. This prohibition shall not be construed to include reasonable amounts of waste generated from properly permitted oil and gas exploration, production, and processing or generated in accordance with allowed uses, including agriculture or fish and wildlife management, conducted in accordance with the provisions of this Easement, and that is disposed of in accordance with applicable local, state and federal requirements, and BMPs adopted by the Florida Department of Agriculture and Consumer Services or its successor agency. There shall also be no dumping, placing or application of sludge and sludge products on the Property, except for use as fertilizer in accordance with applicable BMPs.

B. The mining or excavation of surface or subsurface materials, minerals, dolostone, peat, muck, marl, limestone, limerock, kaolin, fuller's earth, phosphate, common clays, gravel, shell, sand and similar substances either directly or indirectly by Grantor or on Grantor's behalf or with the joinder or consent of Grantor in any application for a permit so to do, under and by virtue of the authority of a grant or reservation or other form of ownership of or interest in or control over or right to such substances, except as reasonably necessary to combat erosion or flooding, or except as necessary and lawfully allowed for the conduct of allowed activities.

C. The exploration for and extraction of oil and gas, except as provided in Article V, Paragraph L, below.

D. Activities that affect the hydrology of the land or that detrimentally affect water conservation, erosion control, soil conservation, or fish and wildlife habitat, except those required for environmental restoration, federal, state or local regulatory

programs, or BMPs. There shall be no activities that will be detrimental to drainage, flood control, or fish and wildlife habitat preservation unless otherwise provided in this Easement. There shall be no dredging of new canals, construction of new dikes, manipulation of natural water courses, or disruption, alteration, or pollution of existing surface or subsurface water flow or natural water sources, fresh water lakes, ponds and pond shores, marshes, creeks or any other water bodies, except as consistent with BMPs for the type of agricultural activities being conducted. Provided, however, Grantor may construct, operate, maintain, or replace ground water wells and watering troughs incident to allowed uses on the Property, restoration and compatible water management features to improve the hydrology, water storage and water quality, all subject to legally required permits and regulations.

E. Planting of nuisance exotic or non-native plants as listed by the Exotic Pest Plant Council or its successor. The Grantor shall, to the extent practical, control and prevent the spread of nuisance exotics or non-native plants on the Property in accordance with Article III, Paragraph I, above. Grantor hereby grants to Grantee the right, in Grantee's sole discretion and at Grantee's expense, to develop and implement an exotic plant removal plan for the eradication of exotics, or non-native wild plants, on the Property. Under no circumstances shall this right conveyed to Grantee be construed to diminish Grantor's responsibilities under this paragraph or as an obligation of the Grantee.

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F. New construction or placing of temporary or permanent buildings, mobile homes or other structures in, on or above the ground of the Property, except as may be necessary by Grantor for maintenance or normal operations of the Property, provided such buildings are not located in an SNA and provided further such buildings will not be residential, but may include cow pens, watering troughs, barns, other structures used for hunting, fishing, wildlife viewing, camping, or hiking, or during emergency situations or as may otherwise be specifically provided for in this Easement. Construction of improvements referenced in this paragraph may be commenced after notice to the Grantee. For purposes of this paragraph the term "emergency" shall mean those situations that will have an immediate and irreparable adverse impact on the Easement Purposes.

G. Construction or placing of roads, billboards or other advertising, utilities, or structures, except those utilities, structures and unpaved roads necessary for the agricultural operations on the land or necessary for other activities allowed under the Easement, and except for linear facilities described in section 704.06(11), Florida Statutes. Provided, however, Grantee may erect and maintain signs designating the Property as land under the protection of Grantee.

H. Fertilizer use for agriculture activities not in accordance with agricultural BMPs recommended by the Natural Resources Conservation Service or the Florida Department of Agriculture and Consumer Services, whichever is more stringent, as

those BMPs may be amended from time to time. No agricultural activities shall occur within a 100-foot buffer around sinkholes and other karst features that are connected to spring conduits, except as provided in the applicable BMPs.

I. Actions or activities that may reasonably be expected to adversely affect threatened or endangered species.

J. Commercial water wells on the Property, but not including agricultural water wells.

K. Cutting of cypress trees anywhere on the Property, except for selective harvesting of cypress to maintain edges of pasture areas.

L. Mitigation banks pursuant to Section 373.4135, et. seq., Florida Statutes.

M. Conversion of SNAs to more improved areas, except where as approved by Grantee it is determined that limited land management activities will improve the habitat, such as wooded pastures.

N. Conversion of forested areas to improved pasture, except that wooded pastures would not be considered improved pastures and can be expanded. Planting of forage grasses and management in accordance with BMPs are allowed in all pasture areas, including wooded pastures.

O. Acts or uses of the Property detrimental to the preservation of the structural integrity or physical appearance of sites on the Property of historical, architectural, archaeological, or cultural significance.

P. New non-game-friendly fencing, except in those areas identified for security as shown in the BDR.

Q. Conversion of forested areas to non-forested areas as shown in the BDR, except that clearing, chopping and other management for wooded pastures not located within a SNA is allowed.

ARTICLE V. GRANTOR'S RESERVED RIGHTS

Grantor reserves to Grantor, and to Grantor's personal representatives, heirs, successors, and assigns, the following specified rights, which are deemed to be consistent with the Easement Purposes (the "Reserved Rights"). The exercise of the Reserved Rights shall be in full accordance with all applicable local, state and federal law, as amended from time to time, as well as in accordance with the terms and conditions of this Easement.

A. Grantor has, and shall be deemed hereby to have retained, the underlying fee

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simple title absolute in the Property. Further, Grantor retains and reserves all rights of, in and to the Property not expressly conveyed to Grantee under Article III or prohibited by Article IV.

B. The right to conduct prescribed burning on the Property; provided, however, that Grantor shall obtain and comply with a prescribed fire authorization from the Florida Forest Service of the Florida Department of Agriculture and Consumer Services or its successor agency.

C. The right to mortgage the Property; provided, however, that the Mortgagee's lien shall be inferior to and lower in priority than this Easement.

D. The right to contest tax appraisals, assessments, taxes and other charges on the Property.

E. The right to continue to use, maintain, repair, and reconstruct, all existing buildings, barns, animal pens, outbuildings, fences, roads, ponds, wells, utilities, drainage ditches and such other facilities on the Property as depicted in the Baseline Documentation Report.

F. Grantor shall have the right to install additional fences, ponds, wells, drainage ditches and other similar agricultural facilities in accordance with BMPs and NRCS recommendations, except in the Special Natural Areas.

G. The right to sell, devise or otherwise transfer ownership of the Property to a third party. This right, however, does not include the right to sell the remaining property rights on the Property for the purposes of a conservation easement or other restriction that would divest the Property of its use under the terms and conditions of this Easement (with the exception of the Stewardship Easement Agreement).

H. The right to exclusive use of the improvements on the Property.

I. Grantor shall obtain and comply with all permits for management of stormwater, for water wells and consumptive uses as may be required by the water management district or any successor agency having jurisdiction over those activities.

J. The right to construct, after giving notice to Grantee, buildings or other structures incident to agricultural uses carried on in accordance with sound agricultural practices, including hunting, fishing, camping, hiking, and wildlife viewing. Such buildings shall not be used as residences for continued habitation.

K. Boundary Maintenance. Nothing herein shall prohibit Grantor from establishing (by survey, fencing or marking) and maintaining property lines around

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the perimeter of the Property to protect the Property from trespassing and to assist Grantor in the management of the Property in accordance with this Easement.

L. The right to observe, maintain, photograph, introduce and stock native fish or wildlife on the Property, to use the Property for hiking, and horseback riding. Grantor reserves, and shall continue to own, the hunting and fishing rights on or related to the Property and Grantor may lease and sell privileges of such rights.

M. The rights of exploration for and extraction and production of oil and gas and all other hydrocarbons under the Property either directly or indirectly by Grantor or on Grantor's behalf or with the joinder or consent of Grantor in any application for a permit so to do, under and by virtue of the authority of a grant or reservation or other form of ownership of or interest in or control over or right to such substances, including but not limited to the drilling for and extraction/production of oil, gas, and all other hydrocarbons under the Property by slant or directional drilling from adjacent properties, so as not to damage or interfere with the Easement area, or except as necessary and lawfully allowed for the conduct of allowed activities, so long as such activities are in accordance with the requirements of the Collier County Comprehensive Plan and Land Development Code and applicable state and federal oil and gas permits.

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N. The rights to pursue complimentary conservation activities, such as gopher tortoise recipient areas, environmental credits, carbon credits, or other activities to protect and enhance habitat for other species. These rights do not include wetland mitigation banks pursuant to Section 373.4135, et. seq., Florida Statutes or Federal Law.

O. Grantor reserves the right to subdivide the Property into not more than three individual parcels, of not less than 500 acres each. Grantor shall provide legal descriptions for the three parcels. There shall be no further subdivision of the Property which is the subject of this Agreement. It is understood by Grantor and Grantee that if the three parcels are conveyed to Grantor's children the conveyances will not be subject to the provisions of Article VIII, Paragraph G.1.

ARTICLE VI. GRANTEE'S REMEDIES

A. **Remedies.** If Grantee determines that Grantor is in violation of the terms of this Easement, including any amendments, modifications, updates or revisions thereto, or that a violation is threatened, Grantee shall give written notice to Grantor of such violation and demand corrective action sufficient to cure the violation and, where the violation involves injury to the Property resulting from any use or activity inconsistent with the Easement Purposes, to restore the portion of the Property so injured. If Grantor fails to cure the violation within 30 days after receipt of notice thereof from Grantee or, under circumstances where the violation cannot reasonably be cured within a 30-day period, fails to begin curing such violation within the 30-day

period, or fails to continue diligently to cure such violation until finally cured, Grantee may bring an action at law or in equity in a court of competent jurisdiction to enforce the terms of this Easement, to enjoin the violation, *ex parte* as necessary, by temporary or permanent injunction, to recover any damages to which it may be entitled for violation of the terms of this Easement or injury to any values protected by this Easement, including damages for the loss of scenic, aesthetic, or environmental values, and to require the restoration of the Property to the condition that existed prior to any such injury.

B. Without limiting Grantor's liability therefor, Grantee, in its sole discretion, may apply any damages recovered to the cost of undertaking any corrective action on the Property. If Grantee, in its sole discretion, determines that circumstances require immediate action to prevent or mitigate significant damage to the values of the Property, Grantee may pursue its remedies under this Article VI without prior notice to Grantor or without waiting for the period provided for cure to expire.

C. Grantee's rights under this Article apply equally in the event of either actual or threatened violations of the terms of this Easement, and Grantor agrees that Grantee's remedies at law for any violation of the terms of this Easement are inadequate and that Grantee shall be entitled to the injunctive relief described in this Article, both prohibitive and mandatory, in addition to such other relief to which Grantee may be entitled, including specific performance of the terms of this Easement, without the necessity of proving either actual damages or the inadequacy of otherwise available legal remedies. Grantee's remedies described in this Article shall be cumulative and shall be in addition to all remedies now or hereafter existing at law or in equity.

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D. **Grantee's Discretion.** Enforcement of the terms of this Easement shall be at the discretion of Grantee, and any forbearance by Grantee to exercise its rights under this Easement in the event of any breach of any term of this Easement by Grantor shall not be deemed or construed to be a waiver by Grantee of such term or of any subsequent breach of the same or any other term of this Easement or of any of Grantee's rights under this Easement. No delay or omission by Grantee in the exercise of any right or remedy upon any breach by Grantor shall impair such right or remedy or be construed as a waiver.

E. **Waiver of Certain Defenses.** Grantor hereby waives any defense of estoppel, adverse possession or prescription.

F. **Acts Beyond Grantor's Control.** Nothing contained in this Easement shall be construed to entitle Grantee to bring any action against Grantor for any injury to or change in the Property resulting from causes beyond Grantor's control, including, without limitation, fire, flood, storm, and earth movement, or from any prudent action taken by Grantor under emergency conditions to prevent, abate, or mitigate significant injury to the Property resulting from such causes. Grantor will continue to

use reasonable efforts to control the exotic species present on the Property. Exotic species which may be present in the future will be controlled with reasonable efforts according to BMPs and in conjunction with Grantee.

G. **Hold Harmless.** Grantor shall hold harmless, indemnify, and defend Grantee and its directors, officers, employees, agents, and contractors and the personal representatives, successors, and assigns of each of them (collectively "Indemnified Parties") from and against all liabilities, penalties, costs, losses, damages, expenses, causes of action, claims, demands, or judgments, including, without limitation, reasonable attorney fees, arising from or in any way connected with: (1) injury to or the death of any person, or physical damage to any property, resulting from any act, omission, condition, or other matter related to or occurring on or about the Property, regardless of cause, except to the extent due to the negligence of any of the Indemnified Parties; (2) the obligations specified in Article VIII, Paragraphs A and B; and (3) the existence or administration of this Easement.

ARTICLE VII. PUBLIC ACCESS

A. **No General Public Access.** The granting of this easement does not convey to the public the right to enter the Property for any purpose whatsoever, and Grantee will cooperate with Grantor in the enforcement of this prohibition.

B. **Scientific, Environmental, Conservation, Educational Organizations.** Notwithstanding the foregoing, Grantor, in its sole discretion, shall grant to scientific, environmental, conservation and educational organizations the right to enter upon the Property or adjoining property of Grantor for conducting scientific or educational investigations or studies, on such terms as Grantor, in its sole discretion, may determine.

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ARTICLE VIII. MISCELLANEOUS

A. **Costs and Liabilities.** Grantor retains all responsibilities and shall bear all costs and liabilities of any kind related to the ownership, operation, upkeep, and maintenance of the Property, including the maintenance of adequate comprehensive general liability coverage, in amounts as determined by Grantor's reasonable discretion. Grantor shall keep the Property free of any liens arising out of any work performed for, materials furnished to, or obligations incurred by Grantor. Grantor will continue to use reasonable efforts to control the exotic species present on the Property. Exotic species which may be present in the future will be controlled with reasonable efforts according to BMPs and in conjunction with Grantee.

B. **Taxes.** Grantor shall pay before delinquency all taxes, assessments, fees, and charges of whatever description levied on or assessed against the Property by competent authority (collectively "taxes"), including any taxes imposed upon or

incurred as a result of this Easement, and shall furnish Grantee with satisfactory evidence of payment upon request. Grantee is authorized but in no event obligated to make or advance any payment of taxes, upon 3 days prior written notice to Grantor, in accordance with any bill, statement, or estimate procured from the appropriate authority, without inquiry into the validity of the taxes or the accuracy of the bill, statement, or estimate, and the obligation created by such payment shall bear interest until paid by Grantor at the maximum rate allowed by law.

C. **Extinguishment.** If circumstances arise in the future that render the Easement Purposes impossible to accomplish, this Easement can only be terminated or extinguished, whether in whole or in part, by judicial proceedings in a court of competent jurisdiction, and the amount of the proceeds to which Grantee shall be entitled, after the satisfaction of prior claims, from any sale, exchange, or involuntary conversion of all or any portion of the Property subsequent to such termination or extinguishment, shall be determined, unless otherwise provided by Florida law at the time, in accordance with Article VIII, Paragraph D. Grantee shall use all such proceeds in a manner consistent with the Purposes or the purposes of the bond or statutory program under which Grantee obtained the purchase money for this Easement. Grantor believes that any changes in the use of neighboring properties will increase the benefit to the public of the continuation of this Easement, and Grantor and Grantee intend that any such changes shall not be deemed to be circumstances justifying the termination or extinguishment of this Easement. In addition, the inability of Grantor to conduct or implement any or all of the uses allowed under the terms of this Easement, or the unprofitability of doing so, shall not impair the validity of this Easement or be considered grounds for its termination or extinguishment.

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D. **Proceeds.** This Easement constitutes a real property interest immediately vested in Grantee, which, for the purposes of Article VIII, Paragraph C, the parties stipulate to have a fair market value determined by multiplying the fair market value of the Property unencumbered by the Easement (minus any increase in value after the date of this grant attributable to improvements) by the ratio of the value of the Easement at the time of this grant to the value of the Property, without deduction for the value of the Easement, at the time of this grant. For the purposes of this paragraph, the ratio of the value of the Easement to the value of the Property unencumbered by the Easement shall remain constant.

E. **Condemnation.** If the Property is taken by any entity other than Grantee, in whole or in part, by exercise of the power of eminent domain, then Grantor shall be entitled to compensation for its fee simple interest in the Property and Grantee shall be entitled to compensation solely for the value of the Easement in accordance with applicable law. If Grantee should take the Property, in whole or in part, by exercise of the power of eminent domain, then Grantor shall be entitled to compensation for its fee simple interest in the Property in accordance with applicable law and Grantee shall not be entitled to any compensation.

F. **Assignment.** This Easement is transferable, but Grantee may assign its rights and obligations under this Easement only to a governmental entity with the capacity to monitor and enforce the provisions of this Easement. As a condition of such transfer, Grantee shall require that the terms and conditions of this Easement continue and are carried out in perpetuity.

G. **Subsequent Transfers.** Grantor further agrees to give written notice to Grantee of the transfer of any interest in the Property. The failure of Grantor or Grantee to perform any act required by this paragraph shall not impair the validity or priority of this Easement or limit its enforceability in any way.

1. Right of Grantee to Negotiate in Advance of Sale. The terms of this right are such that if Grantor intends to sell the Property, or any interest therein or portion thereof, except for a lease or license in the ordinary course of business, Grantor shall deliver to Grantee notice of such intent, including the names and addresses of any party to whom the Property is to be transferred at least 30 days prior to execution of a contract for such sale, and shall, in good faith, afford Grantee an opportunity to negotiate the acquisition of the Property, or such portion thereof or interest therein that Grantor intends to sell. If Grantee desires to negotiate the acquisition of the Property, or such portion thereof or interest therein, Grantee shall so notify Grantor within 30 days after receipt of Grantor's notice of intent. If Grantor and Grantee are unable, in good faith to agree to terms of an acquisition of the Property, or such interest therein or portion thereof as applicable, within 90 days of the Grantor's notice to Grantee, Grantor may sell the Property free of the right granted herein provided, however, that closing on such sale shall occur within one year of the date of Grantor's notice to Grantee. If the Property, or such portion thereof or interest therein as is applicable, has not sold within one year after Grantee's notice to Grantor that Grantee does not intend to negotiate acquisition of the Property or within one year after failure to reach agreement to terms of an acquisition, then any intent to sell the Property thereafter shall require renewed notice to Grantee. This right of notice shall not be triggered by sales, transfers, or conveyances between Grantor and: 1. Aliese Priddy and/or Russell Priddy, or the subsequent conveyance from Aliese and/or Russell Priddy to any Excluded Grantee (hereinafter defined); 2. Any trustee of an estate planning trust established by or for the benefit of Aliese Priddy, Russell Priddy, or their respective children, heirs (including collateral heirs), devisees, distributees, or descendants, or any subsequent conveyance from such trustees to an Excluded Grantee; 3. The executor(s) and/or personal representative(s), children, heirs (including collateral heirs), devisees, distributees, or descendants of Aliese Priddy and/or Russell Priddy; or 4. Any entity or entities in which Grantor and/or Aliese Priddy and/or Russell Priddy and/or any Excluded Grantee owns a majority of the controlling interests (the foregoing are collectively called the "Excluded Grantees" or each an "Excluded Grantee"). The right or notice granted herein otherwise applies to the original Grantor and to said original Grantor's, heirs, successors and assigns.

2. Subsequent Transfers. Grantor agrees to notify Grantee of the names and addresses of any party to whom the Property, is to be transferred at least 30 days prior to the date of such transfer, and agrees to incorporate the terms of this Easement in any deed or other legal instrument by which Grantor divests any interest in the Property, including, without limitation, a lease, or other legal instrument by which any interest in the Property is conveyed.

3. Statement of Compliance. Grantor hereby agrees to request in writing at least 30 days prior to sale, mortgage, transfer or long term (five years or longer) lease of the Property, or any portion thereof, a written statement from Grantee stating that Grantor is in compliance with the terms and conditions of this Easement, or if Grantor is not in compliance with the terms and conditions of this Easement, stating what violations of this Easement exist. Grantee agrees in such cases or at any other time, to acknowledge, execute and deliver to Grantor or to any mortgagee, transferee, purchaser or lessee such a written statement concerning compliance within 30 days from receipt by Grantee of a written request therefore. Nothing contained in this Easement shall relieve the Grantor from the responsibility to comply with applicable federal, state, and local laws and regulations.

4. Grantor's Liability after Transfer. In the event of the sale, and/or the transfer of title of the Property to a party other than the current legal owner, Grantee will meet with the new owner within 30 days and explain, discuss, and plan the transfer of the responsibility of carrying out the terms of this Easement, such that the long-term benefits to everyone concerned and to the terms and conditions of this Easement will not be impaired by default or otherwise. Grantor, and each subsequent owner of the Property shall have no personal liability for the observance or performance of the Covenants and obligations of the Grantor hereunder, with respect to any interest in the Property conveyed, after the Grantor or subsequent owner has conveyed (his or her) interest in the Property.

5. Continuation of Agricultural Production. Grantor shall obtain assurances in writing from the prospective transferee that the Property will continue to be used for bona fide agricultural production purposes in accordance with the Easement Purposes.

H. **Notices.** Any notice, demand, request, consent, approval, or communication that either party desires or is required to give to the other shall be in writing and either served personally or sent by first class mail, postage prepaid, addressed to the parties as set forth above, or to such other addresses such party may establish in writing to the other. If time is of the essence, initial notice by electronic mail is acceptable, but shall be followed by written notice as provided in this paragraph as soon as possible.

COPY

I. **Recordation.** Grantee shall record this instrument and any amendments in timely fashion in the official records of Collier County, Florida, and may re-record it at any time as may be required to preserve its rights in this Easement.

J. **Non-Homestead Certification.** Grantor hereby certifies that if a Grantor who is married signs this Easement without the joinder of his or her spouse, the Property is neither the homestead of Grantor nor the primary physical residence of Grantor, nor is the Property contiguous to the homestead or primary physical residence of Grantor.

K. **Amendments.** The terms and provisions of this Easement may be amended by the mutual consent of the parties hereto. No amendment shall be effective until executed with the formality of a deed and recorded in the public records.

L. **Controlling Law.** The laws of the State of Florida shall govern the interpretation and performance of this Easement.

M. **Liberal Construction.** Any general rule of construction to the contrary notwithstanding, this Easement shall be liberally construed in favor of the Grantee to effect the Easement Purposes and the policy and purpose of Section 570.71, Florida Statutes. If any provision in this instrument is found to be ambiguous, an interpretation consistent with the Easement Purposes that would render the provision valid shall be favored over any interpretation that would render it invalid.

N. **Severability.** If any provision of this Easement, or the application thereof to any person or circumstance, is found to be invalid, the remainder of the provisions of this Easement, or the application of such provision to persons or circumstances other than those as to which it is found to be invalid, as the case may be, shall not be affected thereby.

O. **No Forfeiture.** Nothing contained herein will result in a forfeiture or reversion of Grantor's title in any respect.

P. **Joint Obligation.** The obligations imposed by this Easement upon Grantor shall be joint and several.

Q. **Successors.** The covenants, terms, conditions, and restrictions of this Easement shall be binding upon, and inure to the benefit of, the parties hereto and their respective personal representatives, heirs, successors, and assigns and shall continue as a servitude running in perpetuity with the Property.

R. **Termination of Rights and Obligations.** A party's rights and obligations under this Easement terminate upon transfer of the party's interest in the Easement or Property, except that liability for acts or omissions occurring prior to transfer shall survive transfer.

S. **Captions.** The captions in this instrument have been inserted solely for convenience of reference and are not a part of this instrument and shall have no effect upon construction or interpretation.

T. **References.** References to statutes or rules in this Easement shall be to the text of such statute or rule on the date of execution of this Easement.

TO HAVE AND TO HOLD unto Grantee, its successors, and assigns forever.

IN WITNESS WHEREOF Grantor and Grantee have set their hands on the day and year first above written.

Grantor:
JB Ranch I, LLC, a Florida Limited Liability Company

Witnesses:

Signature of first witness

By: Aliese P. Priddy
Aliese P. Priddy, as Manager and Managing Member

Jamie Temples
Printed name of first witness

Signature of second witness

Monique Jackson
Printed name of second witness

COLLIER COUNTY COPY CLERK OF THE CIRCUIT COURT

STATE OF FLORIDA
COUNTY OF COLLIER

I HEREBY CERTIFY that on this day, before me, an officer duly authorized in the State aforesaid and in the County aforesaid, to take acknowledgments, appeared Aliese P. Priddy, as Manager and Managing Member of JB Ranch I, LLC, a Florida limited liability company, who is personally known to me or who has produced a state driver license as identification, and who did not take an oath and executed the foregoing instrument and he/she/they acknowledged before me that he/she/they executed the same for the purposes therein expressed.

WITNESS my hand and official seal in the County and State last aforesaid this 21 day of June, 2016.

Signed

NOTARY PUBLIC
My Commission Expires:

Jamie Temples
Printed

JAMIE TEMPLES
MY COMMISSION EXPIRES
January 3, 2019
#FF 160973
Bonded thru Notary Public Underwriters
NOTARY PUBLIC, STATE OF FLORIDA

Grantor:
Sunniland Family Limited Partnership,
a Florida Limited Partnership
By: Sunniland Partners LLC, a Florida limited liability company, as General Partner

Witnesses:

_____
Signature of first witness

By: _____
Aliese P. Priddy, as Manager and Managing Member

_____
Printed name of first witness

_____
Signature of second witness

_____
Printed name of second witness

COLLIER COUNTY
COPY
CLERK OF THE CIRCUIT COURT

STATE OF FLORIDA
COUNTY OF COLLIER

I HEREBY CERTIFY that on this day, before me, an officer duly authorized in the State aforesaid and in the County aforesaid, to take acknowledgments, appeared Aliese P. Priddy, as Manager and Managing Member of Sunniland Partners LLC, a Florida limited liability company, the General Partner of Sunniland Family Limited Partnership, a Florida Limited Partnership, on behalf of the partnership, who is personally known to me or who has produced a state driver license as identification, and who did not take an oath and executed the foregoing instrument and he/she/they acknowledged before me that he/she/they executed the same for the purposes therein expressed.

WITNESS my hand and official seal in the County and State last aforesaid this 20th day of June, 2016.

NOTARY PUBLIC
My Commission Expires:

Signed

_____
Printed

JAMIE TEMPLES
MY COMMISSION EXPIRES
January 3, 2019
#FF 160873
Bonded thru
Notary Public Underwriters
NOTARY PUBLIC STATE OF FLORIDA

BOARD OF TRUSTEES OF THE INTERNAL IMPROVEMENT TRUST FUND OF THE STATE OF FLORIDA
BY FLORIDA FOREST SERVICE
DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES

Witnesses:

Signature of first witness

BY: D. ALAN EDWARDS
DIRECTOR OF ADMINISTRATION

Debra Finch
Printed name of first witness

Vianka Colin
Signature of second witness

Vianka Colin
Printed name of second witness

COLLIER COUNTY
COPY
CLERK OF THE CIRCUIT COURT

STATE OF FLORIDA
COUNTY OF LEON

I HEREBY CERTIFY that on this day, before me, an officer duly authorized in the State aforesaid and in the County aforesaid, to take acknowledgments, appeared D. Alan Edwards, as Director of Administration of the Florida Forest Service, Department of Agriculture and Consumer Services on behalf of the Board of Trustees of the Internal Improvement Trust Fund of the State of Florida, who is personally known to me or who has produced a state driver license as identification, and who did not take an oath and executed the foregoing instrument and he/she/they acknowledged before me that he/she/they executed the same for the purposes therein expressed on behalf of the Board of Trustees.

WITNESS my hand and official seal in the County and State last aforesaid this 16th day of June, 2016.

Signed

NOTARY PUBLIC STATE OF FLORIDA
CARMELITA BENNETT
MY COMMISSION # FF 971708
EXPIRES: March 15, 2020
Bonded Thru Budget Notary Services

Carmelita Bennett
Printed
NOTARY PUBLIC
My Commission Expires:

SCHEDULE OF EXHIBITS

A. Legal Description of Property Subject to Easement

B. Map from Baseline Documentation Report showing locations of SNAs

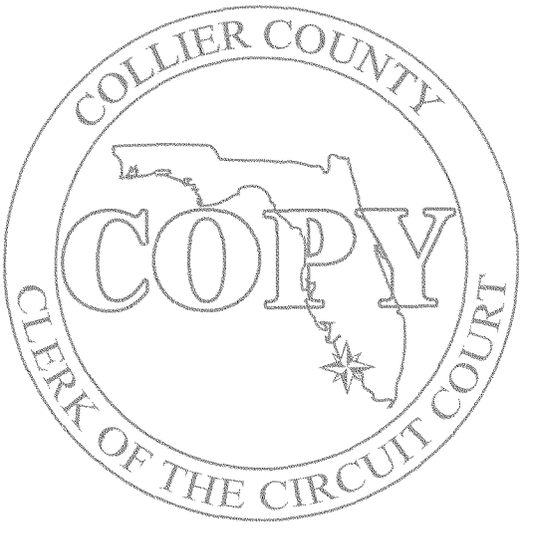


Exhibit "A"

All of Sections 21 and 22 and part of Sections 14 and 28, Township 48 South, Range 30 East, Collier County, Florida and being more particularly described as follows:

BEGIN at the Northwest Corner of the aforementioned Section 21; thence along the North line of said Section 21, North 89°58'12" East, 5,290.45 feet to the Northeast corner of the aforementioned Section 22; thence along the North line of said Section 22, North 89°31'45" East, 5,340.05 feet to the Northeast corner of said Section 22; thence along the East line of said Section 22, South 01°09'29" East, 5279.28 to the Southeast corner of said Section 22; thence, along the South line of said Section 22, South 89°23'21" West, 5,319.14 feet to the Northeast corner of the aforementioned Section 28; thence along the East line of said Section 28, South 01°22'59" East, 3,378.40 feet; thence, leaving said East line, North 40°15'34" West, 774.23 feet; thence North 04°12'32" East, 313.18 feet; thence North 21°30'09" East, 277.45 feet; thence North 27°02'52" West, 304.80 feet; thence North 65°08'50" West, 1,353.44 feet; thence North 66°21'12" West, 1410.01 feet; thence North 24°10'40" West, 866.66 feet to an intersection with the South line of the aforementioned Section 21; thence, along said South line, South 89°39'36" West, 2,046.31 feet to the Southwest corner of said Section 21; thence, along the West line of said Section 21, North 00°41'41" West, 5,320.43 feet to the Northwest corner of Section 21 and the **POINT OF BEGINNING**.

AND

BEGIN at the Southwest corner of the aforementioned Section 14; thence, along the West line of said Section 14, North 00°18'39" West, 2,346.91 feet to an intersection with the Southerly Right of Way of Oil Well Road (County Road 858 and formerly State Road 840, 100 feet wide) according to Road Plat Book 2, Page 63, Collier County, Florida; thence along said Southerly Right of Way for the following three (3) courses:

1. South 68°19'18" East, 812.84 feet;
2. Along the arc of a tangent circular curve concave to the North having for its elements, a radius of 570.87 feet, a central angle of 50°52'19", a chord distance of 490.38 feet, a chord bearing of North 86°14'33" East, an arc distance of 506.87 feet;
3. North 60°48'23" East, 1,901.09 feet;

thence leaving said Southerly Right of Way, South 29°11'37" East, 425.35 feet; thence South 73°14'06" East, 293.84 feet; thence South 40°12'22" East, 416.79 feet; thence South 32°02'07" East, 114.13 feet; thence South 14°18'46" East, 271.15 feet; thence South 25°56'19" East, 382.21 feet; thence South 27°34'43" East, 399.20 feet; thence South 17°21'14" West, 282.84 feet; thence South 44°52'23" West, 657.96 feet; thence South 30°46'16" West, 463.04 feet to an intersection with the South line of the Southeast ¼ of the aforementioned Section 14; thence along said South line, South 89°16'32" West, 703.97 feet to the South ¼ corner of said Section 14; thence along the South line of the Southwest ¼ of said Section 14, South 89°18'50" West, 2,639,79 feet to the **POINT OF BEGINNING**.

JB I Ranch LLC
Collier County

BSM
BY SK
Date: 2.05.2016

COPY

TOGETHER WITH:

A 30 foot wide easement for ingress and egress described as follows:

A parcel of land lying in Sections 27, 28 and 29, Township 48 South, Range 30 East, Collier County, Florida, said parcel being 30.00 feet wide and lying 15.00 feet on either side of the following described centerline:

COMMENCE at the Northeast corner of the aforementioned Section 28, thence along the East line of said Section 28, S.01°22'59"E., 2,448.26 feet to the **POINT OF BEGINNING**; thence S.28°28'37"E., 1,060.61 feet; thence S.61°31'23"W., 16.91 feet; thence along the arc of a tangent circular curve concave to the Southeast having for its elements a radius of 250.00 feet, a central angle of 57°10'06", a chord distance of 239.22 feet, a chord bearing of S.32°56'20"W., an arc distance of 249.44 feet to a point of reverse curvature; thence along the arc of a tangent circular curve concave to the West having for its elements a radius of 875.00 feet, a central angle of 06°32'35", a chord distance of 99.87 feet, a chord bearing of S.07°37'35"W., an arc distance of 99.92 feet; thence S.10°53'52"W., 100.61 feet; thence along the arc of a tangent circular curve concave to the East having for its elements a radius of 105.00 feet, a central angle of 49°53'07", a chord distance of 88.56 feet, a chord bearing of S.14°02'42"E., an arc distance of 91.42 feet; thence S.38°59'15"E., 45.67 feet; thence S.48°57'40"W., 75.11 feet; thence S.55°43'16"W., 108.94 feet; thence along the arc of a tangent circular curve concave to the North having for its elements a radius of 195.00 feet, a central angle of 27°47'22", a chord distance of 93.65 feet, a chord bearing of S.69°36'57"W., an arc distance of 94.58 feet; thence S.83°30'38"W., 282.08 feet; thence S.81°38'22"W., 1,067.40 feet; thence S.82°39'54"W., 331.72 feet; thence S.84°04'46"W., 333.07 feet; thence along the arc of a tangent circular curve concave to the South having for its elements a radius of 340.00 feet, a central angle of 27°27'44", a chord distance of 161.41 feet, a chord bearing of S.70°20'54"W., an arc distance of 162.96 feet; thence S.56°37'02"W., 54.21 feet; thence, along the arc of a non-tangent circular curve concave to the North having for its elements a radius of 208.62 feet, a central angle of 32°40'43", a chord distance of 117.38 feet, a chord bearing of S.72°57'23"W., an arc distance of 118.99 feet; thence S.89°17'44"W., 530.37 feet; thence S.89°35'29"W., 710.24 feet; thence S.89°03'07"W., 668.44 feet; thence S.89°18'41"W., 716.15 feet; thence S.87°34'10"W., 426.83 feet; thence S.89°15'59"W., 266.31 feet; thence N.80°58'58"W., 62.71 feet; thence N.76°25'46"W., 78.34 feet; thence along the arc of a tangent circular curve concave to the South having for its elements a radius of 500.00 feet, a central angle of 21°37'24", a chord distance of 187.58 feet, a chord bearing of N.87°14'29"W., an arc distance of 188.70 feet; thence S.81°56'49"W., 100.82 feet; thence S.83°46'39"W., 156.34 feet; thence S.84°41'50"W., 65.15 feet; thence S.89°06'18"W., 1,058.86 feet; thence S.89°14'26"W., 489.47 feet; thence S.89°20'04"W., 225.38 feet; thence S.89°07'37"W., 140.20 feet to an intersection with the Easterly right-of-way of State Road 29, according to Florida Department of Transportation Right-of-way Map Section 03080-2514 (dated August 14, 1981) and a **POINT OF TERMINATION.**

JB I Ranch LLC
Collier County

BSM
BY SK
Date: 2.05.2016

Exhibit B to Deed of Easement

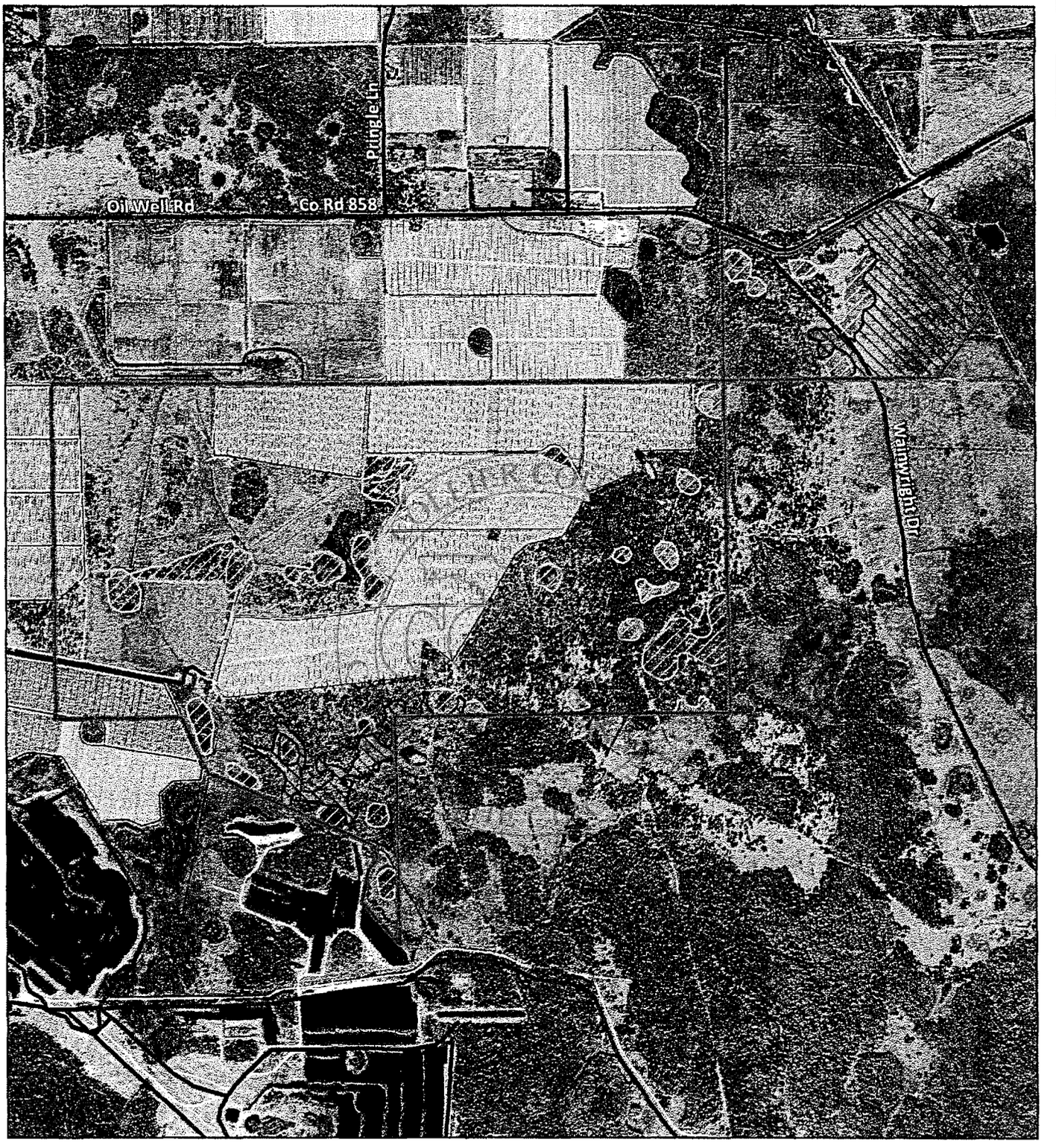


Figure 6
Special Natural Areas Map

JB Ranch, Collier County, FL
2012 Natural Color Orthophotos
(2-foot) resolution

N
W E
S

Jim Stidham & Associates, Inc.
Hydrology, Geology, Civil & Environmental Engineering
L.B. No. 00005629
547 N. Monroe St., Suite 201
Tallahassee, Florida 32301
Telephone: 850-222-3975
Fax: 850-681-0560

JB Ranch
Freshwater Marshes
Forested Wetlands
Wet Prairies

Source: U.S. Geological Survey in cooperation with the U.S. enviromental Protection Agency, USDA Forest Service

0 750 1,500 3,000
Feet

JB RANCH I CONSERVATION EASEMENT

THIS DEED OF CONSERVATION EASEMENT ("Conservation Easement") is given this 29th day of June 2016, by JB Ranch I, LLC, a Florida limited liability company and Sunniland Family Limited Partnership, a Florida limited partnership (together "Grantor"), whose mailing address is Post Office Box 930, Immokalee, Florida, to the Florida Forest Service, Florida Department of Agriculture and Consumer Services ("Grantee"), whose mailing address is The Conner Building, 3125 Conner Boulevard - Room 237, Tallahassee, FL 32399-1650 (collectively, the Grantor and Grantee may hereinafter be referred to as the "Parties"). As used herein, the term "Grantor" shall include any and all heirs, successors or assigns of the Grantor and all subsequent owners of the "Property" (as hereinafter defined), and the term "Grantee" shall include any successor or assignee of Grantee.

WITNESSETH

WHEREAS, the Grantor is the owner in fee simple of certain lands situated in Collier County, Florida, and more specifically described in Exhibit "A" attached hereto and incorporated herein ("Property"); and

WHEREAS, the United States Fish and Wildlife Service ("Service"), an agency within the United States Department of Interior, has jurisdiction over the conservation, protection, restoration, enhancement, and management of fish, wildlife, native plants, and habitat pursuant to various federal laws, including the Endangered Species Act, 16 U.S.C. Section 1531, et seq. ("ESA"), the Fish and Wildlife Coordination Act, 16 U.S.C. Sections 661-666c, the Fish and Wildlife Act of 1956, 16 U.S.C. Section 742(f) et seq., and other provisions of Federal law; and

WHEREAS, the Service maintains that the Property possesses or is capable of possessing ecological and habitat values that benefit endangered, threatened, or other species (collectively "Conservation Values") of great importance to the people of the State of Florida and the United States, including the Puma concolor coryi ("Florida Panther") and other several other protected species, which are addressed in and covered by the proposed Eastern Collier County Multiple Species Habitat Conservation Plan (the "Covered Species"); and

WHEREAS, the Eastern Collier County Multiple Species Habitat Conservation Plan ("HCP") is intended to permanently preserve approximately 107,000 acres of privately held land in Southwest Florida, including the Property, within the boundaries of the area depicted in Exhibit "B" attached hereto (the "HCP Area"), is currently under review by the Service and subject to revision and approval, and will be implemented through an Implementing Agreement ("IA") to be developed and executed by the Service, the Grantor, and the owners of other lands that are located within the HCP Area; and

WHEREAS, Grantee has conveyed to the Board of Trustees of the Internal Improvement Trust Fund of the State of Florida (the "Board") a perpetual easement on the Property pursuant to the Florida Rural and Family Lands Protection Program (the "RFLPP Easement"), based on a mutual recognition by Grantor and the Board of the special character of the Property as a working landscape that has traditionally been used for agriculture, as that term is defined in Section 570.02(1), Florida Statutes, and the common purpose of Grantor and the Board of conserving certain values and character of the Property; and

WHEREAS, the RFLPP Easement specifically reserves Grantor's rights to pursue

complimentary conservation activities, including gopher tortoise recipient areas, environmental credits, carbon credits, and other activities to protect and enhance habitat for other species, such as those addressed in this Conservation Easement; and

WHEREAS, the Agricultural and Conservation Values of the Property are documented in the "Baseline Documentation Report for the JB Ranch Easement Tract in Collier County, Florida," dated February 4, 2016 (the "BDR") and will be documented in the HCP, which together, and along with the exhibits to the BDR and the JB Ranch Panther Habitat Assessment Workbook, are hereby incorporated into this Conservation Easement by reference; and

WHEREAS, the Grantor, in consideration of the values of the BDR and RFLPP Easement, agrees to grant and secure to the Grantee a perpetual conservation easement as defined in Section 704.06, Florida Statutes, over the Property.

NOW, THEREFORE, in consideration of the above recitals and the mutual covenants, terms, conditions, and restrictions contained herein, together with other good and valuable consideration, the adequacy and receipt of which are hereby acknowledged, Grantor hereby grants, creates, and establishes a perpetual conservation easement for and in favor of the Grantee upon the Property which shall run with the land and be binding upon the Grantor and shall remain in full force and effect forever.

The scope, nature, and character of this Conservation Easement shall be as follows:

1. **Recitals.** The recitals hereinabove set forth are true and correct and are hereby incorporated into and made part of this Conservation Easement.

2. **Purpose.** The purpose of this Conservation Easement is to ensure that the Property shall be protected forever, consistent with the BDR and RFLPP Easement. The Parties intend that this Conservation Easement will confine the use of the Property to such uses as are consistent with the purpose of the BDR, the RFLPP Easement and this Conservation Easement.

3. **Grantee and the Service's Rights.** To carry out the purpose of this Conservation Easement, the Grantor conveys the following rights to Grantee and the Service:

a. To enter upon the Property at any time after giving twenty-four (24) hours prior notice to the Grantor in order to monitor Grantor's compliance with this Conservation Easement, monitor and survey the Property for use by the Covered Species and otherwise enforce the terms of this Conservation Easement;

b. To enjoin any activity on or use of the Property that is inconsistent with this Conservation Easement, to require restoration of such areas or features of the Property that may be damaged by any act, failure to act, or any use or activity that is inconsistent with the purposes of this Conservation Easement and to preserve the Conservation Values of the Property;

c. To preserve, protect and sustain the biological resources and Conservation Values of the Property unless specifically excluded from this Conservation Easement; and

d. To enforce the terms, provisions and restrictions of this Conservation Easement.

4. **Prohibited Use.** Unless expressly authorized by and in accordance with the HCP or IA, or as reserved in paragraph 5 of this Conservation Easement, the following activities are

prohibited on the Property:

a. Construction, reconstruction or placement of any road, sign, billboard or other advertising, utilities or any other building or structure on or above the ground;

b. Dumping or placing of soil or other substance or material as landfill, or dumping of trash, waste, biosolids or unsightly or offensive materials;

c. Removal or destruction of trees, shrubs, or other vegetation, except as necessary for the removal of exotic plants;

d. Excavation, dredging, or removal of loam, peat, gravel, soil, rock or other material substance in such manner as to affect the surface;

e. Mineral excavation, draining or dredging;

f. Surface use except for purposes that permit the land or water areas to remain in their existing conditions;

g. Activities detrimental to drainage, flood control, water conservation, erosion control, soil conservation, or fish and wildlife habitat preservation including, but not limited to, ditching, diking and fencing;

h. Acts or uses detrimental to such aforementioned retention of land or water areas in their existing condition;

i. Acts or uses detrimental to the preservation of the structural integrity or physical appearance of sites or properties on the Property having historical, architectural, archaeological, or cultural significance;

j. Alteration of the general topography of the Property;

k. Planting, introduction or dispersal of exotic plant or animal species;

l. Commercial or industrial uses; and

m. Manipulation, impoundment or alteration of any natural watercourse, body of water or water circulation on the Property.

5. **Grantor's Reserved Rights**. Grantor reserves unto itself, its successors and assigns, and all successor owners of the Property or any portion thereof:

a. All rights accruing from its ownership of the Property, including the right to engage in or to permit or invite others to engage in all uses of the Property that are neither expressly prohibited herein, inconsistent with the purpose of this Conservation Easement, the BDR, the HCP or the IA, and are not likely to negatively impact the quality of the Property as habitat for the Covered Species.

b. The right to conduct activities on the Property, including, but not limited to, maintenance and monitoring activities, as set forth in the BDR, the HCP and the IA.

c. The right to maintain historical drainage on the Property in accordance with the BDR, the HCP and the IA.

d. The right to hunt, fish, travel upon, and recreate upon the Property in accordance with the BDR, the HCP and the IA.

e. The right to graze cattle and conduct other agricultural activities upon the Property in accordance with the BDR, the HCP, the IA and the Conservation Easement.

f. The right to use or convey panther habitat units ("PHUs") and other similar credits for use only within the HCP Area, in accordance with the HCP and the IA.

6. **Grantee and the Service's Duties.** Neither Grantee nor the Service shall unreasonably interfere with Grantor or its invitees, guests, and agents' use and quiet enjoyment of the Property. Grantee and Service agree that neither Grantor nor any affiliate, subsidiary or other related party of Grantor shall be liable for or obligated for any liability, penalty, cost, loss, damage, expense, cause of action, claim, demand, or judgment arising from or in any way connected with Grantee's or Service's conduct and/or negligence on or about the Property pursuant to this paragraph. The Grantee further agrees to provide the Service with annual Conservation Easement monitoring reports as may be required by the HCP and/or the IA.

7. **Grantor's Duties.** Grantor shall undertake all reasonable actions to prevent the unlawful entry and trespass upon the Property by persons whose activities may degrade or harm the Conservation Values of the Property. The Grantor also shall be responsible for control of public access to the Property through measures including, but not limited to, the gating and locking of access points and the marking of entry points with no trespassing signs. Grantor shall be responsible for the funding of the payment of all costs and expenses relating to the Property with funding assistance as may be established in the HCP and/or the IA.

8. **No Dedication.** No right of access, ingress, or egress by the general public to any portion of the Property is conveyed by this Conservation Easement.

9. **Obligations of Ownership.** Grantor retains all responsibilities and all obligations related to the ownership, operation, upkeep, and maintenance of the Property. Grantor shall keep the Property free of any liens arising out of any work performed for, materials furnished to, or obligations incurred by Grantor. Grantor shall pay before delinquency all taxes, assessments, fees, and charges of whatever description levied on or assessed against the Property by competent authority, and shall furnish Grantee and the Service with satisfactory evidence of payment upon written request. Grantor remains solely responsible for obtaining any applicable permits and approvals required for any activity or use permitted on the Property by this Conservation Easement, and any such activity or use shall be undertaken in accordance with all applicable federal, state, local and administrative agency laws, statutes, ordinances, rules, regulations, orders and requirements.

10. **Enforcement.** Grantee and/or the Service have the right to enforce the terms, provisions and restrictions of this Conservation Easement. Any forbearance on behalf of Grantee or the Service to exercise its right of enforcement hereunder shall not be deemed or construed to be a waiver of either of their rights hereunder.

11. **Remedies for Violation and Corrective Action.** If Grantee, Grantor or the Service determines there is a violation of the terms of this Conservation Easement or that a violation is threatened, written notice of such violation and a demand for corrective action sufficient to cure the violation shall be given to the putative violator as well as to the Service. In any such instance, measures to cure the violation shall be reviewed and approved by the Service. If a violation is not cured within thirty (30) days after receipt of written notice and demand, or if the cure reasonably requires more than thirty (30) days to complete and there is failure to begin the cure within the 30-day period or to continue diligently to complete the cure, Grantee, Grantor or the Service may bring an action at law or in equity in a court of competent jurisdiction to enforce compliance with the terms of this Conservation Easement, to recover any damages to which Grantee, Grantor or the Service may be entitled for violation of the terms of this Conservation Easement or for any damage to the Conservation Values of the Property or for other equitable relief, including, but not limited to, the restoration of the Property to the condition in which it existed prior to the violation or damage. Without limiting the violator's liability, any damages recovered may be applied to the cost of undertaking any corrective action on the Property.

12. **Acts Beyond Grantor's Control.** Nothing contained in this Conservation Easement shall be construed to entitle Grantee or the Service to bring any action against Grantor for any injury to or change in the Property resulting from natural causes beyond Grantor's control, including, without limitation, fire, flood, storm and earth movement or from any necessary action taken by Grantor under emergency conditions to prevent, abate or mitigate significant injury to the Property or to persons resulting from such causes.

13. **Hold Harmless.** Grantor shall hold harmless, indemnify, and defend Grantee and its members, directors, officers, employers, agents and contractors and the heirs, personal representatives, successors, and assigns of each of them (collectively "Grantee's Indemnified Parties") from and against all liabilities, penalties, costs, losses, damages, expenses, causes of action, claims, demands, orders, liens or judgments, including, without limitation, reasonable attorney's fees, arising from or in any way connected with: (a) injury to or the death of any person, or physical damage to any property, resulting from any act, omission, condition or other matter related to or occurring on or about the Property, regardless of cause, unless due to the negligence of any of the Grantee's Indemnified Parties; (b) Grantor's obligations specified in this Conservation Easement; and (c) the obligations, covenants, representations, and warranties of this Conservation Easement relating to Paragraph 9 of this Conservation Easement. Grantee shall hold harmless, indemnify, and defend Grantor and its members, directors, officers, employers, agents and contractors and the heirs, personal representatives, successors, and assigns of each of them (collectively "Grantor's Indemnified Parties") from and against all liabilities, penalties, costs, losses, damages, expenses, causes of action, claims, demands, orders, liens or judgments, including, without limitation, reasonable attorney's fees, arising from or in any way connected with: (a) injury to or the death of any person, or physical damage to any property, resulting from any act, omission, condition or other matter related to or occurring on or about the Property resulting from the conduct of all or any of Grantee's Indemnified Parties; and (b) Grantee's obligations specified in this Conservation Easement.

14. **No Hazardous Materials Liability.** Grantor represents and warrants that it has no knowledge of any release or threatened release of hazardous materials in, on, under, about or affecting the Property. Without limiting the obligations of Grantor as otherwise provided in this Easement, Grantor agrees to indemnify, protect and hold harmless Grantee's Indemnified Parties, as defined in Paragraph 13, against any and all claims arising from or connected with any hazardous materials present, released in, on, from, or about the Property at any time, of any substance now or hereafter defined, listed, or otherwise classified pursuant to any federal, state, or

local law, regulation, or requirement as hazardous, toxic, polluting, or otherwise contaminating to the air, water, or soil, or in any way harmful or threatening to human health or the environment, unless caused solely by any of the Grantee's Indemnified Parties.

15. **Assignment.** Grantee will hold this Conservation Easement exclusively for conservation purposes and for the purpose set forth in Paragraph 2 of this Conservation Easement. Grantee will not assign its rights and obligations under this Conservation Easement except to another organization or entity qualified to hold such interests under the applicable state and federal laws and committed to hold this Conservation Easement exclusively for the purposes set forth herein. Grantee may not assign this Conservation Easement without written consent of Grantor and the Service.

16. **Subsequent Property Transfer.** Grantor agrees to either refer to this Conservation Easement or, alternatively, incorporate the terms of this Conservation Easement in any deed or other legal instrument by which Grantor divests itself of any interest in all or a portion of the Property, including, without limitation, a leasehold interest. Grantor further agrees to give Grantee and the Service written notice of the intent to transfer any interest at least thirty (30) days prior to the date of such transfer. Grantee or the Service shall have the right to prevent subsequent transfers in which prospective subsequent claimants or transferees are not given notice of the terms, covenants, conditions and restrictions of this Conservation Easement or whenever a subsequent Property transfer will result in a merger of the Conservation Easement and the Property in a single Property owner (thereby extinguishing the Conservation Easement) if no method or mechanism deemed adequate to preserve, protect and sustain the Property in perpetuity has been established. The failure of Grantor to perform any act required by this section shall not impair the validity of this Conservation Easement or limit its enforcement in any way.

17. **Severability.** If any provision of this Conservation Easement or the application thereof to any person or circumstances is found to be invalid, the remainder of the provisions of this Conservation Easement shall not be affected thereby as long as the purpose of the Conservation Easement is preserved.

18. **Recordation.** Grantor shall record this Conservation Easement in timely fashion in the Official Records of Collier County, Florida, and shall re-record it at any time Grantee may require to preserve its rights. Grantor shall pay all recording costs and taxes necessary to record this Conservation Easement in the public records. Grantor will hold Grantee harmless from any recording costs or taxes necessary to record this Conservation Easement in the public records.

19. **Modifications.** This Conservation Easement may be amended, altered, released or revoked only by written agreement between the Parties hereto or their heirs, assigns or successors-in-interest and with written approval of the Service, including any modification as may be desired by the Parties, to address the use of the PHUs or as may be required by the HCP. Any such modification shall be consistent with the purposes of this Conservation Easement, the BDR and HCP and shall not affect the perpetual duration of this Conservation Easement. The Grantee shall promptly record any written modification in the public records of Collier County, Florida and thereafter promptly provide a conformed copy of the recorded modification to the Grantor and to the Service.

20. **Written Notice.** All notices, consents, approvals or other communications hereunder shall be in writing and delivered personally or sent by facsimile or by a recognized overnight delivery service. Notice by either of the previous methods shall be deemed given upon

delivery. Notice also may be sent by United States mail, certified, return receipt requested and postage prepaid. Such notice shall be deemed given five (5) days after deposit in the United States mail. Notice shall be addressed as follows or to such other address as either Party or the Service may from time to time specify in writing:

To Grantor:	Sunniland Family Limited Partnership Post Office Box 930 Immokalee, Florida 34143 (239) 289-0064
To Grantee:	Florida Forest Service Florida Department of Agriculture and Consumer Services The Conner Building 3125 Conner Boulevard - Room 237 Tallahassee, FL 32399-1650 (850) 681-5828
To the Service:	Field Supervisor United States Fish and Wildlife Service South Florida Ecological Services Office 1339 20th Street Vero Beach, Florida 32960-3559 Facsimile: (772) 562-4288

21. **Subordination of Liens.** Grantor hereby covenants with said Grantee that Grantor is lawfully seized of said Property in fee simple; that the Property is free and clear of all encumbrances that are inconsistent with the terms of this Conservation Easement; that all mortgages and liens on the Property, if any, have been subordinated to this Conservation Easement; that Grantor has good right and lawful authority to convey this Conservation Easement; and that Grantor hereby fully warrants and defends the title to the Conservation Easement hereby conveyed against the lawful claims of all persons whomsoever.

22. **Funding.** Funding for the management, maintenance, and monitoring activities required to occur on the Property pursuant to this Conservation Easement shall come from Grantor, with funding assistance as may be established in the HCP and/or the IA.

23. **No Merger or Release**. This Conservation Easement provides specific and substantial rights to the Service as provided herein and in accordance with other agreements between the Grantor and the Service. These rights, among other things, prohibit the release or assignment of the rights, obligations and encumbrances established by this Conservation Easement in any fashion, except upon written approval of the Service. It is the intent of the Grantor, the Grantee and the Service that this Conservation Easement shall be a covenant running with title to the Property and that this Conservation Easement shall be binding upon subsequent owners of the Property. The Parties covenant and agree that this Conservation Easement may not be assigned, terminated or released in any manner or fashion without the consent and written agreement of the Service. In the event that the Grantor or any subsequent owner of the Property shall convey fee title to the Property to the Grantee or to any successor of the Grantee, the Parties expressly covenant and agree that this Conservation Easement shall not be terminated or extinguished by operation of law pursuant to the doctrine of merger or any similar or dissimilar doctrine or rule of law.

24. **Management.** Grantor hereby covenants that the management of the Property shall be undertaken either by Grantor directly or by another party. If management is to be undertaken by another party, Grantor must obtain that party's consent to undertake the management and provide payment to that party from Grantor, with funding assistance as may be established in the HCP and/or the IA.

25. **Preserving Perpetual Rights.** Grantor shall insert the terms and restrictions of the Conservation Easement in any subsequent deed or other legal instrument by which Grantor divests itself of any interest in the Property. Grantor must record a notice of conservation easement once during the 30 year period beginning with the date of this easement and each 30 year period thereafter. Grantor must record the notice and provide a copy of the recorded notice to Grantee and the Service between the 28th and 29th year of each 30 year period. The notice must satisfy the requirements of Florida Statute Sections 704.06 and 712.06.

TO HAVE AND TO HOLD unto Grantee forever. The covenants, terms, conditions, restrictions, and purposes imposed with this Conservation Easement shall be binding upon Grantor and shall continue as a servitude running in perpetuity with the Property.

[This space is intentionally left blank. Signature pages follow.]

GRANTOR:

SUNNILAND FAMILY LIMITED PARTNERSHIP, A FLORIDA LIMITED PARTNERSHIP

By: Sunniland Partners LLC, a Florida limited liability company, as General Partner

By: Aliese P. Priddy
Aliese P. Priddy, as Manager

Witnesses:

Signature of first witness

Perla Cardenas
Printed name of first witness

Signature of second witness

Rosa Linda Garcia
Printed name of second witness

E-RECORDED simplifile

ID: OR 5290 Pg 1461

County: COLLIER

Date: 7/5/16 Time: 11:50 A.

STATE OF FLORIDA
COUNTY OF COLLIER

I HEREBY CERTIFY that on this day, before me, an officer duly authorized in the State aforesaid and in the County aforesaid, to take acknowledgments, appeared Aliese P. Priddy, as Manager of Sunniland Partners LLC, the General Partner of Sunniland Family Limited Partnership, a Florida limited partnership, on behalf of the partnership, who is personally known to me or who has produced a state driver license as identification, and who did not take an oath and executed the foregoing instrument and she acknowledged before me that she executed the same for the purposes therein expressed.

WITNESS my hand and official seal in the County and State last aforesaid this 29th day of June, 2016.

Notary Public State of Florida
Rachel Ingram
My Commission FF 935580
Expires 11/27/2019

Signed

Rachel Ingram
Printed

NOTARY PUBLIC
My Commission Expires: 11/27/19

IN WITNESS WHEREOF, Grantor has hereunto set its authorized hand this 29th day of June, 2016.

GRANTOR:

JB RANCH I, LLC, A FLORIDA LIMITED LIABILITY COMPANY

Witnesses as to both:

Signature of first witness

Perla Cardenas
Printed name of first witness

Signature of second witness

Rosa Linda Garcia
Printed name of second witness

By: Aliese P. Priddy
Aliese P. Priddy, as Manager

By: Russell A. Priddy
Russell A. Priddy, as Manager

E-RECORDED simplifile
ID: OR 5290 PG 1461
County: COLLIER
Date: 7/5/16 Time: 11:50A

STATE OF FLORIDA
COUNTY OF COLLIER

I HEREBY CERTIFY that on this day, before me, an officer duly authorized in the State aforesaid and in the County aforesaid, to take acknowledgments, appeared Aliese P. Priddy, and Russell A. Priddy, respectively, as Managers of JB Ranch I, LLC, Florida limited liability company, who are personally known to me or who have produced a state driver license as identification, and who did not take an oath and executed the foregoing instrument and they acknowledged before me that they executed the same for the purposes therein expressed.

WITNESS my hand and official seal in the County and State last aforesaid this 29th day of June, 2016.

Notary Public State of Florida
Rachel Ingram
My Commission FF 935580
Expires 11/27/2019

Rachel C Ingram
Signed

Rachel Ingram
Printed
NOTARY PUBLIC
My Commission Expires: 11/27/19

EXHIBIT "A"

LEGAL DESCRIPTION OF PROPERTY

EXHIBIT "B"

Panther Habitat Unit Boundary Map

Exhibit "A"

All of Sections 21 and 22 and part of Sections 14 and 28, Township 48 South, Range 30 East, Collier County, Florida and being more particularly described as follows:

BEGIN at the Northwest Corner of the aforementioned Section 21; thence along the North line of said Section 21, North 89°58'12" East, 5,290.45 feet to the Northeast corner of the aforementioned Section 22; thence along the North line of said Section 22, North 89°31'45" East, 5,340.05 feet to the Northeast corner of said Section 22; thence along the East line of said Section 22, South 01°09'29" East, 5279.28 to the Southeast corner of said Section 22; thence, along the South line of said Section 22, South 89°23'21" West, 5,319.14 feet to the Northeast corner of the aforementioned Section 28; thence along the East line of said Section 28, South 01°22'59" East, 3,378.40 feet; thence, leaving said East line, North 40°15'34" West, 774.23 feet; thence North 04°12'32" East, 313.18 feet; thence North 21°30'09" East, 277.45 feet; thence North 27°02'52" West, 304.80 feet; thence North 65°08'50" West, 1,353.44 feet; thence North 66°21'12" West, 1410.01 feet; thence North 24°10'40" West, 866.66 feet to an intersection with the South line of the aforementioned Section 21; thence, along said South line, South 89°39'36" West, 2,046.31 feet to the Southwest corner of said Section 21; thence, along the West line of said Section 21, North 00°41'41" West, 5,320.43 feet to the Northwest corner of Section 21 and the **POINT OF BEGINNING**.

AND

BEGIN at the Southwest corner of the aforementioned Section 14; thence, along the West line of said Section 14, North 00°18'39" West, 2,346.91 feet to an intersection with the Southerly Right of Way of Oil Well Road (County Road 858 and formerly State Road 840, 100 feet wide) according to Road Plat Book 2, Page 63, Collier County, Florida; thence along said Southerly Right of Way for the following three (3) courses:

1. South 68°19'18" East, 812.84 feet;
2. Along the arc of a tangent circular curve concave to the North having for its elements, a radius of 570.87 feet, a central angle of 50°52'19", a chord distance of 490.38 feet, a chord bearing of North 86°14'33" East, an arc distance of 506.87 feet;
3. North 60°48'23" East, 1,901.09 feet;

thence leaving said Southerly Right of Way, South 29°11'37" East, 425.35 feet; thence South 73°14'06" East, 293.84 feet; thence South 40°12'22" East, 416.79 feet; thence South 32°02'07" East, 114.13 feet; thence South 14°18'46" East, 271.15 feet; thence South 25°56'19" East, 382.21 feet; thence South 27°34'43" East, 399.20 feet; thence South 17°21'14" West, 282.84 feet; thence South 44°52'23" West, 657.96 feet; thence South 30°46'16" West, 463.04 feet to an intersection with the South line of the Southeast ¼ of the aforementioned Section 14; thence along said South line, South 89°16'32" West, 703.97 feet to the South ¼ corner of said Section 14; thence along the South line of the Southwest ¼ of said Section 14, South 89°18'50" West, 2,639,79 feet to the **POINT OF BEGINNING**.

JB I Ranch LLC
Collier County

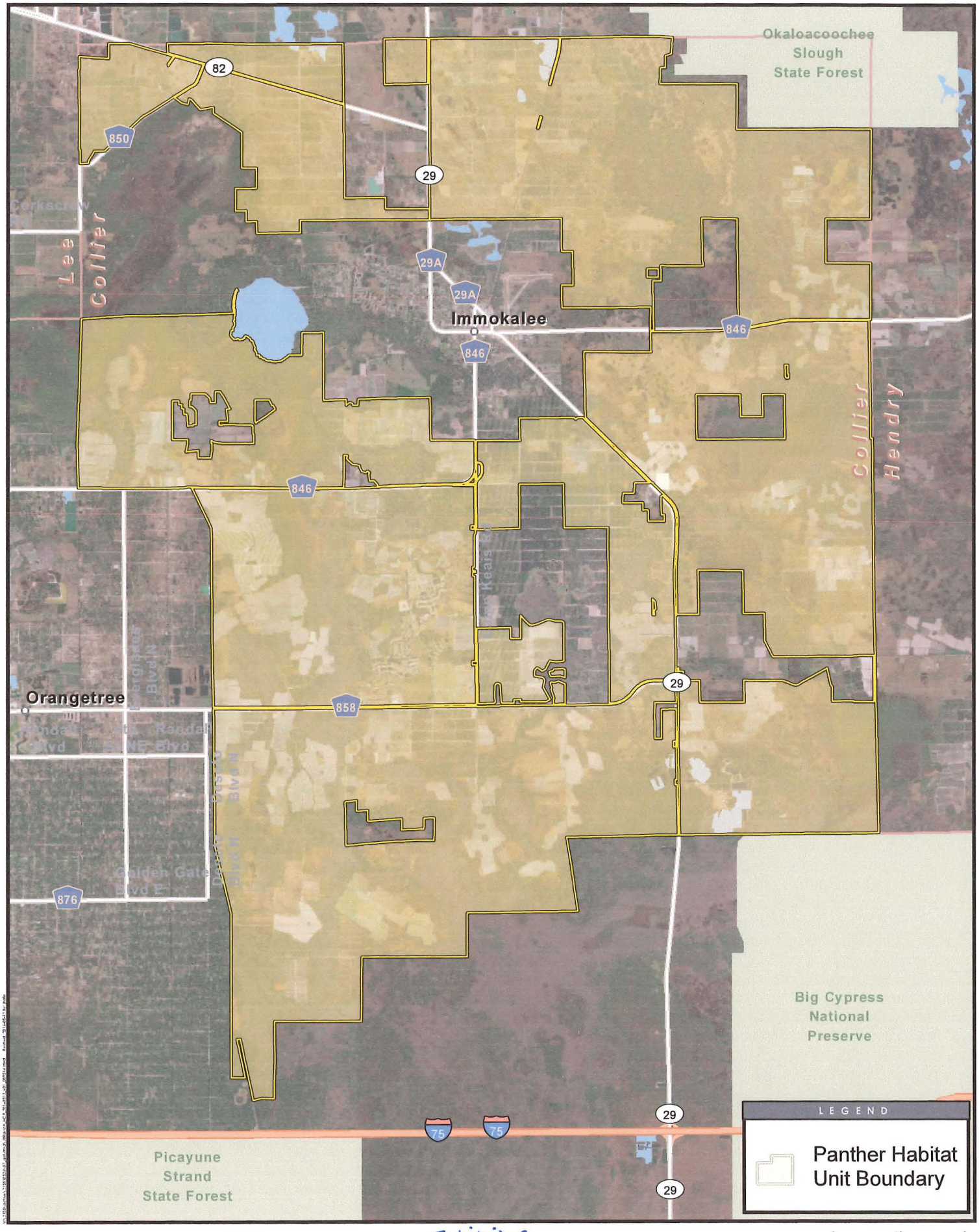
BSM
BY SK
Date: 2.05.2016

TOGETHER WITH:

A 30 foot wide easement for ingress and egress described as follows:

A parcel of land lying in Sections 27, 28 and 29, Township 48 South, Range 30 East, Collier County, Florida, said parcel being 30.00 feet wide and lying 15.00 feet on either side of the following described centerline:

COMMENCE at the Northeast corner of the aforementioned Section 28, thence along the East line of said Section 28, S.01°22'59"E., 2,448.26 feet to the **POINT OF BEGINNING**; thence S.28°28'37"E., 1,060.61 feet; thence S.61°31'23"W., 16.91 feet; thence along the arc of a tangent circular curve concave to the Southeast having for its elements a radius of 250.00 feet, a central angle of 57°10'06", a chord distance of 239.22 feet, a chord bearing of S.32°56'20"W., an arc distance of 249.44 feet to a point of reverse curvature; thence along the arc of a tangent circular curve concave to the West having for its elements a radius of 875.00 feet, a central angle of 06°32'35", a chord distance of 99.87 feet, a chord bearing of S.07°37'35"W., an arc distance of 99.92 feet; thence S.10°53'52"W., 100.61 feet; thence along the arc of a tangent circular curve concave to the East having for its elements a radius of 105.00 feet, a central angle of 49°53'07", a chord distance of 88.56 feet, a chord bearing of S.14°02'42"E., an arc distance of 91.42 feet; thence S.38°59'15"E., 45.67 feet; thence S.48°57'40"W., 75.11 feet; thence S.55°43'16"W., 108.94 feet; thence along the arc of a tangent circular curve concave to the North having for its elements a radius of 195.00 feet, a central angle of 27°47'22", a chord distance of 93.65 feet, a chord bearing of S.69°36'57"W., an arc distance of 94.58 feet; thence S.83°30'38"W., 282.08 feet; thence S.81°38'22"W., 1,067.40 feet; thence S.82°39'54"W., 331.72 feet; thence S.84°04'46"W., 333.07 feet; thence along the arc of a tangent circular curve concave to the South having for its elements a radius of 340.00 feet, a central angle of 27°27'44", a chord distance of 161.41 feet, a chord bearing of S.70°20'54"W., an arc distance of 162.96 feet; thence S.56°37'02"W., 54.21 feet; thence, along the arc of a non-tangent circular curve concave to the North having for its elements a radius of 208.62 feet, a central angle of 32°40'43", a chord distance of 117.38 feet, a chord bearing of S.72°57'23"W., an arc distance of 118.99 feet; thence S.89°17'44"W., 530.37 feet; thence S.89°35'29"W., 710.24 feet; thence S.89°03'07"W., 668.44 feet; thence S.89°18'41"W., 716.15 feet; thence S.87°34'10"W., 426.83 feet; thence S.89°15'59"W., 266.31 feet; thence N.80°58'58"W., 62.71 feet; thence N.76°25'46"W., 78.34 feet; thence along the arc of a tangent circular curve concave to the South having for its elements a radius of 500.00 feet, a central angle of 21°37'24", a chord distance of 187.58 feet, a chord bearing of N.87°14'29"W., an arc distance of 188.70 feet; thence S.81°56'49"W., 100.82 feet; thence S.83°46'39"W., 156.34 feet; thence S.84°41'50"W., 65.15 feet; thence S.89°06'18"W., 1,058.86 feet; thence S.89°14'26"W., 489.47 feet; thence S.89°20'04"W., 225.38 feet; thence S.89°07'37"W., 140.20 feet to an intersection with the Easterly right-of-way of State Road 29, according to Florida Department of Transportation Right-of-way Map Section 03080-2514 (dated August 14, 1981) and a **POINT OF TERMINATION.**



Stantec

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

Exhibit B

JB Ranch

Panther Habitat Unit Boundary

May 2016

Stantec Consulting Services Inc.
3200 Bailey Ln. Ste. 200
Naples, FL 34105
tel 239.649.4040
fax 239.649.5716

0 1.5 3 Miles

N

Prepared by: JBH 05/13/16

From: Johnson, Bruce
To: Cassler, Constance
Subject: [EXTERNAL] RE: Last call for species data the Applicants don"t have
Date: Friday, February 22, 2019 10:44:26 AM
Importance: High

Hi Connie,

Thank you for the additional information. Our GIS analysts are checking these data against what we already have in our system. We will update the occurrence data figures as necessary, and will do the same for the narrative.

Does Vero need any additional information from our team? We are working so hard on responses and revisions that I/we may have forgotten something.

Thanks,

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

Stantec Consulting Services Inc.
300 Primera Blvd., Suite 300
Lake Mary, FL 32746-2145 US

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From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Friday, February 22, 2019 10:19 AM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>
Subject: Fwd: Last call for species data the Applicants don't have

Hi Bruce,

There is some scrub-jay information we are not sure you have. See the email I'm forwarding. I'll follow-up by forwarding another email where Liz has Immokalee information attached.

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960

office: 772-469-4243
fax: 772-562-4288
email: constance_cassler@fws.gov

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Follow us on InstaGram @usfws_south_florida
Visit our web site at www.fws.gov/verobeach/

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---------- Forwarded message ---------
From: **Landrum, Elizabeth** <elizabeth_landrum@fws.gov>
Date: Fri, Feb 22, 2019 at 10:03 AM
Subject: Re: Last call for species data the Applicants don't have
To: Cassler, Constance <constance_cassler@fws.gov>

Connie,

The HCP doesn't mention anything beyond the 1992-93 scrub-jay survey data, which Dr. Bowman apparently told them was the only data available in that area. Since I attached the Immokalee GIS files to my last email, I have attached the Lake Trafford Pre-construction Survey report to this email.

The only other info I found was a handmarked map of scrub-jays in Immokalee (attached: 20070326_email_Rousso to HatcherR.jpg). I have no coordinates for the scrub-jay observations marked on the map, but they are in the same areas as the GIS locations I sent yesterday, and appear to correspond to some scrub habitat polygons (attached: seven "flahab1" GIS files).

Liz.

Elizabeth Landrum
Fish and Wildlife Biologist
US Fish and Wildlife Service
1339 20th Street
Vero Beach, FL 32960

Tel.: 772-469-4304
Fax: 772-562-4288

E-mail: elizabeth_landrum@fws.gov

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On Fri, Feb 22, 2019 at 8:11 AM Cassler, Constance <constance_cassler@fws.gov> wrote:

> Hi Liz,
>
> Can you please look at the HCP (\\IFW4FO-FLVEB620\Biologists\Trust Resources\HCP\County Collier\E Collier Multispecies HCP (2008FA0786)\HCP\Draft HCPs\20180822 Draft) on p 170 and 171 of the pdf and compare to what you have then send me anything different.
>
> Thank you,
>
> Connie
>
> Constance L. Cassler, Ph.D.
> Supervisory Fish and Wildlife Biologist
> U.S. Fish and Wildlife Service
> 1339 20th Street
> Vero Beach, Florida 32960
> office: 772-469-4243
> fax: 772-562-4288
> email: constance_cassler@fws.gov
>
> Follow us on Twitter @USFWSVERO
> Follow us on Facebook @USFWSSouthFlorida
> Follow us on InstaGram @usfws_south_florida
> Visit our web site at www.fws.gov/verobeach/
>
> NOTE: All email correspondence and attachments received from or sent to me are subject to the Freedom of Information Act (FOIA) and may be disclosed to third parties
>
> On Thu, Feb 21, 2019 at 6:35 PM Landrum, Elizabeth <elizabeth_landrum@fws.gov> wrote:
>
> > Connie,
> >
> > You said Heather found scrub-jay info in the Lake Trafford survey, so I won't include that. I assume they also have the 1992-93 survey data. Was the applicant supplied with the Immokalee Development scrub-jay

info? If not, I have attached the 12 GIS files, and in case the attachments mess up, the path to the two files is - L:\Trust Resources\HCP\County Collier\Immokalee\GIS \Immokalee_FSJ_03262007.shp and \Immokalee_FSJ_05102007.shp
Liz.

Elizabeth Landrum
Fish and Wildlife Biologist
US Fish and Wildlife Service
1339 20th Street
Vero Beach, FL 32960

Tel.: 772-469-4304
Fax: 772-562-4288
E-mail: elizabeth_landrum@fws.gov

All email correspondence and attachments received from or sent to me are subject to the Freedom of Information Act (FOIA) and may be disclosed to third parties.

On Thu, Feb 21, 2019 at 11:23 AM Cassler, Constance <constance_cassler@fws.gov> wrote:

> He Team,
>
> Last week, the Applicants requested any species data we have that they didn't present in their HCP. I have received info for some species and have passed it along to Bruce Johnson. If there is additional information please send it to me ASAP so I can send it to the applicants. If there is a reason we can't share it with them, please let me know that too.
>
> Thanks in advance,
>
> Connie
>
> Constance L. Cassler, Ph.D.
> Supervisory Fish and Wildlife Biologist
> U.S. Fish and Wildlife Service
> 1339 20th Street
> Vero Beach, Florida 32960
> office: 772-469-4243
> fax: 772-562-4288
> email: constance_cassler@fws.gov
>
> Follow us on Twitter @USFWSVERO
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From:	Johnson, Bruce
To:	Cassler, Constance
Cc:	Kelso, Charles; Dell, David
Subject:	[EXTERNAL] RE: Oil Well Road BO
Date:	Friday, March 15, 2019 10:22:22 AM
Importance:	High

Hi Connie,

Thanks for the information. I'll coordinate with Tom today and will respond to you as soon as we're able.

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

Stantec Consulting Services Inc.
300 Primera Blvd., Suite 300
Lake Mary, FL 32746-2145 US

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From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Friday, March 15, 2019 9:53 AM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>
Cc: Charles Kelso <charles_kelso@fws.gov>; David Dell <david_dell@fws.gov>
Subject: Oil Well Road BO

Hi Bruce,

I'm attaching the Oil Well Road BO. It is the wetland mitigation for that project that is west of Ave Maria. Please let us know what you think when you have had a chance to look at it and talk to Tom Jones.

I'll send the other project I saw as soon as I track it down.

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960

office: 772-469-4243
fax: 772-562-4288
email: constance_cassler@fws.gov

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From: Johnson, Bruce
To: Cassler, Constance
Subject: [EXTERNAL] RE: request from Applicants for species data
Date: Wednesday, February 20, 2019 11:23:09 AM
Importance: High

Connie,

Thank you for forwarding the data. We will incorporate it into the updated document.

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

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From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Wednesday, February 20, 2019 11:16 AM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>
Subject: Fwd: request from Applicants for species data

Hi Bruce,

This is the last on I think I have for now. It is for both gopher tortoises and sandhill cranes.

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
office: 772-469-4243
fax: 772-562-4288
email: constance_cassler@fws.gov

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---------- Forwarded message ---------
From: **Hitt, Heather** <heather_hitt@fws.gov>
Date: Fri, Feb 15, 2019 at 1:19 PM
Subject: Re: request from Applicants for species data
To: Cassler, Constance <constance_cassler@fws.gov>

Hi Connie,

Attached is the report from the Lake Trafford dump site gopher tortoise survey. They had scrub jays too. It includes the GPS points for all the burrows, but I don't have it in GIS.

For sandhill crane I used E-bird and filtered it by the breeding season (April through September).

Heather Hitt
Fish and Wildlife Biologist
US Fish and Wildlife Service
1339 20th Street
Vero Beach, FL 32960
Phone: 772-469-4267
Fax: 772-562-4288
Email: heather_hitt@fws.gov

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On Fri, Feb 15, 2019 at 11:03 AM Cassler, Constance <constance_cassler@fws.gov> wrote:

> Good morning,
>
> During a call with the ECMSHCP applicants this morning, Bruce Johnson (Stantec) requested that the Service send any species location information we have that is not in the HCP. It is probably easiest for each biologist to figure out what that information is for their species and then send it to me so I can forward it to Bruce. They would like it in the form of GIS. Some observations came from eBrid and other on-line sources. You can let me know if this is the case and we can point them to that source. Please do this as soon as possible

because the applicants expect to get us an updated HCP by next Friday (Feb 22).

Bruce indicated during the call that he would be able to send us an updated map that subtracts the Ave Maria footprint and mitigation area from the HCP area and an updated habitat table. He though he could get us that by today or Monday at the latest.

Thank you,

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
office: 772-469-4243
fax: 772-562-4288
email: constance_cassler@fws.gov

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From:	Johnson, Bruce
To:	Dell, David
Cc:	Tawes, Robert; Cassler, Constance
Subject:	[EXTERNAL] RE: Status of East Collier Applications?
Date:	Tuesday, August 28, 2018 3:36:56 PM
Attachments:	ITP_application_formHalf_Circle_L_20180828.pdf
Importance:	High

David,

We are actively rounding up the remaining applications. The updated form for Half Circle L Ranch is attached, and we will be forwarding the others as soon as we receive them.

Thanks,
Bruce

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

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From: Dell, David <david_dell@fws.gov>
Sent: Tuesday, August 28, 2018 1:51 PM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>
Cc: Robert Tawes <Robert_Tawes@fws.gov>; Constance Cassler <Constance_Cassler@fws.gov>
Subject: Status of East Collier Applications?

Bruce: Just checking in on your progress with the remaining landowner applications. Thanks.

David Dell
Southeast Region
HCP and Safe Harbors Coordinator
404/679-7313
fax: 7081
david_dell@fws.gov

NOTE: All email correspondence and attachments received from or sent to me are subject to the Freedom of Information Act (FOIA) and may be disclosed to third parties.

FEDERAL FISH AND WILDLIFE PERMIT APPLICATION FORM

Native Endangered and Threatened Species - Incidental Take Permits Associated with a Habitat Conservation Plan (HCP)

Return to: U.S. Fish and Wildlife Service (USFWS)
click here for return addresses

Complete Sections A or B, and C, D, and E of this application. U.S. address may be required in Section C, see instructions for details.

See attached instruction pages for information on how to make your application complete and help avoid unnecessary delays.

A. Complete if applying as an individual

1.a. Last name	1.b. First name	1.c. Middle name or initial	1.d. Suffix

2. Date of birth (mm/dd/yyyy)	3. Occupation	4.a. Affiliation/Doing business as (see instructions)	4.b. Website URL (if applicable)

5.a. Telephone number	5.b. Alternate telephone number	6. E-mail address

B. Complete if applying on behalf of a business, corporation, public agency, Tribe, or institution

1.a. Name of business, agency, Tribe, or institution	1.b. Doing business as (dba)
Half Circle L Ranch Partnership, LLP	

2. Tax identification no.	3.a. Description of business, agency, Tribe, or institution	3.b. Website URL (if applicable)
59-0700531	Agricultural Production	

4.a. Principal officer (P.O.) last name	4.b. P.O. first name	4.c. P.O. middle initial	4.d. P.O. e-mail address
Scofield	Dane	T	LJTHORP@AOL.COM

5. P.O. title	6. Primary contact name
Managing Partner	Dane Scofield

7.a. P.O. telephone number	7.b. Alternate phone no.	8.a. Primary contact telephone no.	8.b. Primary contact e-mail address
239-657-3401		239-207-7636	LJTHORP@AOL.COM

C. All applicants complete address information

1.a. Physical address (Street address; Apartment #, Suite #, or Room #; no P.O. Boxes)
2424 Thorp Rd.

1.b. City	1.c. State	1.d. Zip code/Postal code	1.e. County/Province	1.f. Country
Immokalee	FL	34142	Collier	USA

2.a. Mailing address (include if different than physical address; include name of contact person if applicable)

2.b. City	2.c. State	2.d. Zip code/Postal code	2.e. County/Province	2.f. Country

D. All applicants MUST complete

1. Check or money order payable to the U.S. FISH AND WILDLIFE SERVICE **in the amount indicated on pages 2-3 (nonrefundable processing fee)**. Federal, Tribal, State, and local government agencies, and those acting on behalf of such agencies, are exempt from the processing fee – ***attach documentation of fee exempt status as outlined in instructions.*** (50 CFR 13.11(d))

2. Do you currently have or have you ever had any Federal Fish and Wildlife permits?
   ☐ Yes If yes, list the number of the most current permit you have held or that you are applying to renew or amend: _____
   ☐ No

3. Certification: I hereby certify that I have read and am familiar with the regulations contained in ***Title 50, Part 13 of the Code of Federal Regulations*** and the other ***applicable parts in subchapter B of Chapter I of Title 50***, and I certify that the information submitted in this application for a permit is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to the criminal penalties of 18 U.S.C. 1001.

Dane Scofield — Signature of applicant/person responsible for permit (No photocopied or stamped signatures)

8/28/2018 — Date (mm/dd/yyyy)

** See page 15 for additional instructions on completing the above form. See page 16 for information on the Paperwork Reduction Act, Privacy Act, and Freedom of Information Act aspects of this application form.

If a biological survey is required, you will need to send us your complete Recovery permit application package and have it accepted at least 3 months prior to commencement of survey activities to facilitate processing of your Recovery permit application. The Recovery permit application is designated as U.S. Fish and Wildlife Service form # 3-200-55 and can be found on our Endangered Species permit web page at http://www.fws.gov/forms/3-200-55.pdf.

Option B: You may hire biological consultants who already hold Recovery Permits to conduct biological surveys on your behalf. We maintain a list of Recovery permittees who have authorized the release of their contact information to third parties for conducting biological surveys on a contract basis. This list is provided to the public at the discretion of each U.S. Fish and Wildlife Service Regional Office as time and workload allow. Please be aware that this list does not represent an endorsement by us of any particular permittee.

****

If you are not applying as an individual but as a business, corporation, tribe, institution, or non-Federal public agency (block B. on page 1 of the application), the person to whom the permit will be issued (e.g., the landowner, president, director, executive director, or executive officer) is legally responsible for implementing the permit. Although other people under the direct control of the permittee (e.g., employees, contractors, consultants) receive third party take authorization in their capacity as designees of the permittee, the individual named as the permittee ultimately is legally responsible for the permit and any activities carried out under the permit except as otherwise limited in the case of permits issued to State or local government entities under 50 CFR 13.25(e).

****

If you wish to coordinate the processing of this permit application through an **authorized agent**, and to have that agent represent you as the primary contact with us, check the box below. Sign (in blue ink) and date the authorization statement, and provide contact information for your authorized agent.

☑ I hereby authorize the following person to act as an authorized agent on my behalf in the processing of this permit application and to furnish, upon request, supplemental information in support of this permit application.

Dane Scofield
Signature

DANE SCOFIELD
Please print name legibly

8/28/18
Date

Your Authorized Agent's Contact Information (please print legibly)

Name: Mr. Tom Jones

Address: 2600 Golden Gate Parkway, 2nd Floor

City: Naples State: FL Zip Code: 34105

Telephone: 239-262-2600 Cell Phone: 239-842-0025

E-mail: tjones@barroncollier.com Fax: 239-263-3339

INCIDENTAL TAKE PERMIT APPLICATION CERTIFICATION NOTICE

The same person who signs in box D. on page 1 of the application must sign (in blue ink) the following certification.

By submitting this application and receiving an Incidental Take permit pursuant to Section 10(a)(1)(B) of the Endangered Species Act, I Dane Thorp Scofield, Michael (Kip) Scofield (print name(s)) attest that I/we own the lands indicated in this application, or have sufficient authority or rights over these lands to implement the measures of the Habitat Conservation Plan (and Implementing Agreement, if applicable) covered by the Incidental Take permit. Further, upon receipt of the Incidental Take permit, I/we agree to conduct the activities as specified in the Habitat Conservation Plan (and Implementing Agreement, if applicable) according to the terms and conditions of the Incidental Take permit and its supporting documents.

Dane Scofield — Signature (in blue ink)

8/28/18 — date

DANE SCOFIELD — Please print name legibly

Michael K Scofield — Signature (in blue ink)

8/28/18 — date

Michael K Scofield — Please print name legibly

From:	Johnson, Bruce
To:	Dell, David; Cassler, Constance
Cc:	Christian Spilker (CSpilker@collierenterprises.com)
Subject:	[EXTERNAL] Response to Sierra Club
Date:	Friday, March 22, 2019 7:10:35 PM
Attachments:	Response to March 5, 2019 Letter from Sierra Club.pdf
Importance:	High

David and Connie,

Collier Enterprises, together with ECPO, has prepared the attached response to the comment letter that Sierra Club submitted on March 5 regarding the Rural Lands West project. We would like to submit this response for the Service's consideration and for inclusion in the record for this rulemaking proceeding.

Regards,

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

Stantec Consulting Services Inc.
300 Primera Blvd., Suite 300
Lake Mary, FL 32746-2145 US

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Response of Applicant Collier Enterprises to March 5, 2019 Letter from Sierra Club
Docket ID FWS-R4-ES-2018-0079-1836

Sierra Club submitted a comment letter on March 5, 2019, concerning the Collier Enterprises Rural Lands West (RLW) project. The following response is submitted on behalf of applicant Collier Enterprises Management, Inc. (Collier Enterprises). The Eastern Collier Property Owners (ECPO) members have reviewed and agree with this response.

The HCP developed by ECPO is a 50-year conservation plan covering 151,442 acres of privately owned land in Collier County, Florida. The HCP will permanently preserve 106,442 acres of ecologically valuable land, worth an estimated $1.4 billion, that is otherwise open to development under local zoning. The preservation of this land will permanently secure valuable habitat for the Florida panther and eighteen other protected species in Southwest Florida. The HCP also designates up to 39,973 acres for new development, which will be clustered within designated areas that provide less or little habitat value compared to the preservation areas (primarily intensive row crop fields and citrus groves).[1] The HCP's overall configuration permanently preserves wildlife dispersal corridors that provide crucial linkages between existing public conservation lands.

The HCP was prepared in connection with applications for incidental take permits (ITPs) submitted by the eleven separate landowners whose properties comprise the HCP area. The applications are submitted under section 10 of the Endangered Species Act (ESA), which authorizes the U.S. Fish & Wildlife Service (USFWS) to issue permits for the incidental (not purposeful) "take" of federally-listed species pursuant to otherwise lawful activities. 16 U.S.C. §1539(a)(1)(B). The activities to be covered by the ITPs include residential and commercial development and earth mining within the circumscribed "Covered Activities" portion of the HCP. The form of take anticipated to occur incidental to these activities is, for most species, limited to unintentional "harassment" – e.g., a development activity that unintentionally annoys a species to the extent that normal behavioral patterns are disrupted. No intentional take (such as hunting, capturing or killing) will occur, and no such take authorization is requested.

By design and consistent with ESA section 10, the HCP and associated ITPs will provide incidental take coverage for all Covered Activities conducted in compliance with the HCP and ITPs over the 50-year term of the ITPs. The HCP and ITPs define the scope of and conditions governing the authorization of incidental take associated with the Covered Activities, but do not otherwise dictate details such as when within the 50-year term those activities occur or in what order they proceed. Naturally, the specific projects that may be conducted within the Covered Activities area over the next 50 years have not been determined. Accordingly, the HCP and ITPs do not dictate whether a particular project is 500 or 5,000 acres or built in year 5 or year 25. Nor do the HCP and ITPs dictate how local or county permitting is conducted for Covered Activities. Rather, the HCP and ITPs require that, in order to receive incidental take authorization, Covered

[1] The HCP identifies 49,276 acres of land, within which up to 45,000 acres of development may occur. The 5,027-acre Town of Ave Maria is included in the 45,000-acre cap for overall planning purposes, even though federal permitting and ESA section 7 consultation have been completed for Ave Maria and the project is substantially built. The applicants do not seek take coverage for the 5,027-acre Town of Ave Maria, thereby reducing the maximum acreage of development covered by the incidental take permits to 39,973 acres.

Activities must be conducted within the area designated for those activities, offset by the form of mitigation specified in the HCP (e.g., placement of habitat under permanent conservation easements), and otherwise comply with the terms and conditions of the HCP and ITPs.

Within the HCP area, one future project that has been planned (but not yet permitted) is RLW, a proposed residential and commercial development located on an approximately 4,000-acre site, which comprises only a fraction of the lands that Collier Enterprises owns within the HCP area. At the federal level, Collier Enterprises has applied to the U.S. Army Corps of Engineers (Corps) for a Clean Water Act (CWA) section 404 permit authorizing all discharges of dredged or fill material associated with the overall RLW project. Likewise, at the state level, Collier Enterprises has applied for an Environmental Resource Program (ERP) permit for the overall RLW project. At the county level, while Collier Enterprises originally sought a permit for the overall RLW project, it is now seeking a county permit for Rivergrass Village, the first part of the project. This change in approach to county-level permitting does not reflect a change in the overall plans for RLW, including the plan to permanently preserve and maintain over 12,000 acres of preservation lands to offset development of the 4,000-acre site. Therefore, Collier Enterprises is not planning to withdraw its applications to the Corps or the state for the overall RLW project, or its application to USFWS for an ITP.

The sequence and process by which an applicant receives local or other permits for a Covered Activity makes no difference for HCP or ITP purposes, provided the project complies with all terms and conditions of the HCP and ITPs. The HCP and ITPs do not authorize specific projects. Rather, the ITPs authorize take that occurs incidental to Covered Activities, provided that the ITP holders comply with the terms and conditions of the HCP and ITPs. Thus, a change in approach to county-level permitting for a project within the HCP area, including RLW, does not affect USFWS or Corps review of the ITP or CWA 404 permit applications now pending before those agencies, including their National Environmental Policy Act (NEPA) or ESA reviews. Such a change likewise has no effect on the adequacy of the opportunity for the public to review and comment on the HCP (which is unchanged with respect to RLW), or the associated draft environmental impact statement. Collier Enterprises will obtain all required permits before beginning development of RLW, leaving no question whether the development is an "otherwise lawful activity" under ESA section 10(a)(1)(B). Finally, maintaining the application for a Corps permit associated with the overall RLW project allows the RLW project to be analyzed comprehensively rather than incrementally.

In sum, the HCP covers 151,442 acres of privately owned land in Collier County. The owners of that land have committed to permanently preserve 106,442 acres of valuable land that would be otherwise open to development. In exchange, the ITPs will provide incidental take coverage for up to 39,973 acres of new development over a 50-year term. By design, the HCP allows the landowners to determine which Covered Activities to pursue and the order in which they are pursued, provided those activities comply with the terms and conditions of the HCP and ITPs. A specific approach to county-level permitting for a Covered Activity, or a change in that approach, does not affect USFWS or Corps review of the ITP or CWA 404 permit applications.

From:	Johnson, Bruce
To:	Cassler, Constance
Cc:	Dell, David
Subject:	[EXTERNAL] Section 7 actions within the HCP area
Date:	Thursday, March 21, 2019 12:30:02 PM
Attachments:	Pages from 20180831_Letter_ServicetoCorps_AveMaria.pdf
Importance:	High

Good Morning Connie,

Per our last conference call, this email summarizes our review of mitigation areas associated with prior actions that underwent section 7 consultation within the HCP Area, and their relationship to the HCP design. Overall, we note the following (summarized in the table below):

- Oil Well Road. The mitigation within the HCP Area for the Oil Well Road widening was all CWA 404 wetland mitigation; no PHUs were credited for that mitigation; panther mitigation was all located outside the HCP Area
- Hogan Island. The mitigation within the HCP Area for the Hogan Island Quarry was all CWA 404 wetland mitigation; no PHUs were credited for that mitigation; panther mitigation was all located outside the HCP Area
- Ave Maria. The mitigation within the HCP Area for Ave Maria did include 6,294 acres of panther and caracara mitigation within the HCP area, and did transfer PHUs from those areas; however, there are still 8,255 acres in SSA 6 set aside for Ave Maria under the RLSP but which have not transferred PHUs to any project
- Caracara. Most of the caracara areas within SSA 6 are located within the 8,255 acres where PHUs have not been credited yet; one caracara mitigation area occurs within the panther easement.

The location of all of these areas contribute to the overall HCP design and serve an integrated, comprehensive function within the HCP that adds more conservation value for the covered species than would be served by these areas standing alone. Accordingly, these areas should at least be recognized for their PHU compensation value under the HCP; in particular, in those areas where PHU transfers have not already occurred. But even if even if these areas were not counted for PHU compensation, there is more than enough total mitigation provided by the HCP to offset the impacts of the covered activities. The brief paragraphs and tables below outline the details of each action.

Ave Maria: As depicted on the attached Figure 7 from the 2018 Biological Opinion for Ave Maria, two sets of caracara mitigation areas are located within the HCP area. One is situated within a parcel dedicated by easement for panther compensation. The PHUs from that caracara area were credited. The other caracara area occurs within SSA 6 and is under a RLSP stewardship easement, but is not under a federally enforceable easement and the PHUs have not been transferred from these areas.

Oil Well Road widening: The panther was the only “may affect” determination (wood stork received a MANLAA determination due to a large excess of wetland mitigation provided by the offsite panther compensation parcels and the 525-acre Camp Keais wetland mitigation). All of the PHUs for panther compensation were provided by offsite parcels located outside of the HCP Area. Therefore the PHUs tied to the 525-acre wetland mitigation were never utilized.

Hogan Island Quarry: All panther compensation occurred offsite and outside of the HCP Area. Compensation for wood stork consisted primarily of littoral shelves on the east side of the quarry, which are subject to effectiveness monitoring. The wetland mitigation overall was far in excess of what was required for wetland impacts, as it included the two parcels adjacent to the quarry (27.78 acres) and also the 688 acres of wetlands within the panther compensation parcels. The two parcels adjacent to the

project (27.78 acres) did not provide PHUs for any project compensation.

Project	Mitigation Areas	In HCP Area?	For Wetland Purposes?	For ESA Purposes?	PHU Credits within HCP Transferred?
Ave Maria	Panther compensation (SSAs 1-4; part of SSA 6 = 6,294 acres); caracara compensation in SSA 6 (one within panther easement)	Yes	No	Yes (panther compensation and caracara compensation)	Yes from SSAs 1-4 and 1,656 acres of SSA 6 for PHUs, but not balance of SSA 6 (8,255 acres)
Oil Well Road	525-acre wetland mitigation parcel in Camp Keais Strand	Yes	Yes	No ["The CKSWMS is proposed as compensation for impacts to wetlands only, and is not intended as compensation for the project's adverse effects to the Florida panther (as discussed below)." Biological Opinion, page 7; emphasis added]	No
	363.7-acre parcel outside of HCP Area.	No	No	Yes (panther compensation).	No
Hogan Island	Adjacent wetland OM-1 (27.8 acres)	Yes	Yes	No	No
	Three large offsite parcels (1,181 acres)	No	No (but includes 668 acres of wetlands)	Yes (panther compensation)	No

Since the Oil Well Road and Hogan Island Quarry mitigation areas did not utilize their PHU value (or other species mitigation value) as compensation for any section 7 action, and because the HCP is primarily directed toward panther conservation on an integrated landscape-scale basis, these areas should be included in the HCP and mitigation calculations for the ITPs. Because of the landscape-scale design of the HCP, Ave Maria and its mitigation areas remain integrated into the plan, as 8,255 acres within SSA 6 never transferred PHUs as panther compensation.

Regards,

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

Stantec Consulting Services Inc.
300 Primera Blvd., Suite 300

Lake Mary, FL 32746-2145 US

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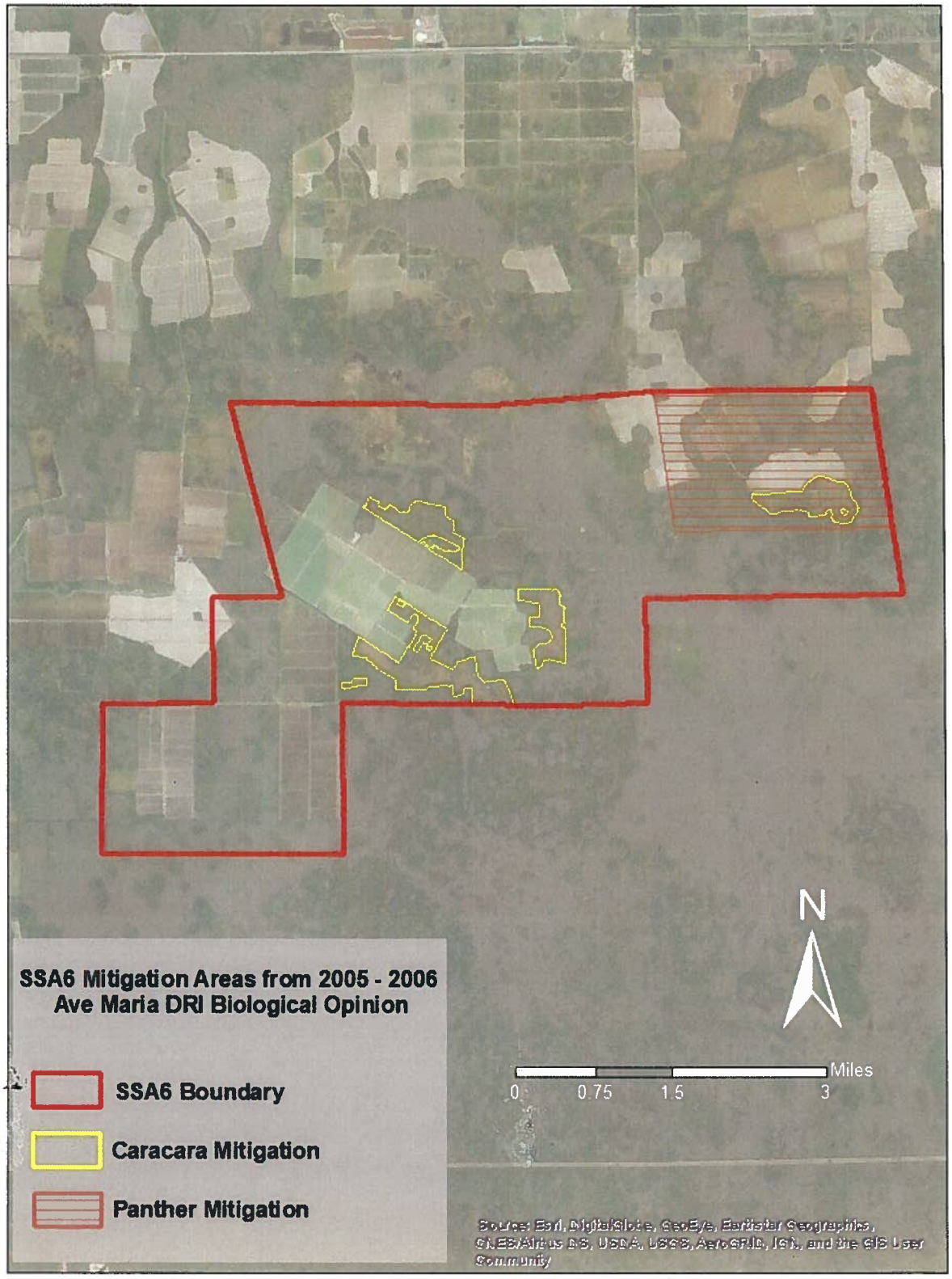

Figure 7. Caracara mitigation areas within SSA6.

From:	amber crooks
To:	amber crooks
Subject:	FW: Eastern Collier HCP - wildlife admin data
Date:	Friday, February 08, 2019 12:17:10 PM

From: joanna fitzgerald
Sent: Wednesday, February 06, 2019 4:35 PM
To: amber crooks
Subject: FW: Eastern Collier HCP - wildlife admin data

Hi Amber,

These are the numbers I compiled doing a quick search for the main species we know we have admitted with poison being the possible cause of admission. Only the three bald eagles are confirmed to have died as a result of high levels of anticoagulant rodenticide intoxication. I want to strongly reiterate that these numbers are not based on positive test results. These patients exhibited symptoms associated with what we typically see in rodenticide poisoning when admitted and, therefore, was our basis for listing poison as cause of admission.

SPECIES	ADMIT NUMBERS from 2014-2019 (YTD): Poison listed as Cause of Admission
Bald Eagle	3
Great-horned Owl	3
Barred Owl	1
Virginia Opossum	38
Red-shouldered hawk	27

At this time I could not plot the areas where these animals were found. I think Leif has that capability, through 2017, but I don't know if he could get that in the time frame that you need.

I'm sure you considered this but it can't hurt to mention. The numbers for certain species, like the owls, are actually higher. Several of these were babies, if they were exposed, their parents were too, they just weren't admitted. Vice versa is true, if an adult is admitted during breeding season there is a high likelihood it had babies and they were left orphaned.

The opossum numbers are so high because many of these admits were females that had a litter of babies. One female opossum suffering the effects of rodenticide poisoning passes the poisons to her babies through her milk. The average litter size for an opossum is seven and each baby would get an admit number.

With the rampant and unregulated use of rodenticides I fear the mortality numbers are staggeringly high.

Joanna Fitzgerald
Director
von Arx Wildlife Hospital
Conservancy of Southwest Florida
1495 Smith Preserve Way Bldg 300
Naples, Florida 34102
Phone: (239) 403-4227
Fax: (239) 430-2464
JoannaF@conservancy.org
www.conservancy.org

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From: Cassler, Constance
To: Johnson, Bruce
Cc: Dell, David; Tawes, Robert
Subject: Ave Maria
Date: Wednesday, February 13, 2019 1:40:29 PM

Hi Bruce,

I just missed grabbing the phone, but I did get your message about Ave Maria. I understand the Applicants don't need additional take coverage through the HCP for Ave Maria. This will make it the BO cleaner. I'll let the biologists working on the HCP know.

Connie

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GEOGRAPHIC DISTRIBUTION OF ENVIRONMENTAL CONTAMINANTS IN THE FLORIDA PANTHER

27 March 2012

Cooperative Agreement No. 401817J004
Florida Fish and Wildlife Conservation Commission file code: F2655-06-11-F

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ABSTRACT: Previous published and unpublished studies reported elevated tissue concentrations of environmental contaminants, including mercury (Hg), organochlorines (OCs), and polychlorinated biphenyls (PCBs), in many Florida panthers (*Puma concolor coryi*). These contaminants can have direct lethal effects, and elevated contaminants were found in some panthers that died of unknown causes. These contaminants also can have sublethal effects impairing fitness and reproductive success. Many of the reproductive anomalies seen in panthers, suspected to be the result of inbreeding depression, also may be caused or exacerbated by environmental contaminants. To further assess the presence of environmental contaminants in the panther population we tested archived and newly collected panther tissues collected 1989-2009 for OCs, PCBs, and anticoagulant rodenticides. Contaminants detected in this study included OCs (p,p'-DDE, p,p'-DDT, p,p'-DDD, oxychlordane, dieldrin, heptachlor epoxide, mirex, *cis*-nonachlor, and *trans*-nonachlor), PCBs (congeners 18, 66, 118, 153, 105, 138, 187, 128, 180, 170, 195, and 206), and anticoagulants (brodifacoum, bromodialone). Sample size precluded analyses of interactions among factors (region, age class, gender); however, the following showed significant differences ($p > 0.05$). Among regions, the Everglades ecosystem had higher values for p,p'-DDE, dieldrin, mirex, *trans*-nonachlor, total PCBs, PCB 118, 153, 138, 180, 170, 105, and 128, and brodifacoum, and males had higher concentrations of p,p'-DDE. There were no significant effects among age classes for the contaminants examined. A more comprehensive study will include data collected in this study, contaminant results from additional panthers, and Hg data reported by Brandon (2011).

INTRODUCTION

The Florida panther (*Puma concolor coryi*) is an endangered subspecies of puma whose population had dwindled to as few as 30-50 individuals by the 1980s (Belden, 1986). Research to investigate this decline identified a number of putative or confirmed morbidity and mortality factors. These included anthropogenic and intraspecific trauma, inbreeding depression, infectious diseases, and environmental contaminants (reviewed by Forrester, 1992).

As a top trophic level carnivore, the Florida panther may be at particular risk for exposure to environmental contaminants bioaccumulating through the food chain. Mercury (Hg), organochlorines (OCs), and polychlorinated biphenyls (PCBs) commonly bioaccumulate through

aquatic ecosystems (reviewed by Environmental Protection Agency, 2000), and species associated with aquatic systems (e.g. raccoons and alligators) are frequently consumed by panthers (Maehr et al., 1990; Dalrymple and Bass, 1996). Further, prey associated with aquatic ecosystems constitutes a greater proportion of some individual panther's diets in some regions (Smith and Bass, 1994). Environmental contaminant burdens in prey also vary by location with raccoons in some regions having significantly higher Hg concentrations compared to other areas of southern Florida (Roelke et al., 1991). Finally, contaminants not associated with the aquatic food chain include toxins entering the food chain through baits (e.g. anticoagulant rodenticides).

Environmental contaminants examined in this study are described in Table 1. Organochlorines include pesticides such as DDT and its metabolites, cyclodienes and similar compounds (aldrin/dieldrin, endrin, heptachlor, chlordane), toxaphene, mirex, and hexachlorocyclohexane (lindane) as well as breakdown products (e.g. *cis* and *trans*-nonachlor). PCBs are a class of compounds used for a variety of industrial purposes. PCBs are differentiated by structure based on the number and placement of the chlorines on the biphenyl molecule. Using this criteria there are 209 different PCB structures or congeners. For commercial purposes, PCBs were marketed as mixtures of congeners, most commonly the Arochlor series, with varying percentages by weight of total chlorine. PCBs and OCs, many of which have been banned in the United States (and in the case of PCBs, worldwide), are characterized by persistence in the environment and bioaccumulation. Anticoagulant rodenticides are used for the control of rodents. First generation anticoagulants include warfarin, chlorophacinone, and diphacinone, and are less toxic and more rapidly metabolized. They usually require multiple feedings to have a lethal effect. Second generation anticoagulants, such as brodifacoum and bromadiolone, are more toxic and may persist in the body.

Environmental contaminants including Hg, OCs, PCBs, and anticoagulant rodenticides have been shown to have a variety of lethal and sublethal effects in humans, domestic animals, and/or wildlife (Reviewed by Blus et al., 1996; O'Hara and Rice, 1996; EPA, 2000). Methylmercury (Hg's most common and more toxic form) can impair reproductive success, is neurotoxic (resulting in motor, sensory, and cognitive impairment and behavioral changes), and is a probable carcinogen (EPA, 2000). Similarly, OCs impair reproduction, are neurotoxic, alter behavior, cause organ and body mass atrophy, and are known or suspected carcinogens. Additionally, these compounds may cause liver, kidney, and/or blood disorders and some can act as endocrine disrupters (Blus et al., 1996; Yamamoto et al., 1996; EPA, 2000). PCBs are related to many OCs in their chemical, physical, and toxicologic properties (EPA, 2000). Although quantitative health risks for specific congeners do not exist, there is evidence that PCB congeners differ in their toxicity. Health risks appear to increase with increased chlorination and have varying potencies for producing a variety of adverse biological effects including hepatotoxicity, cardiovascular toxicity, wasting, reproductive and developmental toxicity, immunotoxicity, neurotoxicity, behavior changes (including affects on maternal behavior), endocrine disruption, and carcinogenicity (O'Hara and Rice, 1996; Yamamoto et al., 1996; EPA, 2000). Anticoagulant rodenticides impair blood coagulation and are speculated to affect immunocompetence. Experimental evidence for the latter effect, however, is lacking.

Published studies examining environmental contaminant burdens in other free-ranging felids are rare. Hg, OCs, and PCBs were detected at low levels in Iberian lynx (Millán et al., 2008; Mateo et al., 2011), and morbidity and mortality in pumas (*P. concolor*) (Littrell, 1988; Uzal et al., 2007) and bobcats (*Lynx rufus*) (Riley et al., 2007) due to anticoagulant exposure has been reported. Further, exposure of pumas and bobcats in these studies to sublethal

concentrations of anticoagulants may have led to notoedric mange (Riley et al., 2007; Uzal et al., 2007).

Although research and management has addressed many of the morbidity and mortality factors affecting panthers, environmental contaminants have largely been overlooked. Roelke et al's (1991) report provided a detailed examination of Hg concentrations in panthers and implicated high Hg concentrations as the cause of death in three panthers. Since then, however, there have been no further analyses of Hg data (Beier et al., 2003). Further, there have been no surveys for OCs or PCBs in panthers since the mid-1990s (Facemire et al., 1995; Sileo et al., 1997) or comparisons of these contaminant concentrations in panthers from different geographic locations. Nevertheless, continued Hg monitoring and testing of some panthers for organochlorines and PCBs indicate that concentrations of some contaminants remain high. Because of the possible clinical and subclinical effects of some environmental contaminants, and because some of these contaminants have been found at high levels in panthers, the Scientific Review Team (SRT) has recommended an in-depth analysis of environmental contaminants in this species (Beier et al., 2003).

MATERIALS AND METHODS

Adult and neonatal Florida panthers were live-captured as described by Shindle et al. (2004). Captured adult and juvenile pumas were fitted with a VHF or VHF/GPS radio-collar and located three times weekly. Location coordinates also were collected daily at various intervals for panthers wearing GPS collars. Venous blood was collected in Na Heparin, serum separator, and EDTA blood tubes, processed, and frozen at -72°C until analyzed. Hair was collected from the ventral abdomen and similarly frozen. All dead panthers were necropsied at the University of Florida College of Veterinary Medicine (UF-CVM, Gainesville, Florida, USA), Disney's Animal Kingdom (Celebration, Florida), or the Wildlife Research Laboratory (Florida Fish and Wildlife Conservation Commission, Gainesville, Florida). Organ tissues and fluids (blood, urine, and aqueous humor) were collected at necropsy. All tissues not immediately analyzed were archived at -20° or -72°C.

Adult, subadult, and juvenile panthers were sampled from various geographic locations (Fig. 1), and date collected ranged from July 1989 to April 2009. Environmental contaminant results collected at necropsy of Florida panthers 2000 to 2009 as part of mortality investigations also are included. Geographic regions were divided into North (north of Interstate [I] 75), Central (between I-75 and US41), and South (Everglades south of US41 in Dade County [EVER]). All samples available from EVER were included in the study, and representative samples were chosen randomly from other regions. Due to small sample size, location comparisons were limited to EVER versus all other areas. Ages were either known (handled as kittens) or were estimated from tooth wear and gum line recession (Shaw et al., 2007). See Table 2 for demographic data and cause of death for panthers sampled in this study.

Mercury

Hair and heparinized whole blood were analyzed for Hg concentration at the Florida Department of Environmental Protection (DEP, Tallahassee, Florida) by cold vapor atomic absorption spectrophotometry (Hatch and Ott, 1968). Results are presented in a separate report (Brandon, 2011).

Organochlorines

Abdominal fat collected at necropsy from 18 panthers was tested for OCs (aldrin, alpha-BHC, beta-BHC, delta-BHC, gamma-BHC (lindane), *cis*-chlordane, *cis*-nonachlor, *trans*-chlordane, *trans*-nonachlor, o,p-DDD, p,p'-DDD, o,p-DDE, p,p'-DDE, o,p-DDT, p,p'-DDT, dieldrin, endosulfan I, endosulfan II, endosulfan sulfate, endrin, heptachlor, heptachlor epoxide, hexachlorobenzene, mirex, methoxychlor, toxaphene) at the FL-DEP. Organochlorine testing (alpha-BHC, beta-BHC, delta-BHC, gamma-BHC, *cis*-chlordane, *trans*-chlordane, p,p'-DDD, p,p'-DDE, p,p'-DDT, dieldrin, endosulfan I, heptachlor, heptachlor epoxide, toxaphene) for 19 panthers also was performed at the Diagnostic Center for Population and Animal Health (DCPAH, Michigan State University (MSU), Lansing, MI). Results from the two labs were statistically comparable and were combined for this report.

Polychlorinated biphenyls

We examined 21 of the 209 congeners comprising the PCB family of molecules including the minimum 18 recommended by the National Oceanographic and Atmospheric Administration (NOAA, 1989) and an additional three "Highest Priority" congeners (PCBs 169, 195, and 206) recommended by McFarland and Clarke (1989). Abdominal fat from 18 panthers was tested for PCBs 8, 18, 28, 44, 52, 66, 77, 101, 105, 118, 126, 128, 138, 153, 170, 180, 187, 195, and 206 at the Florida DEP. Minimum total PCBs were calculated as the sum of the above congeners (EPA, 2000). Total PCBs, calculated as Arochlors compared to an Arochlor 1260 standard, also were determined by MSU for 15 panthers.

Anticoagulant rodenticides

Archived liver samples from 34 necropsied panthers were analyzed by High Performance Liquid Chromatography at the DCPAH for brodifacoum, bromadiolone, chlorphacinone, coumachlor, difenacoum, difethialone, diphacinone, and warfarin.

Statistics

All analyses were performed in SAS v 9.3 (Cary, North Carolina). Only parameters with less than 50% of the values as zero were suitable for analysis. All variables were log transformed ($yt = \log[y+1]$) with a start of one to meet the assumptions for parametric analysis. Total PCB, PCB 118, 153, 138, 187, 180, 170, 206, p,p'-DDE, mirex, and *trans*-nonachlor were analyzed with an ANOVA including region and gender as fixed explanatory factors. Age class also was included as a fixed factor for p,p'-DDE. No interactions were included because of insufficient data. Log-transformed means were back-transformed to the original scale and represent median contaminant levels (and 95% confidence intervals). Some contaminants (brodifacoum, PCB 105, PCB 128, PCB 195, dieldrin, and *cis*-nonachlor) were converted to a presence/absence (0/1) response to assess prevalence, as they were not suitable for assessing differences in contaminant levels. These parameters were analyzed with a chi-square including the Fisher's exact test to compare prevalence between regions. Spearman rank non-parametric correlations were performed to compare various classes of contaminants.

RESULTS

Contaminants detected in this study included OCs (p,p'-DDE, p,p'-DDT, p,p'-DDD, oxychlordane, dieldrin, heptachlor epoxide, mirex, *cis*-nonachlor, and *trans*-nonachlor [Table 3]), PCBs (congeners 18, 66, 118, 153, 105, 138, 187, 128, 180, 170, 195, and 206 [Tables 4 and 5]), and anticoagulants (brodifacoum, bromodialone [Table 6]).
For each contaminant the significance test is reported along with either the back-transformed contaminant levels and 95% confidence interval, or the prevalence according to region (Table 7). Spearman rank non-parametric correlation, significance, and the degrees of freedom for each correlation are shown in Tables 8 a,b. Gender was not significant for any contaminant (P>0.10) except DDE ($F_{2,29}$=4.14, P=0.051), where males had a higher level on average than females (0.88 ppm, CI: 0.24 – 1.86 ppm, versus 2.08, CI: 1.84 – 3.33 ppm). Age class was not significant ($F_{2,29}$ =1.79, P=0.1841).

Mercury

Mercury data analysis was conducted in collaboration with Florida Gulf Coast University, and an examination of temporal and geographic trends in Hg concentrations in Florida panthers is published in a separate report (Brandon, 2011). This data will be combined with data presented here and additional contaminants data currently being collected and presented in a more comprehensive report.

Organochlorines

Organochlorines were found in all panthers examined. *Trans*-nonachlor was the most prevalent (100%, range 0.012 to 9.6 ppm) followed by p,p'-DDE (89.2%, range 0.037 to 130 ppm). Other OCs detected included dieldrin (21.6%, range 0.009 to 0.55 ppm), mirex (83.3%, range 0.03 to 4.1 ppm), *cis*-nonachlor (75%, range 0.022 to 1.1 ppm), oxychlordane, p,p'-DDD, p,p'-DDT, and heptachlor epoxide. Organochlorine results are presented in Table 3.

Polychlorinated Biphenyls

PCB congeners were detected in all panthers tested by DEP (Table 4) but only 4 (23.5%) tested for Arochlors by MSU (Table 5). Concentrations of total PCBs detected by DEP ranged from 0.79 to 52.6 ppm. Individual congeners detected included PCBs 18, 66, 118, 153, 105, 138, 187, 128, 180, 170, 195, and 206. PCB 153 and 180 were most ubiquitous (100%) followed by PCB 206 (91.7%) and PCB 138, 187, and 170 (83.3%).

Anticoagulant Rodenticides

Only brodifacoum and bromadiolone were detected in tissues from 7 (20.6%) and 2 (5.9%) panthers respectively. Concentrations ranged from 0.02 to 0.282 ppm (brodifacoum) and 0.15 to 0.18 ppm (bromadiolone). Panthers with bromadiolone also had detectable brodifacoum. Anticoagulant results are presented in Table 6.

The presence of PCBs (total and PCBs 66, 118, 153, 105, 138, 187, 128, 180, 170, 195, and 206) was significantly correlated with the presence of p,p'-DDE, dieldrin, mirex, *cis*-nonachlor, and *trans*-nonachlor (Table 7). There also was a significant correlation with the presence of dieldrin and brodifacoum (Table 8 a,b). Mean contaminant concentrations were significantly higher (p > 0.05) in EVER for brodifacoum, total PCB, PCBs 118, 153, 138, 180, 170, 105, 128, p,p'DDE, dieldrin, mirex, and t*rans*-Nonachlor (Figs. 2-14).

DISCUSSION

Environmental contaminant exposure among Florida panthers was ubiquitous with multiple contaminants found in every panther tested. Generally, Hg, OCs, and PCBs were most common in the Everglades ecosystem.

Various factors may have influenced results. For example the failure to find methoxychlor in adipose tissue was not unexpected as this insecticide is rapidly metabolized and does not accumulate in fat (Kapoor et al., 1970). Alternatively, reported levels of some contaminants may be biased slightly higher due to continuing calibration verification (CCV) failure. Because of the presence of multiple contaminants in tissues, there were small impacts to the results from matrix interferences despite attempts to clean up the sample extracts. Most of the impacts were associated with non-detected compounds; however, results for some compounds were affected by a potential high bias observed in the CCV. The bias was likely due to several possible causes, notably: 1) effects on the chromatography column, sample introduction system and detector by the matrix; and 2) possible carryover from previous samples containing high analyte concentrations (T. Fitzpatrick, pers. commun.). Concentrations reported in this study were not adjusted to counter these possible biases; however, they are not believed to have significantly impacted the results. Table 9 lists CCV failures for samples tested in this study. Similarly, toxaphene can also affect PCB and OC results; however, this compound was not detected in a subset of samples tested. Age can also affect contaminant concentrations through differences in diet among age groups and through bioaccumulation with increasing age. In this study, however, age class was not shown to statistically affect results. This is most likely the result of small sample size, and additional testing may shed light on contaminant accumulation with age.

Total PCBs in this study were determined by adding the values for the 21 reported congeners. This value, however, represents a minimum as theoretically 209 possible congeners may be detected. The 21 reported are the most likely to bioaccumulate and likely comprise the vast majority of the total PCBs. Total PCB results in some studies (including data previously reported for Florida panthers) are frequently presented as Arochlors and result in an often larger value. For example, FP85, an adult male from the Everglades ecosystem had 100 ppm total PCBs as measured in Arochlors and 52 ppm as the sum of tested congeners. Total Arochlor PCBs determined by MSU were reported as compared to an Arochlor 1260 standard. Arochlors are manufactured PCB products and contain a mixture of congeners which undergo progressive chlorination of biphenyls until the desired percentage of chlorine by weight is achieved. Arochlor 1260 is a biphenyl containing 60% chlorine by mass in the mixture. Alterations may occur during biological uptake of Arochlors thus limiting their usefulness in assessing PCB burdens in organisms. Additionally, some PCBs (coplanar) may accumulate at greater concentrations in the liver versus fat in some carnivores (Kunisue et al., 2006; Mateo et al., 2011). A comparison of coplanar PCB concentrations between liver and fat was not performed in this study.

Only second generation anticoagulant rodenticides (brodifacoum and bromadialone) were found in panthers and this is most likely due to their greater use and greater persistence – both in target species and panthers. Second generation anticoagulants are more toxic and persistent, but like first generation products, have a delayed toxicity due to the time needed for the depletion of clotting factors. Therefore a rodent may ingest many times the lethal dose yet survive to be preyed upon by predators. Early clinical effects in target rodents may actually predispose them to predation. The source of anticoagulants in panthers was likely rodents although direct

consumption of baits is theoretically possible. Approved target species for brodifacoum and bromadialone include house mice (*Mus musculus*) and Norway rats (*Rattus norvegicus*) (Riley et al., 2007). These are not usual prey items for panther; however, non-target rodents or other non-target species may consume baits and subsequently be preyed upon by panthers. Further, Riley et al. (2007) speculated that mountain lions may be exposed to anticoagulants through predation on secondarily exposed carnivores such as coyotes (*Canis latrans*). Predation of coyotes by panthers was recently documented (D. Onorato, unpubl. data).

The finding of multiple anticoagulants in individuals suggests repeated exposures as commercial baits contain only a single anticoagulant (Uzal et al., 2007). Highest concentrations were found in urban and agricultural areas, which is similar to Riley et al's (2007) findings in bobcats. Mortality and sublethal effects such as possible increased susceptibility to notoedric mange as the result of anticoagulant exposure has been documented in mountain lions, bobcats, and other wildlife (Stone et al., 1999, 2002; Riley et al., 2007; Uzal et al., 2007). No clinical effect was seen in exposed panthers.

Diagnosis of exposure or death due to toxicity in wildlife is based on history of exposure, pathological lesions, and contaminant concentrations in tissues. Abdominal body fat is used to assess and compare lipophilic contaminant burdens among groups; however, brain concentrations are most important for diagnosing some contaminants (Hg, OCs) as the cause of death in individuals (Blus et al., 1996; Heinz, 1996). Histology may be supportive but is not diagnostic of toxicity. Anticoagulant rodenticides act by blocking the vitamin K cycle resulting in the inability to produce essential blood-clotting factors. Some anticoagulants also damage capillaries which can contribute to bleeding. Therefore, clinical signs and lesions associated with toxicity typically are related to anemia and hemorrhaging although sublethal effects may be possible.

Finally, the impact of environmental contaminants on the health of a free-ranging population, including panthers, is complicated by a host of confounding genetic, dietary, and demographic factors, and the different stressors experienced by free-ranging versus captive animals (Kamrin and Ringer, 1996). High concentrations of contaminants in some tissues do not necessarily indicate cause of debility or death (Bernard, 1963; Keith, 1996). Conversely, contaminants such as PCBs can interact with other toxicants or infectious agents to produce disease at concentrations considered safe (O'Hara and Rice, 1996). Weight loss (mobilization of fat reserves) may increase tissue concentrations of lipophilic contaminants (OCs, PCBs) (Blus et al., 1996; O'Hara and Rice, 1996) and this may have been seen in some panthers (e.g. FP85).

Assessing the health and reproductive effects of contaminants on wildlife is difficult. The standard approach to assess how hazardous a chemical may be to wildlife is to compare their tissue concentrations to those found in affected laboratory animals (Peakall, 1996; Keith, 1996). Such data do not exist for panthers; however, the effects of PCBs and OCs have been examined extensively in both free-ranging and experimental mink populations. Exposure of American mink to PCBs or PCB-contaminated fish resulted in reproductive impairment and mortality (Kamrin and Ringer, 1996; O'Hara and Rice, 1996; Mateo et al., 2011). Differences in rate of exposure and differences in species sensitivity to contaminants limit interpretation.

Several panthers have died with elevated levels of environmental contaminants, however, none have been conclusively shown to have died as a direct result of toxicity. One Florida panther (FP85) died of unknown causes in Everglades National Park with hair Hg concentrations of 150 ppm and DDE and total PCB concentrations in abdominal fat of 100 ppm and 50 ppm respectively. Concentrations of these contaminants in the brain and liver were not considered

clinically significant. Extensive toxicological testing of tissues from panthers dying from unknown causes for other contaminants including organophosphates/carbamates, tributyltin and other heavy metals, sodium fluoroacetate (1080), and/or algal toxins were negative (with the exception of elevated Hg in some panthers).

Although little has been done to examine these contaminant concentrations in neonatal panthers, high concentrations have been seen in the small number sampled. Neonates may be more susceptible to the toxic effects of Hg (Berglund and Berlin, 1969). Two sibling neonates from the Florida Panther National Wildlife Refuge had hair concentrations of 35 and 40 ppm and did not survive to leave their natal den.

Management Implications

Management for ungulates is critical not only for the nutritional value (Schortemeyer et al., 1991) but also to decrease exposure to environmental contaminants. Several environmental contaminants bioaccumulate through the aquatic food chain reaching elevated levels in raccoons and other aquatic prey. There is evidence that ungulate populations are decreasing in some areas of South Florida (J. Bozzo, pers. Commun). These decreases may, in part, be due to a more dense panther population. This trend may worsen exposure to environmental contaminants as panthers shift their prey selection to raccoons, alligators, and other non-ungulate prey. Further, increased water levels associated with restoration of historic hydrologic flow in the Everglades and other areas (Comprehensive Everglades Restoration Plan) may increase the risk of bioaccumulation of contaminants in panthers in some areas (Brandon, 2011). Exposure to Anticoagulants may be reduced by more judicious and/or restricted use of baits.

Although panther mortality has not been conclusively attributed to environmental contaminants, it is possible that contaminants in fact caused or contributed to morbidity and/or mortality. At a minimum, contaminants are an additional stressor that, alone or combined with other stressors (poor nutrition, decreased genetic variation, parasites/diseases), likely have an impact on panther health and reproduction. Further research is needed to assess impact of environmental contaminants on these parameters. Continued monitoring for environmental contaminants, especially in the EVER ecosystem is warranted. This is especially critical as water dynamics change with Everglades Restoration. Testing PCB congeners, not Arochlors, should be performed on panthers.

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Acknowledgements:

Many thanks to biologists and veterinarians with the Florida Fish and Wildlife Conservation Commission, National Park Service, US Fish and Wildlife Service, and Rancher's Supply for panther capture and sample collection. Additionally, we are deeply indebted to Erin Leone (FWC) for statistical analysis, and we very much appreciate the technical assistance of T. Fitzpatrick (DEP), D. Axelrod (DEP), and W. Rumbeiha (MSU). This project was funded by the US Fish and Wildlife Service under Cooperative Agreement No. 401817J004.

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KEY TO TABLES

FP = Radio-collared Florida panther, UC = uncollared Florida panther (i.e. had not been previously handled), K = Florida panther previously handled as a neonatal kitten, TX = Texas puma.

FeLV = Feline leukemia virus infection, HBC = killed by vehicle, ISA = intraspecific aggression, Unk = cause of death unknown.

BCNP = Big Cypress National Preserve, BCNP-RP = Raccoon Point Unit, BCNP-AL = Addition Lands, BCNP-ML = Monument Lake Unit, BCNP-TR = Turner River Unit, BCNP-DL = Deep Lake Unit, BCNP-BI = Bear Island Unit, BCSIR = Big Cypress Seminole Indian Reservation, CREW = Collier Regional Ecosystem Watershed, CSSP = Collier Seminole State Park, MIR = Miccosukee Indian Reservation, EVER = Everglades National Park and surrounding ecosystem, FPNWR = Florida Panther National Wildlife Refuge, OKS = Okaloacoochee Slough Wildlife Management Area, PL = Private lands.

N = North (north of I-75), C = Central (between US41 and I-75), S = South (Everglades ecosystem).

DEP = Florida Department of Environmental Protection, MSU = Michigan State University Diagnostic Center for Population and Animal Health.

PCB = Polychlorinated biphenyl

CNS = Central nervous system

Table 1. Summary of environmental contaminants tested for in pumas from Florida 1989-2009.

	Intended Use	Duration of Use	Currently Banned	Bioaccumulative	Persistent in Environment	Organ System affected in non-target species	Comments
Organochlorines							
Cyclodienes							Precursor is hexachlorocyclopentadiene.
Aldrin	Insecticide+C4 to treat seed and soil	1946-1976	Yes	Yes	Yes	CNS, Endocrine disrupter, carcinogenic	Rapidly converted to dieldrin once in the body.
Dieldrin	Insecticide	1950-1974	Yes	Yes	Yes	CNS, Reproductive system, teratogenic, carcinogenic	Related to endrin but more persistent in the environment.
Endrin	Broad-spectrum pesticide	1951-1984	Yes		Yes	CNS, carcinogenicity is unknown	Highly toxic to mammals but not commonly found in fish monitoring programs.
Cis-Chlordane	Insecticide, termite control	1948-1988	Yes	Yes	Yes	Probable carcinogen	Component of technical grade chlordane.
Trans-Chlordane	Insecticide, termite control	1948-1988	Yes	Yes	Yes	Probable carcinogen	Component of technical grade chlordane.
Cis-Nonachlor		1948-1988	Yes	Yes	Yes	Liver, Carcinogenic	Component of chlordane, less toxic than *trans*-nonachlor.
Endosulfan I	Insecticide (agricultural use), acaricide	1954-Present	No	Yes	Yes	CNS, Reproductive system (endocrine disrupter)	Will soon be banned in the US. Degrades to Endosulfan sulfate
Endosulfan II							
Endosulfan sulfate							
Heptachlor	Insecticide - termites, agricultural pests	1960s-1988	Yes	Yes	Yes	CNS, Reproductive system, Immune system, liver, kidneys, carcinogenic	Degradation product heptachlor epoxide is more toxic than parent compound. Heptachlor currently is used only for the control of ants in power transformers.
Heptachlor epoxide	None			Yes	Yes	CNS, liver, kidneys, blood, carcinogenic	A metabolite of Heptachlor and chlordane and is more toxic than either parent compound.
Cyclodiene-like							
Mirex	Fire ant control, fire retardant, polymerizing agent in plastics	1955-1978	Yes	Yes	Yes	Liver, kidneys, gastrointestinal tract, reproductive system (endocrine disrupter), probable carcinogen	Also used as a fire retardant. Degrades to chlordecone.
Hexachlorocyclohexane and byproducts	Insecticide		Yes	Yes	Yes	CNS	Alpha, Beta, and Delta-BHC are by-products of lindane production.
Gamma-BHC	Insecticide, treatment for lice and scabies	1940s-	No	Yes	Moderate	CNS, liver, kidneys, reproductive (Endocrine disrupter – anti-estrogenic/estrogenic), aplastic anemia, possible carcinogen	Also known as Lindane. Use other than for the treatment for lice and scabies was banned in 2002.
DDT and breakdown products	Insecticide (mosquitoes)	1939-1972	Yes	Yes	Yes	Genotoxic, diabetes, CNS (Parkinson's), Reproductive system (endocrine disrupter - anti-androgen), carcinogenic	More toxic to birds than mammals. Degradation products include DDE and DDD.
Methoxychlor	Insecticide, ectoparasiticide	1950s-2003	Yes	No	Low	CNS, reproductive system (endocrine disrupter - estrogenic), liver, kidney, heart	Replacement for DDT because it does not bioaccumulate. Increased in use after ban of DDT in 1972. Low relative toxicity and is rapidly metabolized (does not accumulate in fat).
Hexachlorobenzene	Fungicide	1945-1965	Yes	Yes	Yes	Liver, skin, thyroid, CNS, immune system; carcinogenic	Passed to nursing young through lactation.
Toxaphene	Insecticide, piscicide	1947-1990	Yes	Yes	Yes	Lungs, CNS, kidneys, probable carcinogen	A mixture of approximately 200 organic compounds. Is a volatile compound that can be transported in the atmosphere. One of "dirty dozen" environmental contaminants banned internationally in 2004. Used extensively after DDT was banned.
PCBs	Dielectric fluids in transformers, capacitors, and coolants; pesticide extenders, plasticizers; and other industrial uses	1929-1979	Yes	Yes	Yes	Liver, blood (anemia), CNS, GI tract, thyroid, developmental effects, carcinogenic	PCB products (e.g. Arochlors) contained a mixture of congeners. Congeners have varying toxicities.

(Table 1. Continued)

	Intended Use	Duration of Use	Currently Banned	Bioaccumulative	Persistent in Environment	Organ System affected in non-target spp.	Comments
Anticoagulants							
1st Generation							Some rodents have developed a resistance to 1st generation anticoagulants.
Chlorphacinone*	Rodent, vampire bat control		No	No	No	Clotting cascade, capillary permeability	
Dicoumarol	Rodent control		No	No	No	Clotting cascade, capillary permeability	Naturally occurring mycotoxin.
Diphacinone*	Rodent, pigeon, vampire bat control		No	No	No	Clotting cascade, capillary permeability	Use retricted to certified applicators.
Warfarin	Rodent control, therapeutic drug		No	No	No	Clotting cascade, capillary permeability	
2nd Generation							Longer half-life in body (20-130 days).
Brodifacoum	Rodent control		No	No	No	Clotting cascade, capillary permeability	Also used in opossum control.
Bromodialone	Rodent control		No	No	No	Clotting cascade, capillary permeability	
Coumachlor	Rodent control		No	No	No	Clotting cascade, capillary permeability	
Coumafuryl	Rodent control		No	No	No	Clotting cascade, capillary permeability	
Coumatetryl	Rodent control		No	No	No	Clotting cascade, capillary permeability	
Difenacoum	Rodent control		No	No	No	Clotting cascade, capillary permeability	
Difethialone	Rodent control		No	No	No	Clotting cascade	

* Considered 2nd generation anticoagulant by Watt et al. (2005).

Table 2. Demographic data for pumas in Florida sampled for environmental contaminants 1989-2009.

ID	Sex	Age	Age Class	Date Killed	Cause	Location	Region
FP014	F	10.5	Adult	6/20/1991	Unk	EVER	S
FP027	F	3.5	Adult	7/23/1989	Unk	EVER	S
FP039	M	3.5	Adult	6/18/1990	Unk-trauma	EVER	S
FP049	F	12	Adult	1/3/2002	ISA	BCNP-AL	N
FP059	M	9.4	Adult	11/22/2004	ISA	FPNWR	N
FP070	F	8.6	Adult	1/14/2006	HBC	BCNP-TR	C
FP085	M	5	Adult	3/1/2004	Unk	EVER	S
FP091	M	4.5	Adult	12/12/2003	ISA	BCNP-TR	C
FP099	M	2.75	Adult	11/28/2002	HBC	PL	N
FP100	M	10	Adult	1/25/2007	Unk	MIR	N
FP105	F	7	Adult	1/16/2002	Unk	FPNWR	N
FP108	M	1.8	Juvenile	11/16/2002	Unk-trauma	BCNP-RP	C
FP112	F	4	Adult	9/11/2002	ISA	BCNP-BI	N
FP115	F	4.5	Adult	5/17/2003	FeLV	OKS	N
FP118	F	1	Juvenile	4/4/2003	Unk	BCSIR	N
FP126	M	1.6	Juvenile	1/1/2005	ISA	PL	N
FP129	F	5	Adult	3/22/2006	Unk	BCNP-RP	C
FP130	M	4	Adult	3/21/2007	HBC	Central FL	N
FP132	M	3.25	Adult	7/22/2004	FeLV	OKS	N
FP134	M	5.5	Adult	1/29/2007	ISA	BCNP-AL	N
FP138	M	7	Adult	5/12/2008	Unk	BCNP-ML	C
FP152	M	5.5	Adult	10/22/2008	ISA	BCNP-TR	C
K049	F	7.8	Adult	12/2/2005	HBC	BCNP-DL	C
K128	M	2.5	Subadult	12/6/2004	HBC	PL	N
K153	M	2.1	Subadult	8/29/2005	HBC	Belle Meade	C
TX107	F	8.5	Adult	1/18/2001	Unk	BCNP-RP	C
UC057	F	5	Adult	5/15/2003	Unk	BCSIR	N
UC060	M	2.5	Subadult	12/9/2003	HBC	CSSP	C
UC070	F	1	Juvenile	12/1/2004	HBC	PL	N
UC071	M	2.5	Subadult	2/4/2005	HBC	BCNP-TR	C
UC072	M	2	Subadult	2/25/2005	HBC	PL	N
UC073	M	.6	Juvenile	4/7/2005	HBC	Naples	C
UC074	M	3	Adult	6/4/2005	HBC	Central FL	N
UC075	M	2	Subadult	6/19/2005	HBC	PL	N
UC076	M	1	Juvenile	9/18/2005	HBC	Belle Meade	C
UC078	M	.75	Juvenile	1/25/2006	HBC	PL	N
UC079	F	2	Subadult	1/26/2006	HBC	PL	N
UC080	F	2	Subadult	2/2/2006	HBC	EVER	S
UC083	M	3	Adult	3/11/2006	ISA	CREW	N
UC084	M	3.5	Adult	4/14/2006	HBC	Central FL	N

(Table 2. Continued)

ID	Sex	Age	Age Class	Date killed	Cause	Location	Region
UC085	M	3.5	Adult	6/5/2006	HBC	OKS	N
UC087	M	3	Adult	8/24/2006	HBC	CREW	N
UC088	F	2	Subadult	11/26/2006	HBC	Belle Meade	C
UC094	M	2.5	Subadult	4/3/2007	HBC	Belle Meade	C
UC095	M	2.5	Subadult	4/18/2007	HBC	Central FL	N
UC096	F	3	Adult	5/9/2007	HBC	EVER	S
UC101	M	4	Adult	6/26/2007	HBC	EVER	S
UC103	M	2.5	Subadult	3/9/2008	HBC	Naples	C
UC106	M	2	Subadult	5/4/2008	HBC	PL	N
UC107	F	2.5	Subadult	5/22/2008	HBC	Rookery Bay	C
UC115	M	4	Adult	1/11/2009	HBC	OKS	N
UC119	F	2.5	Subadult	4/9/2009	HBC	BCNP-TR	C

Table 3. Organochlorine (OC) concentrations (ppm) in abdominal fat from pumas in Florida necropsied 1989-2009.

ID	OC Lab	Aldrin	Alpha-BHC	Beta-BHC	Delta-BHC	Gamma-BHC	oxychlordane	*Cis*-Chlordane	*Trans*-Chlordane	p,p'DDD	p,p'-DDE	p,p'-DDT	o,p'-DDD	o,p'-DDE	o,p'-DDT	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulfate	Endrin	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Methoxychlor	Mirex	*Cis*-Nonachlor	*Trans*-Nonachlor	Toxaphene
FP014	DEP	0	0	0	0	0	0	0	0	0	1.5	0	0	0	0	0.027	0	0	0	0	0	0	0	0	0.5	0	1.8	0
FP027	DEP	0	0	0	0	0	0	0	0	0	22	0	0	0	0	0.15	0	0	0	0	0	0	0	0	0.54	0.16	1.2	0
FP039	DEP	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0.13	0	0	0	0	0	0	0	0	1.5	0.3	2.1	0
FP049	DEP	0	0	0	0	0	0	0	0	0	0.097	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03	0	0.04	0
FP059	DEP	0	0	0	0	0	0	0	0	0.066	2.7	0.15	0	0	0	0	0	0	0	0	0	0	0	0	0.31	0.022	0.32	0
FP070	MSU	0	0	0	0	0		0	0	0	0	0				0	0				0	0						
FP085	DEP	0	0	0	0	0	0	0	0	0	130	0	0	0	0	0.55	0	0	0	0	0	0.2	0	0	4.1	1.1	9.6	0
FP091	DEP	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0.07	0
FP099	DEP	0	0	0	0	0	0	0	0	0	0.31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0
FP105	DEP	0	0	0	0	0	0	0	0	0	0.037	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.14	0
FP108	MSU	0	0	0		0				0	1.71	0	0		0	0				0	0	0						
FP112	DEP	0	0	0	0	0	0	0	0	0	0.15	0	0	0	0	0	0	0	0	0	0	0	0	0	0.07	0.18	4	0
FP115	DEP	0	0	0	0	0	0	0	0	0	1.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0.06	0	0.12	0
FP118	MSU	0	0	0		0				0	0.33	0	0		0	0				0	0	0						
FP126	MSU	0	0	0	0	0		0	0	0	0.42	0				0	0				0	0						
FP129	DEP	0	0	0	0	0	0	0	0	0	1.9	0	0	0	0	0.024	0	0	0	0	0	0	0	0	0.45	0.03	0.16	0
FP134	DEP	0	0	0	0	0	0	0	0	0	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.08	0	0.17	0
K049	MSU	0	0	0	0	0		0	0	0	0	0				0	0				0	0						
K128	MSU	0	0	0		0				0	0.425	0	0		0	0				0	0	0						
K153	MSU	0	0	0	0	0		0	0	0	0.22	0				0	0				0	0						
TX107	DEP	0	0	0	0	0	0	0	0	0	0.34	0	0	0	0	0	0	0	0	0	0	0	0	0	0.05	0	0.012	0
UC057	MSU	0	0	0		0	0.21			0	0.88	0	0		0	0				0	0	0					0.28	
UC060	DEP	0	0	0	0	0	0	0	0	0.024	0.24	0.086	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.056	0
UC070	MSU	0	0	0	0	0		0	0	0	0.212	0				0	0				0	0						
UC071	MSU	0	0	0	0	0		0	0	0	1.59	0				0	0				0	0						
UC072	MSU	0	0	0	0	0		0	0	0	0	0				0	0				0	0						
UC073	MSU	0	0	0	0	0		0	0	0	0.082	0				0	0				0	0						

(Table 3. Continued)

ID	OC Lab	Aldrin	Alpha-BHC	Beta-BHC	Delta-BHC	Gamma-BHC	oxychlordane	*Cis*-Chlordane	*Trans*-Chlordane	p,p'-DDD	p,p'-DDE	p,p'-DDT	o,p'-DDD	o,p'-DDE	o,p'-DDT	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulfate	Endrin	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Methoxychlor	Mirex	*Cis*-Nonachlor	*Trans*-Nonachlor	Toxaphene
UC075	MSU	0	0	0	0	0		0	0	0	0.272	0				0	0				0	0						
UC076	MSU	0	0	0	0	0		0	0	0	0	0				0	0				0	0						
UC078	MSU	0	0	0	0	0		0	0	0	0.257	0				0	0				0	0						
UC079	MSU	0	0	0	0	0		0	0	0	0.052	0				0	0				0	0						
UC080	DEP	0	0	0	0	0	0	0	0	0	1.4	0	0	0	0	0.0087	0	0	0	0	0	0	0	0	0.16	0.033	1	0
UC083	MSU	0	0	0	0	0		0	0	0	0.213	0				0	0				0	0						
UC084	MSU	0	0	0	0	0		0	0	0	0.619	0				0	0				0	0						
UC085	MSU	0	0	0	0	0		0	0	0	0.264	0				0	0				0	0						
UC096	DEP	0	0	0	0	0	0	0	0	0	4.4	0.04	0	0	0	0.046	0	0	0	0	0	0	0	0	0.34	0.075	1.4	0
UC101	DEP	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0.065	0	0	0	0	0	0	0	0	0.63	0.094	0.58	0

Table 4. Polychlorinated biphenyl (PCB) congener concentrations (ppm) in abdominal fat of pumas in Florida sampled 1989-2009.

ID	Total PCBs	PCB 8	PCB 18	PCB 28	PCB 52	PCB 44	PCB 66	PCB 101	PCB 118	PCB 153	PCB 105	PCB 138	PCB 187	PCB 128	PCB 180	PCB 170	PCB 195	PCB 206	PCB 77	PCB 126
FP014	3.71	0	0	0	0	0	0	0	0.12	0.84	0.04	0.3	0.2	0	1.3	0.42	0.03	0.46	0	0
FP027	9.91	0	0	0	0	0	0.083	0	0.68	3.2	0.16	2	0.63	0.028	2.1	0.64	0.069	0.32	0	0
FP039	12.176	0	0	0	0	0	0.24	0	0.61	3.3	0.16	1.9	1.1	0.072	3.3	0.86	0.094	0.54	0	0
FP049	0.141	0	0	0	0	0	0	0	0	0.045	0	0	0	0	0.059	0.014	0	0.023	0	0
FP059	1.436	0	0	0	0	0	0	0	0.063	0.38	0.017	0.18	0.081	0	0.38	0.25	0.012	0.073	0	0
FP085	52.35	0	0	0	0	0	0	0	2.9	14	0.98	7.6	5.6	0.21	14	4.3	0.46	2.3	0	0
FP091	1.5817	0	0	0	0	0	0.0097	0	0.049	0.57	0.012	0.17	0.077	0	0.39	0.18	0.014	0.11	0	0
FP099	0.154	0	0	0	0	0	0	0	0	0.042	0	0.032	0.012	0	0.038	0.013	0	0.017	0	0
FP105	0.051	0	0	0	0	0	0	0	0	0.017	0	0	0	0	0.019	0	0	0.015	0	0
FP112	0.591	0	0	0.014	0	0	0.11	0	0	0.089	0	0	0.021	0	0.13	0.077	0	0.15	0	0
FP115	0.616	0	0	0	0	0	0	0	0.01	0.2	0	0.1	0.06	0	0.15	0.047	0.011	0.038	0	0
FP129	3.717	0	0	0	0	0	0.035	0	0.23	0.99	0.086	0.45	0.35	0.014	0.86	0.48	0.032	0.19	0	0
FP134	1.5355	0	0	0	0	0	0	0	0.024	0.61	0	0.15	0.04	0	0.48	0.16	0.0085	0.063	0	0
TX107	0.335	0	0	0	0	0	0	0	0	0.11	0	0.047	0.028	0	0.1	0.025	0	0.025	0	0
UC060	0.0699	0	0	0	0	0	0	0	0	0.022	0	0.014	0.0089	0	0.025	0	0	0	0	0
UC080	0.7947	0	0	0	0	0	0	0	0.04	0.21	0.018	0.11	0.043	0	0.23	0.081	0.0087	0.054	0	0
UC096	2.53	0	0	0	0	0	0	0	0.14	0.73	0.035	0.41	0.18	0.012	0.51	0.35	0.023	0.14	0	0
UC101	4.531	0	0	0	0	0	0	0	0.33	1.3	0.1	0.6	0.38	0.014	1.1	0.49	0.037	0.18	0	0

Table 5. Polychlorinated biphenyl (PCB) Arochlor concentrations (ppm) in abdominal fat of Florida panthers sampled 1989-2009.

ID	Total PCBs (Arochlors)
FP070	0
FP085	100
FP126	0.854
FP129	3.16
K049	0
K153	0
UC070	0
UC071	3.08
UC072	0
UC073	0
UC075	0
UC076	0
UC078	0
UC079	0
UC083	0
UC084	0
UC085	0

Table 6. Concentrations (ppm) of anticoagulant rodenticides in liver from pumas in Florida necropsied 1989-2009.

ID	Brodifacoum	Bromodialone	Chlorphacinone	Coumachlor	Coumafuryl	Coumatetryl	Dicoumarol	Difenacoum	Difethialone	Diphacinone	Warfarin
FP049	0	0	0	0	0	0	0	0	0	0	0
FP059	0	0	0	0	0	0	0	0	0	0	0
FP085	0	0	0	0	0	0	0	0	0	0	0
FP091	0	0	0	0	0	0	0	0	0	0	0
FP100	0	0	0	0	0	0	0	0	0	0	0
FP105	0	0	0	0	0	0	0	0	0	0	0
FP112	0	0	0	0	0	0	0	0	0	0	0
FP115	0	0	0	0	0	0	0	0	0	0	0
FP118	0	0	0	0	0	0	0	0	0	0	0
FP129	0	0	0	0	0	0	0	0	0	0	0
FP130	0	0	0	0	0	0	0	0	0	0	0
FP132	0	0	0	0	0	0	0	0	0	0	0
FP134	0	0	0	0	0	0	0	0	0	0	0
FP138	0	0	0	0	0	0	0	0	0	0	0
FP152	0	0	0	0	0	0	0	0	0	0	0
K153	0.021	0	0	0	0	0	0	0	0	0	0
TX107	0	0	0	0	0	0	0	0	0	0	0
UC057	0	0	0	0	0	0	0	0	0	0	0
UC073	0.022	0	0	0	0	0	0	0	0	0	0
UC074	0	0	0	0	0	0	0	0	0	0	0
UC076	0	0	0	0	0	0	0	0	0	0	0
UC080	0.11	0	0	0	0	0	0	0	0	0	0
UC084	0	0	0	0	0	0	0	0	0	0	0
UC087	0.008	0	0	0	0	0	0	0	0	0	0
UC088	0	0	0	0	0	0	0	0	0	0	0
UC094	0	0	0	0	0	0	0	0	0	0	0
UC095	0	0	0	0	0	0	0	0	0	0	0
UC096	0.022	0.15	0	0	0	0	0	0	0	0	0
UC101	0.282	0	0	0	0	0	0	0	0	0	0
UC103	0	0	0	0	0	0	0	0	0	0	0
UC106	0	0	0	0	0	0	0	0	0	0	0
UC107	0.163	0.18	0	0	0	0	0	0	0	0	0
UC115	0	0	0	0	0	0	0	0	0	0	0
UC119	0	0	0	0	0	0	0	0	0	0	0

Table 7. Environmental contaminants differing significantly among regions in either the percentage of pumas having detectable contaminant levels or mean concentrations. Reported for each contaminant are either the back-transformed contaminant levels and 95% confidence interval, or the percentage having detectable contaminants by region. Means sharing any common letters are not significantly different (P>0.05).

Contaminant	North	Central	South (EVER)
p,p'-DDE	0.436B (0.037, 0.988)	0.561B (0.018, 1.39)	8.99A (4.85, 16.08)
Dieldrin	0%	9.09%	100%
Mirex	0.074B (0, 0.405)	0.136B (0, 0.621)	0.852A (0.415, 1.423)
Cis-Nonachlor	28.57%	25.0%	85.71%
Trans-Nonachlor	0.212B (0.090, 0.50)	0.052B (0.016, 0.176)	1.66A (0.666, 4.16)
Total PCBs	0.367B (0.118, 1.14)	0.609B (0.136, 2.73)	5.77A (1.85, 18.0)
PCB 118	0.014B (0, 0.282)	0.066AB (0, 0.453)	0.519A (0.201, 0.920)
PCB 153	0.104B (0.033, 0.324)	0.192B (0.043, 0.864)	1.581A (0.508, 4.93)
PCB 138	0.064B (0, 0.542)	0.158B (0, 0.893)	1.19A (0.513, 2.18)
PCB 180	0.106B (0.037, 0.308)	0.170B (0.042, 0.696)	1.49A (0.513, 4.32)
PCB 170	0.077B (0, 0.417)	0.1578AB (0, 0.663)	0.748A (0.328, 1.30)
PCB 105	14.29%	50.0%	100.0%
PCB 128	0%	25.0%	71.43%
PCB 195	42.86%	50.0%	100%
Brodifacoum	5.88%	23.08%	75.0%

Table 8a. Spearman correlation coefficients (significant correlations in bold), probability > |*r*| under H0: Rho=0, and number of observations for environmental contaminants sampled in pumas in Florida 1989-2009.

	DDE	Dieldrin	Mirex	*Cis*-nonachlor	*Trans*-nonachlor	Brodifacoum
Total PCBs (DEP)	**0.91538**	**0.86217**	**0.97105**	**0.68466**	**0.67595**	0.35298
	<.0001	<.0001	<.0001	0.0017	0.0021	0.2368
	18	18	18	18	18	13
PCB66	0.27035	0.26096	0.34420	0.49533	0.33304	-0.29397
	0.2779	0.2956	0.1619	0.0366	0.1769	0.3296
	18	18	18	18	18	13
PCB118	**0.94183**	**0.89549**	**0.96169**	**0.68726**	**0.65171**	0.40691
	<.0001	<.0001	<.0001	0.0016	0.0034	0.1676
	18	18	18	18	18	13
PCB153	**0.90506**	**0.86217**	**0.96898**	**0.66041**	**0.64706**	0.35298
	<.0001	<.0001	<.0001	0.0029	0.0037	0.2368
	18	18	18	18	18	13
PCB105	**0.87518**	**0.94300**	**0.94953**	**0.73645**	**0.67205**	0.52370
	<.0001	<.0001	<.0001	0.0005	0.0023	0.0662
	18	18	18	18	18	13
PCB138	**0.95657**	**0.86850**	**0.93575**	**0.62421**	**0.57808**	0.35493
	<.0001	<.0001	<.0001	0.0056	0.0120	0.2340
	18	18	18	18	18	13
PCB187	**0.95199**	**0.86262**	**0.96327**	**0.68281**	**0.65256**	0.35346
	<.0001	<.0001	<.0001	0.0018	0.0033	0.2361
	18	18	18	18	18	13
PCB180	**0.88235**	**0.85991**	**0.97105**	**0.65159**	**0.70279**	0.35298
	<.0001	<.0001	<.0001	0.0034	0.0011	0.2368
	18	18	18	18	18	13

(Table 8a. Continued)

	DDE	Dieldrin	Mirex	*Cis*-nonachlor	*Trans*-nonachlor	Brodifacoum
PCB170	**0.90656**	**0.86262**	**0.98810**	**0.73134**	**0.71141**	0.35298
	<.0001	<.0001	<.0001	0.0006	0.0009	0.2368
	18	18	18	18	18	13
PCB195	**0.93763**	**0.87818**	**0.95326**	**0.64684**	**0.62859**	0.35793
	<.0001	<.0001	<.0001	0.0037	0.0052	0.2298
	18	18	18	18	18	13
PCB206	**0.77915**	**0.81232**	**0.94209**	**0.73538**	**0.79773**	0.20807
	0.0001	<.0001	<.0001	0.0005	<.0001	0.4951
	18	18	18	18	18	13

Table 8b. Spearman correlation coefficients (significant correlations in bold), probability > |*r*| under H0: Rho=0, and number of observations for environmental contaminants sampled in pumas in Florida 1989-2009.

	Brodifacoum
DDE	0.18799
	0.4409
	19
Dieldrin	0.48576
	0.0350
	19
Mirex	0.44958
	0.1232
	13
Cis-nonachlor	0.46507
	0.1093
	13
Trans-nonachlor	0.43732
	0.1179
	14

Table 9. Continuing calibration verification (CCV) failures possibly affecting some environmental contaminant results for samples collected from pumas in Florida 1989-2009 as reported by the Florida Department of Environmental Protection.

ID	Flagged positives due to CCV failure	Bias	Estimated impact – up to (%)
FP014	*Trans*-Nonachlor	high	3
FP027	*Cis*-Nonachlor	high	12
FP039	*Cis*-Nonachlor	high	12
	PCB 206	high	13
FP049	Not affected		
FP059	*Cis*-Nonachlor	high	10
	DDT-p,p'	high	38
FP085	PCB 128	high	1
	Cis-Nonachlor	high	12
FP091	Not affected		
FP099	Not affected		
FP105	Not affected		
FP112	PCB 28	high	1
	PCB 187	high	3
	Cis-Nonachlor	high	11
	Trans-Nonachlor	high	3
FP115	Not affected		
FP129	*Cis*-Nonachlor	high	11
	Trans-Nonachlor	high	3
FP134	PCB 195	high	10
	Trans-Nonachlor	high	3
TX107	Not affected		
UC101	*Cis*-Nonachlor	high	10
UC060	p,p'-DDT	high	38
UC080	PCB 195	high	21
	Trans-Nonachlor	high	3
UC096	p,p'-DDT	high	38
	Trans-Nonachlor	high	3

Figure 1. Locations (red circles) of Florida panthers sampled for environmental contaminants 1989-2009.

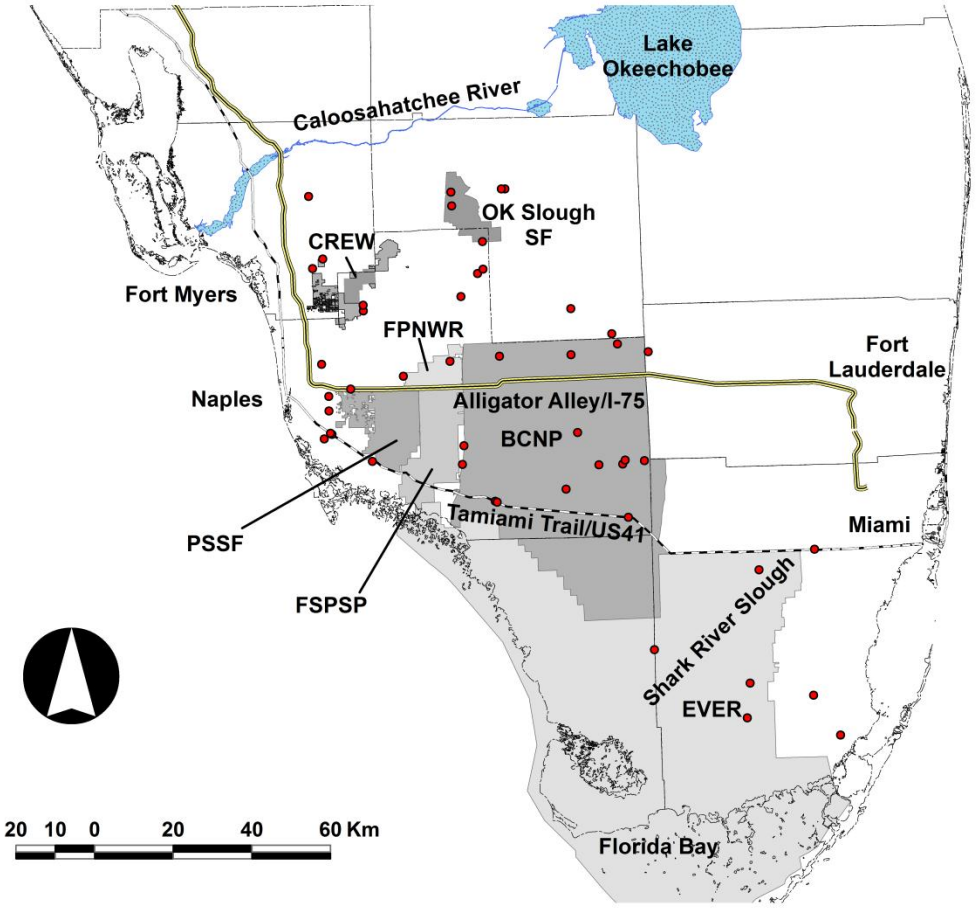


Figure 2. Graph depicting mean concentrations of p,p'-DDE by region in abdominal fat collected from pumas in Florida 1989-2009.

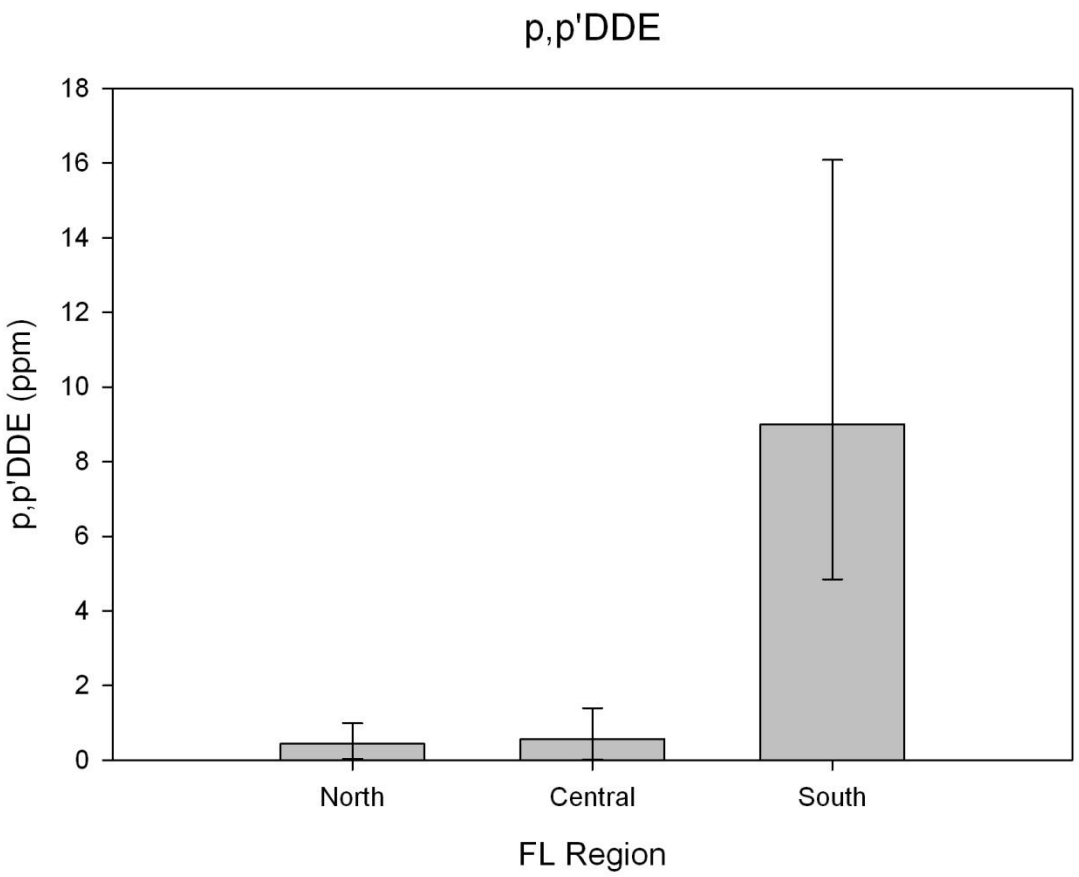


Figure 3. Graph depicting percentage of samples collected from pumas in Florida 1989-2009 with detectable dieldrin concentrations in abdominal fat by region.

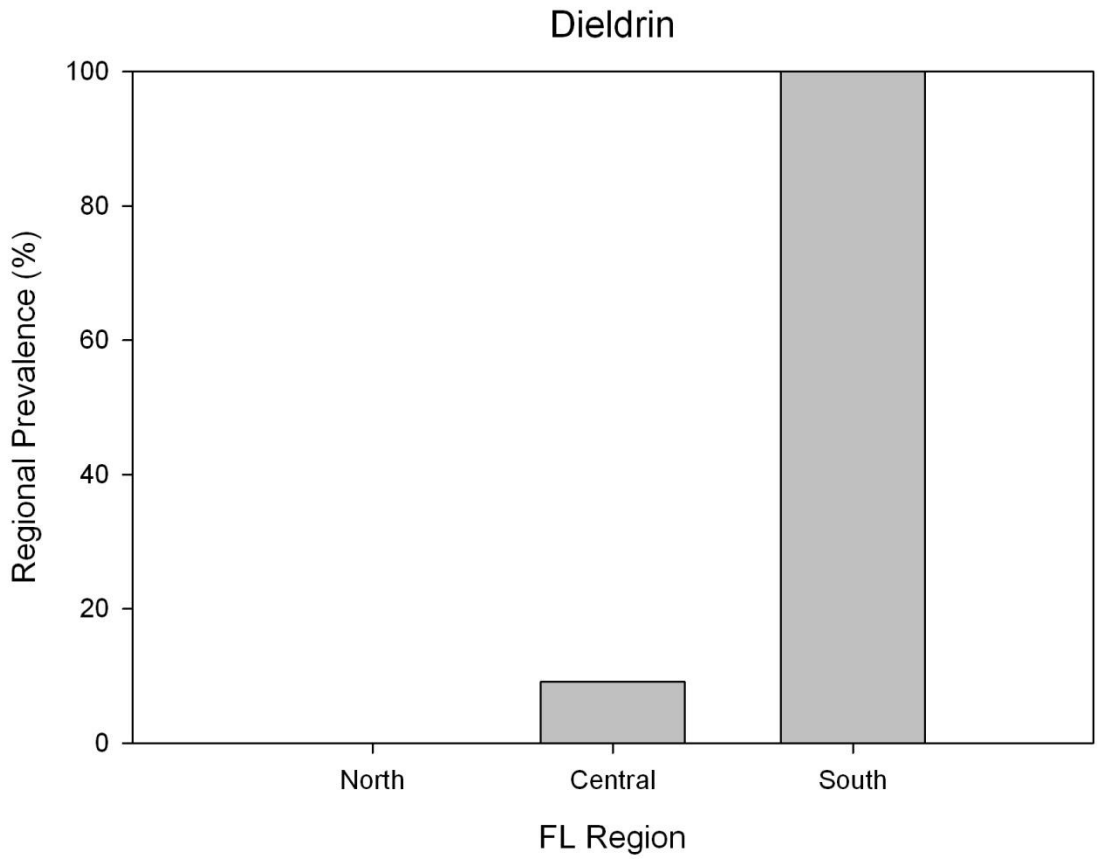


Figure 4. Graph depicting mean concentrations of *trans*-nonachlor by region in abdominal fat collected from pumas in Florida 1989-2009.

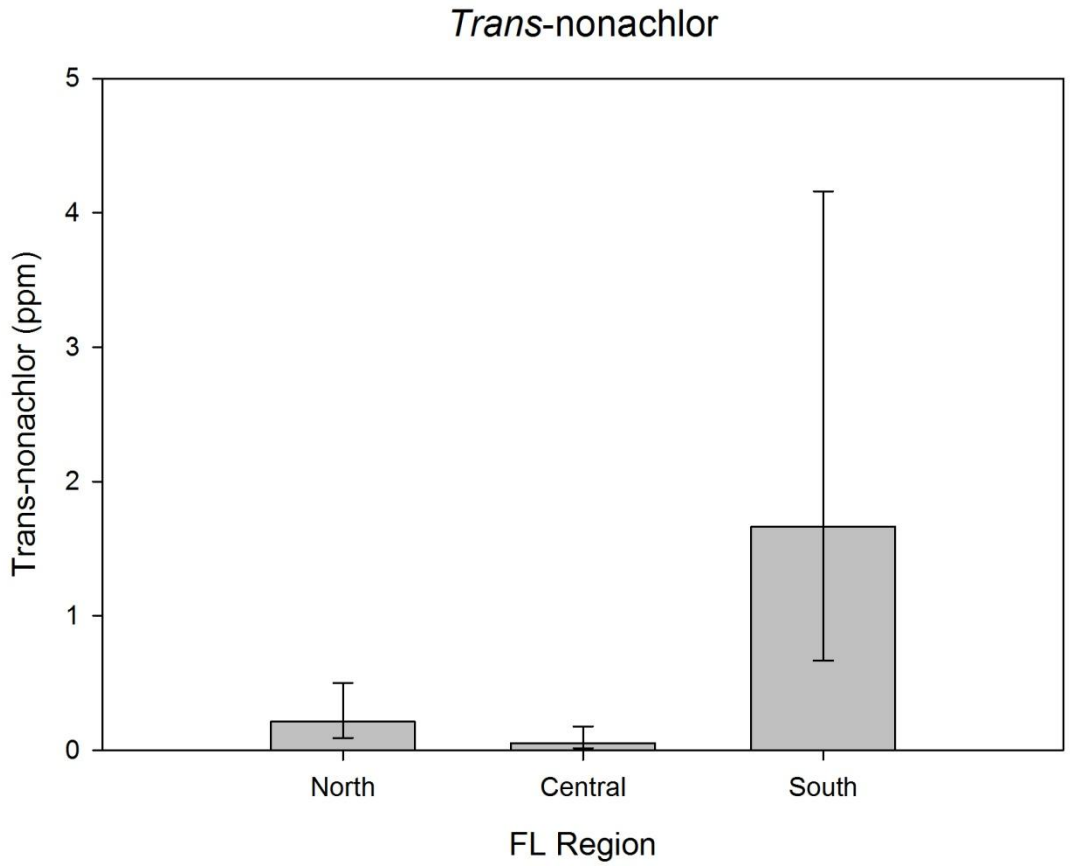


Figure 5. Graph depicting mean concentrations of mirex by region in abdominal fat collected from pumas in Florida 1989-2009.

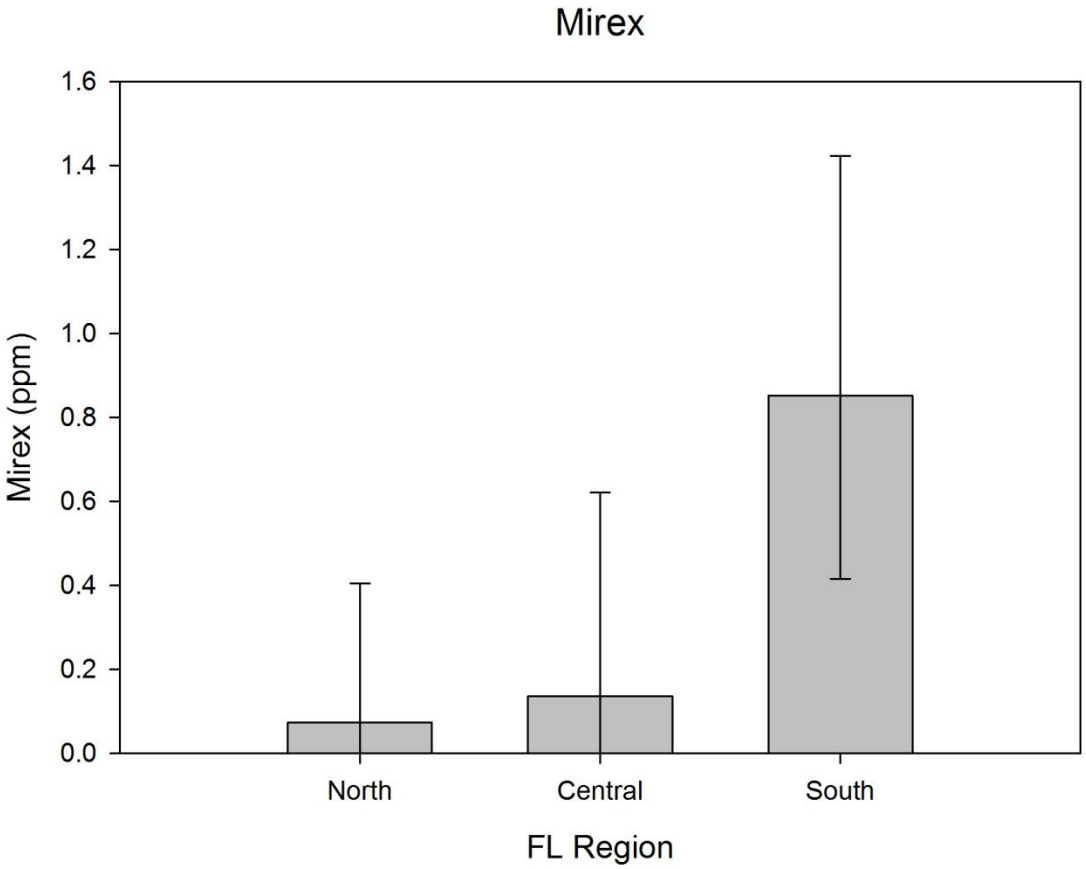


Figure 6. Graph depicting mean concentrations of total polychlorinated biphenyls (PCBs) by region in abdominal fat collected from pumas in Florida 1989-2009.

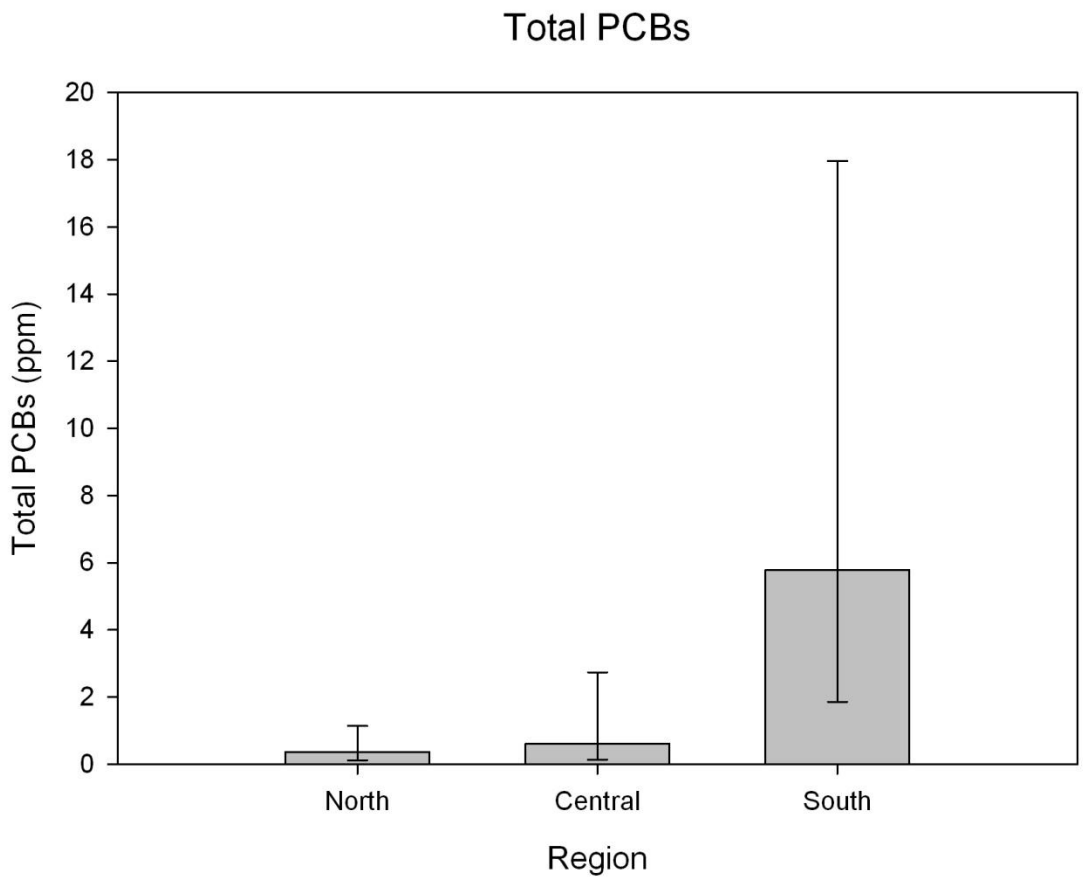


Figure 7. Graph depicting percentage of samples collected from pumas in Florida 1989-2009 with detectable PCB105 concentrations in abdominal fat by region.

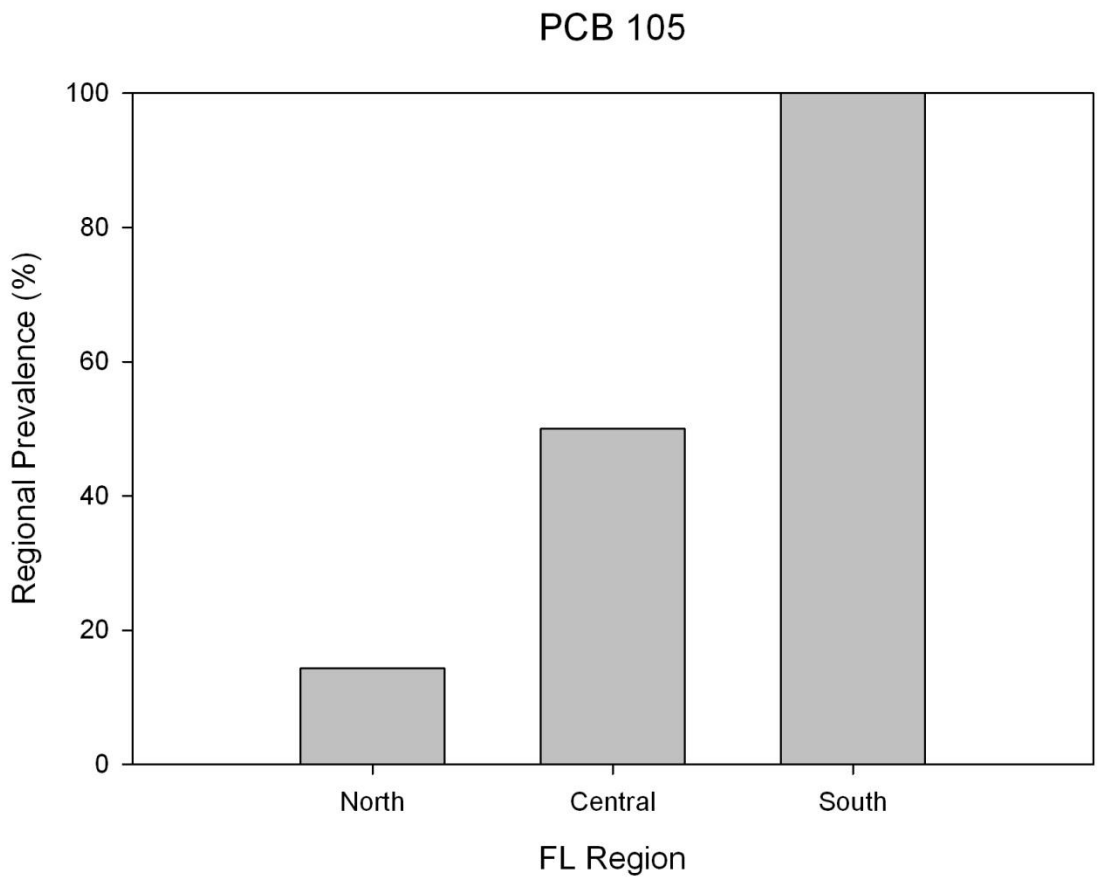


Figure 8. Graph depicting mean concentrations of PCB118 by region in abdominal fat collected from pumas in Florida 1989-2009.

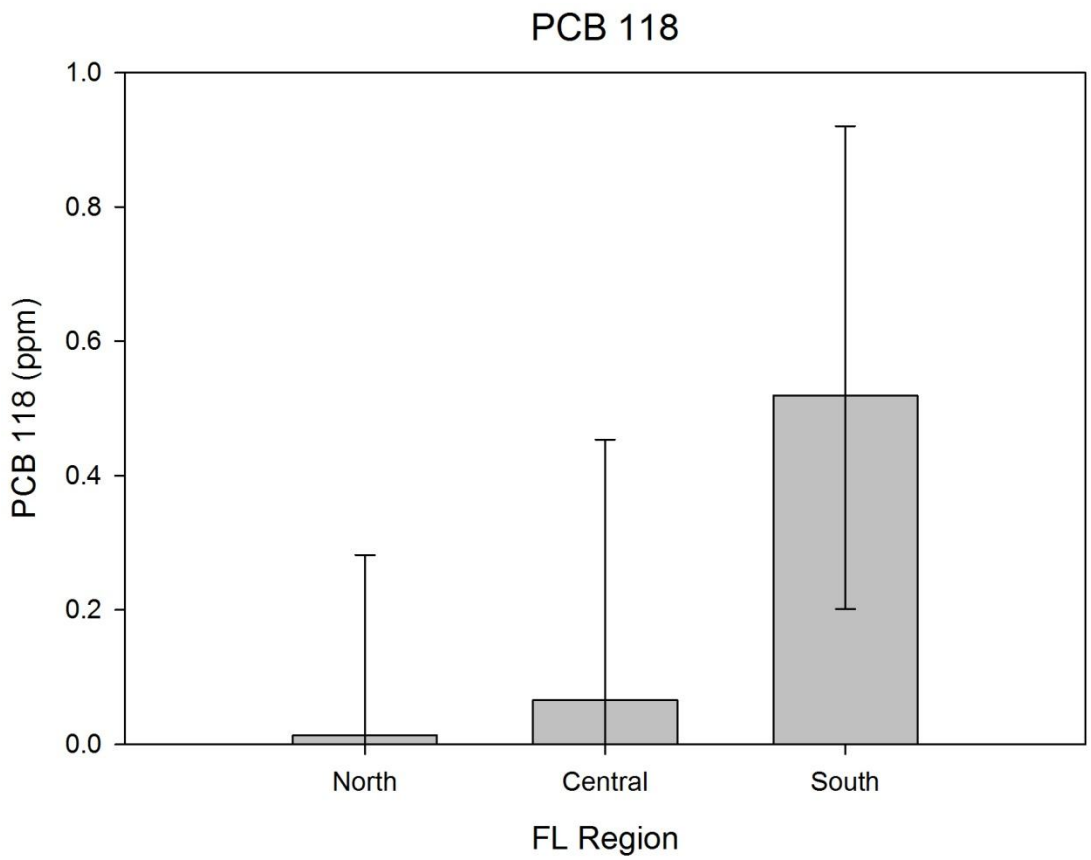


Figure 9. Graph depicting percentage of samples collected from pumas in Florida 1989-2009 with detectable PCB128 concentrations in abdominal fat by region.

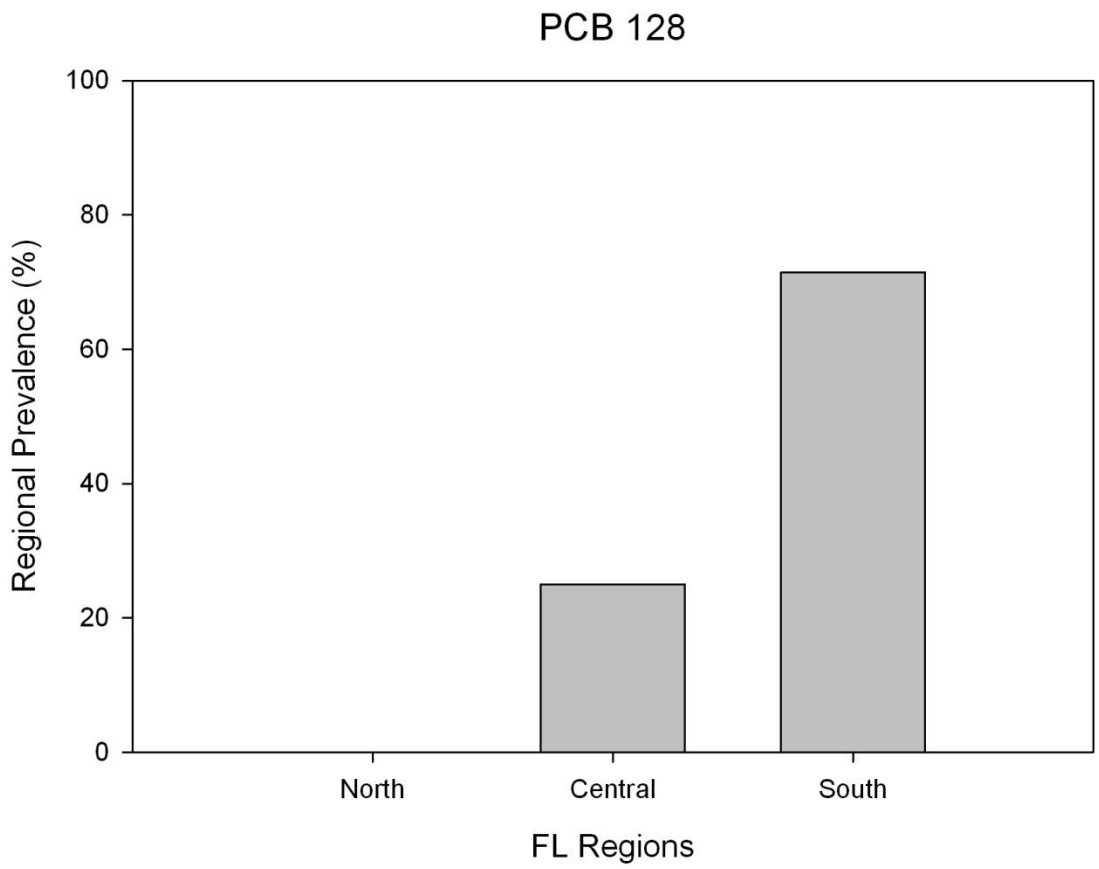


Figure 10. Graph depicting mean concentrations of PCB138 by region in abdominal fat collected from pumas in Florida 1989-2009.

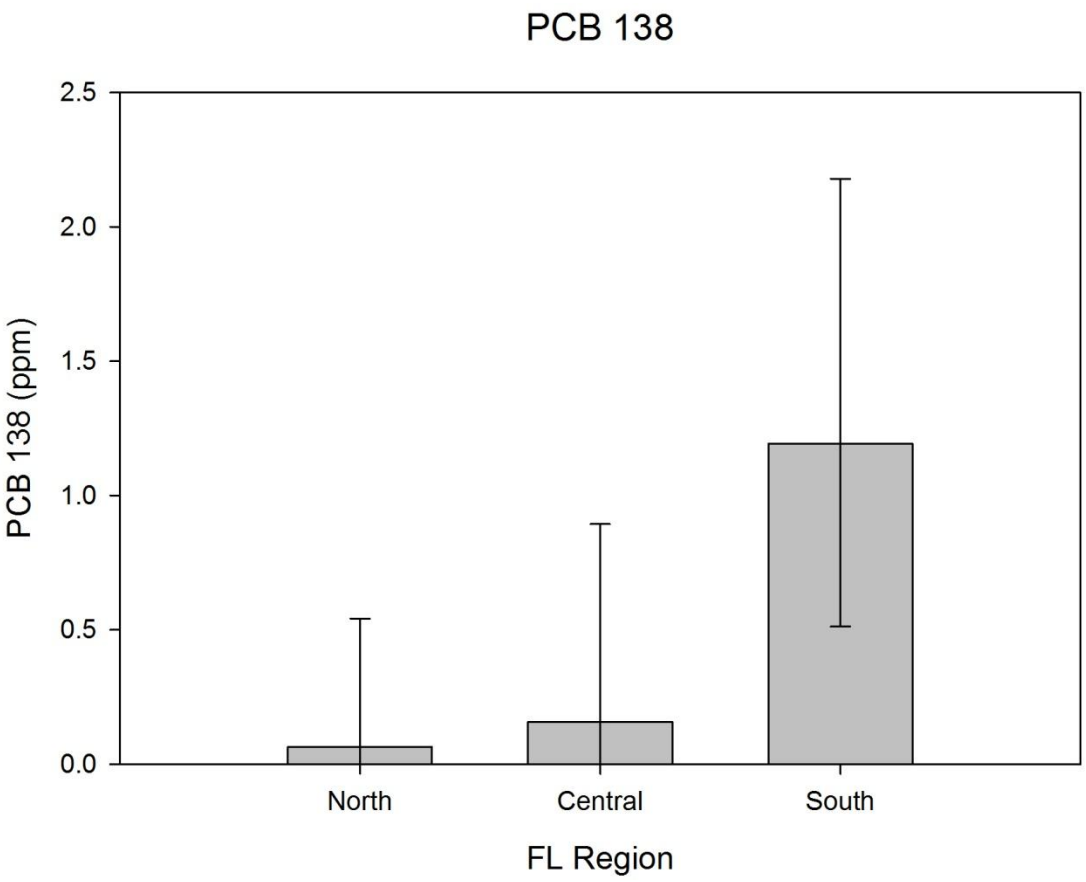


Figure 11. Graph depicting mean concentrations of PCB153 by region in abdominal fat collected from pumas in Florida 1989-2009.

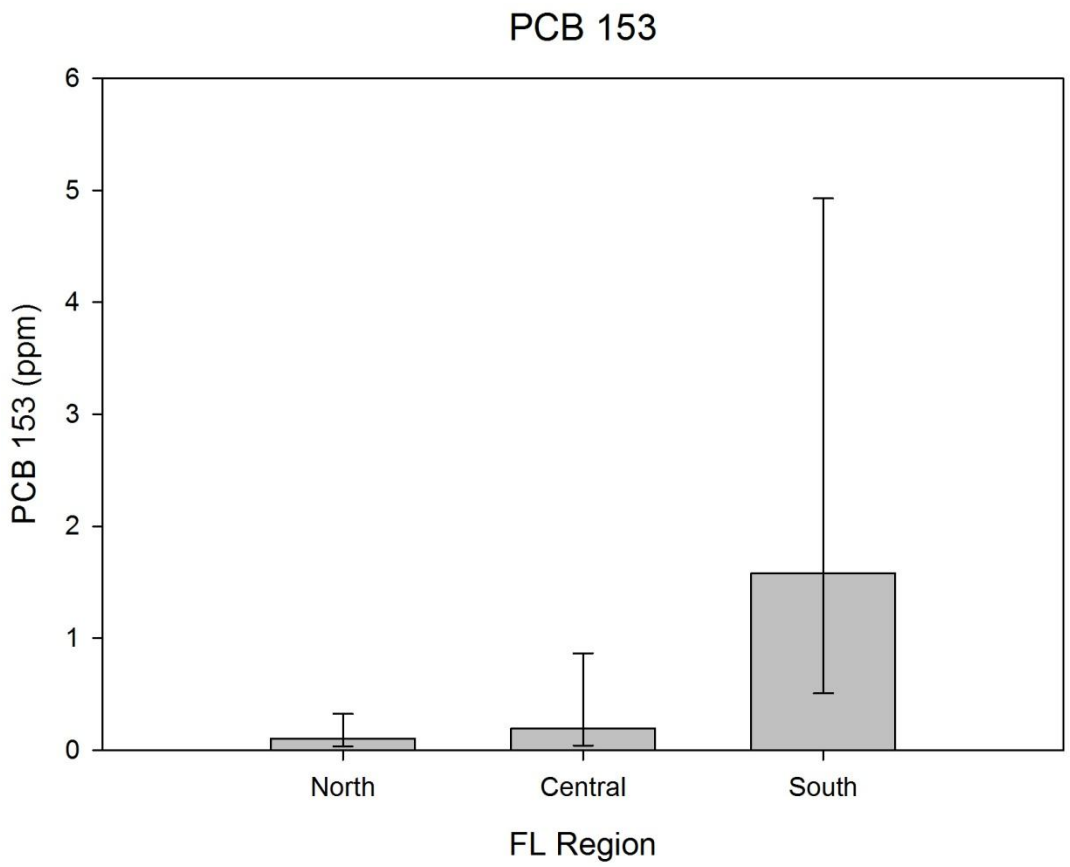


Figure 12. Graph depicting mean concentrations of PCB170 by region in abdominal fat collected from pumas in Florida 1989-2009.

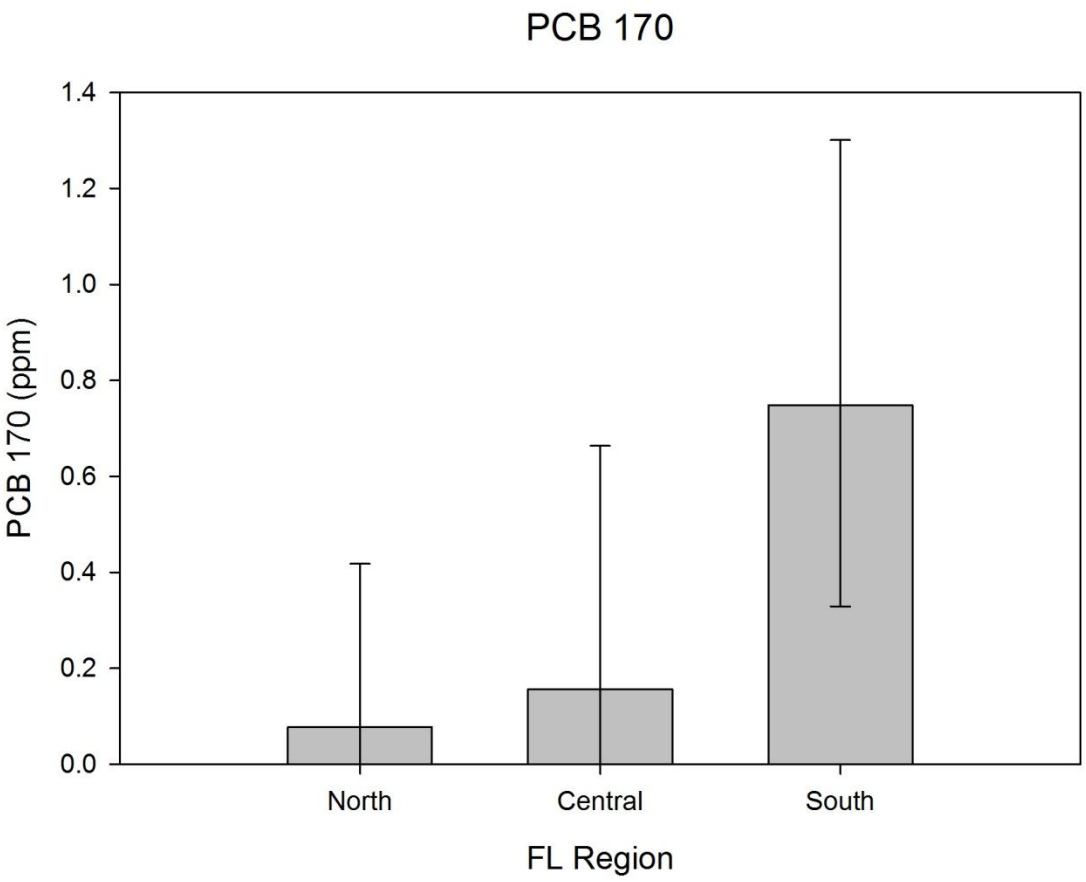


Figure 13. Graph depicting mean concentrations of PCB180 by region in abdominal fat collected from pumas in Florida 1989-2009.

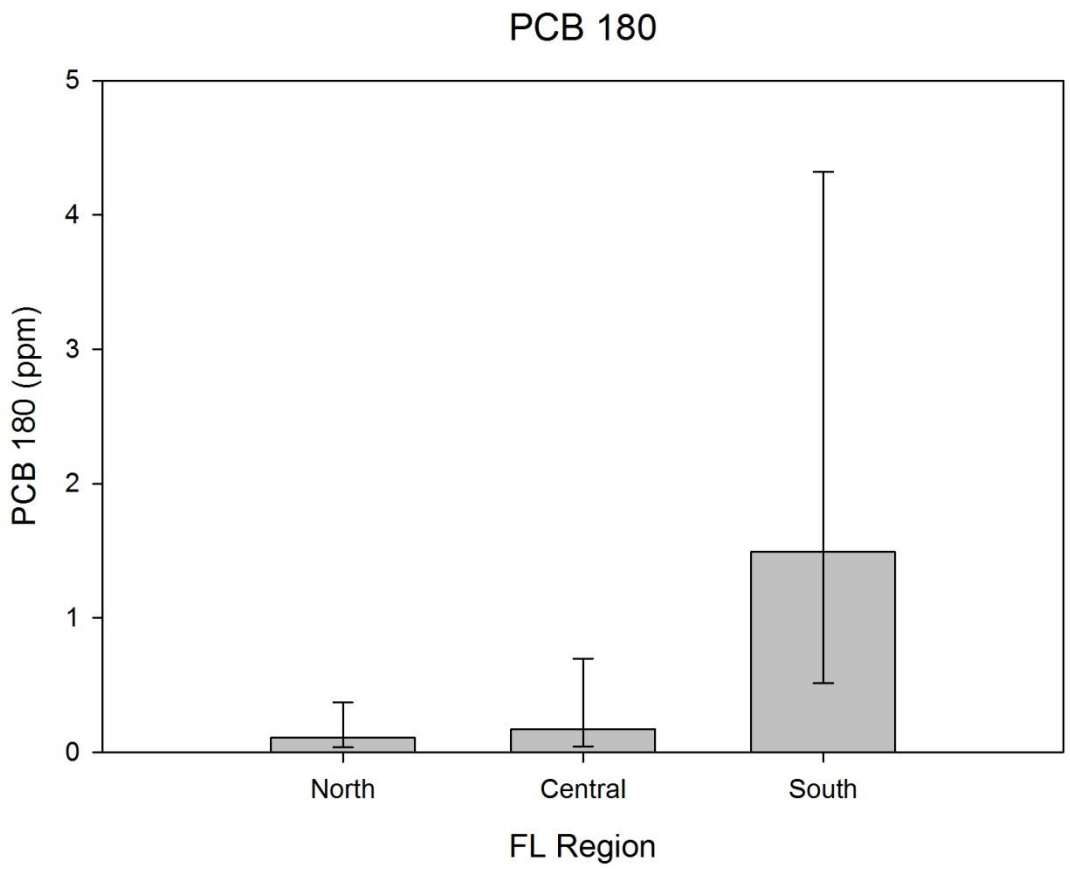
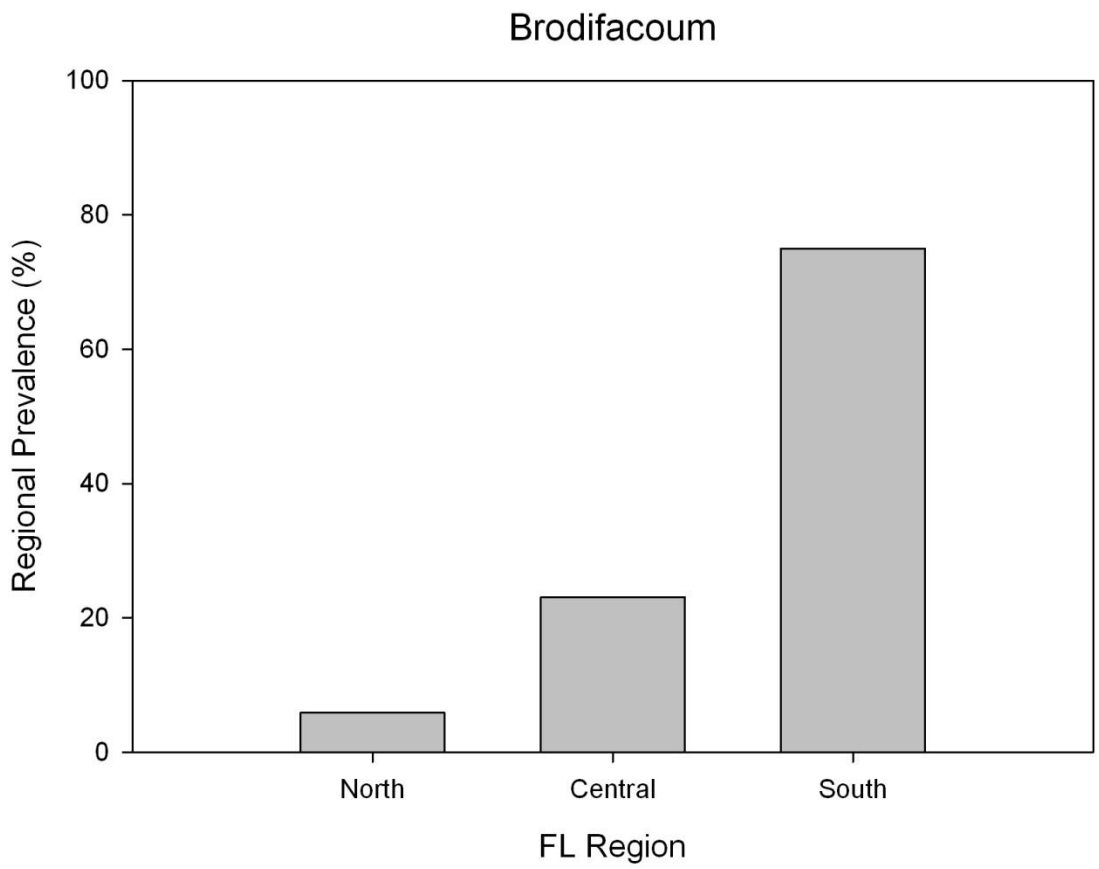


Figure 14. Graph depicting percentage of samples collected from pumas in Florida 1989-2009 with detectable brodifacoum concentrations in liver by region.



SPECIES	COUNT
OPOS - Virginia Opossum	40
RSHA - Red-shouldered Hawk	31
EVBA - Evening Bat	6
EACO - Eastern Cottontail	4
GRSQ - Eastern Gray Squirrel	3
MODU - Mottled Duck	2
BAEA - Bald Eagle	1
BLSK - Black Skimmer	1
BLVU - Black Vulture	1
BWHA - Broad-winged Hawk	1
CAWR - Carolina Wren	1
COHA - Cooper's Hawk	1
GBHE - Great Blue Heron	1
GHOW - Great Horned Owl	1
GREG - Great Egret	1
HEGU - Herring Gull	1
RTHA - Red-tailed Hawk	1
TUVU - Turkey Vulture	1
WTDE - White-tailed Deer	1

From:	Cassler, Constance
To:	Christian Spilker; Johnson, Bruce; Tom Jones; Mitch Hutchcraft; Turner, Andrew; Clements, E. Carter Chandler
Cc:	Hinzman, Roxanna; Williams, Larry O; Tawes, Robert; Ziewitz, Jerry; Kelso, Charles; Dell, David; Mcdonald, Kenneth
Subject:	Description of traffic analysis from draft BO
Date:	Friday, May 10, 2019 1:04:01 PM
Attachments:	2019-04-11 ECMSHCP BO_Traffic section.pdf

Hi,

I'm attaching the description of the traffic analysis from the draft BO that Jerry mentioned in our call this morning.

Connie

Constance L. Cassler, Ph.D.
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NOTE: All email correspondence and attachments received from or sent to me are subject to the Freedom of Information Act (FOIA) and may be disclosed to third parties

1.1. Projected Traffic

Continuing human population growth in southwest Florida drives a demand for new residential and commercial development. The location and density of development, such as the proposed development under the HCP, directly influences the distribution and volume of traffic on existing public roads, as well as the construction of additional lanes to existing roads and entirely new transportation corridors. The distribution and volume of traffic in the Action Area is relevant to this BO/CO, because roadkill is a leading cause of Florida panther mortality, and affects other Covered Species as well.

In our draft Environmental Impact Statement (EIS) for the HCP, we predicted changes in traffic volume on existing roads within a defined Transportation Analysis Area (TAA) (USFWS 2018). The 1,400 miles^2 of the TAA included the 249 miles^2 of the HCP Plan Area, but not the entire 4,320 miles^2 we define as the Action Area (a 25-mile radius around the Plan Area) for this BO/CO. For the final EIS and this BO/CO, we have supplemented the transportation forecasts of the draft EIS with traffic predictions for additional roads that have a history of panther fatalities in the larger Action Area (USFWS 2019). Figure 3-1 shows the existing roads included in our projected traffic analyses.

The transportation analyses of the EIS relied upon the Florida Department of Transportation (FDOT) District 1 Regional Planning Model (D1RPM). D1RPM is a tool for simulating the distribution and volume of traffic on the road network of the 12 southwest Florida counties included within FDOT District 1. The current version of D1RPM uses socioeconomic data (population and employment) for the base year of 2010 to predict the observed traffic count data for 2010. Model users predict future traffic patterns by altering the base-year socioeconomic data for up to 5,628 traffic analysis zones (TAZ) delineated in D1RPM. D1RPM is a "trip-based" model designed to predict spatial and temporal (e.g., peak hours) variability in traffic patterns resulting from a spatially explicit distribution of population and employment. We are using output from D1RPM expressed as average annual daily traffic (AADT).

FDOT (20??) compiled a set of socioeconomic data to represent expected population/employment growth in all of the D1RPM TAZ for the year 2040. For the EIS, we applied a linear growth projection to extend these 2040 projections to the year 2060, using specific socioeconomic projections for TAZ that are within the Plan Area based on the proposed HCP. These projections anticipated development at a density comparable to that in Ave Maria on 39,973 acres of the Plan Area. We estimated that the proposed HCP alternative would support about 72,200 residential/commercial units and 21,300 jobs in year 2060. Using these inputs, we used D1RPM to predict AADT on the road segments shown in Figure 3-1. We obtained AADT data for the year 2017 for the roadways within the TAA that FDOT monitors to represent traffic levels in the baseline of relevant species-specific analyses (see the Final EIS, Appendix F).

Our analyses of baseline and predicted traffic divide the roads shown in Figure 3-1 into 62 discrete segments. Table 3-1 reports the 2017 AADT data from FDOT and the 2060 AADT estimates from D1PRM for each of these segments. Data for 2017 traffic levels in one segment, "Everglades Blvd N to Desoto Blvd N" within the "Golden Gate Blvd" corridor, were not available. The D1PRM estimates represent the traffic generated by regional population growth

and development expected for the year 2060, which includes the HCP proposed development in the Plan Area. We report the estimated 2060 traffic levels in three columns of Table 3-1: "AADT due to Proposed HCP;" "AADT due to Other Sources;" and "Total AADT." The right-most column in Table 3-1 lists the percentage of the 2060 Total AADT that is due to trips originating or ending in the HCP Development areas.

The busiest road segments predicted for 2060 were generally the busiest segments in 2017. Of the 10 highest volume segments in 2017, 8 are in the top 10 for 2060. Our application of D1RPM estimates that the 62 segments would experience an average 3.4-fold increase in AADT (i.e., the ratio of segment "2060 Total AADT" to segment "2017 AADT"). The residents and jobs associated with the HCP developments account for an average of 29 percent of 2060 Total AADT, with a range of 0–98 percent among all segments. The HCP developments would contribute to more than 50 percent of 2060 AADT on 18 segments, and less than 50 percent on 44 segments. Because D1RPM predicts traffic based on spatially explicit socioeconomic data, the developments associated with the proposed HCP would contribute a greater percentage of the total traffic volume on road segments that are within and adjacent to the Plan Area than on more distant road segments. Figure 3-2 depicts the road network within and adjacent to the Plan Area with a color scheme that indicates the expected percentage of 2060 Total AADT that we predict is due to residences and jobs located within the HCP developments.

For a more detailed description of the data and methods applied in the transportation analyses that provided the inputs to Table 3-1 and Figures 3-1 and 3-2, please refer to the following sections of the final EIS (USFWS 2019):

- 3.8 AFFECTED ENVIRONMENT: Transportation
- 4.8 ENVIRONMENTAL CONSEQUENCES: Transportation
- APPENDIX F: Existing and Planned Roadway Network Present within the TAA

From:	Cassler, Constance
To:	Christian Spilker; Tom Jones; Mitch Hutchcraft; Turner, Andrew; Clements, E. Carter Chandler; Tawes, Robert; Ziewitz, Jerry; Dell, David; Hinzman, Roxanna; Williams, Larry O; Mcdonald, Kenneth; Kelso, Charles; Romito, Angela M
Subject:	Discussion about how Collier County views impact fees for traffic
Date:	Friday, May 10, 2019 3:39:01 PM

Hi Everyone,

After our ECMSHCP update call this morning, I was talking to Ken about how Collier County views impact fees. He reminded me he met with Collier County before he was deployed. His understanding from his conversation was that the County assumes if the Service needed a crossing to offset effects of a project, then the Service would have asked the applicant for that during a consultation. Therefore, they do not plan to use impact fees they collect for underpasses, but instead use them for other aspects of infrastructure.

This does not prevent us from discussing with the County how money could go from the Marinelli Fund to the County in the future and be set aside for the sole purpose of a crossing.

I hope this clarifies some of our earlier discussion.

Connie

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UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

Potential Risks of Nine Rodenticides to Birds and Nontarget Mammals: a Comparative Approach

July 2004

Office of Pesticides Programs
Environmental Fate and Effects Division

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Executive Summary

This document presents the Agency's assessment of potential risks to birds and nontarget mammals from 9 rodenticides, including 3 second-generation anticoagulants (brodifacoum, difethialone, bromadiolone), 3 first-generation anticoagulants (diphacinone, chlorophacinone, warfarin), and 3 non-anticoagulant compounds (zinc phosphide, bromethalin, cholecalciferol). These rodenticides are predominantly used to control commensal rats and mice in and around buildings, transport vehicles, and in sewers. Some, mainly zinc phosphide, chlorophacinone, and diphacinone, also have products registered for other outdoor uses against other rodent and small mammalian pests. A major concern in using rodenticides is that they are not selective to the target species; birds and nontarget mammals that feed on grain-based baits (pellets, meal, treated grains, wax blocks) or meat-based, vegetable, or fruit baits are potentially at risk. The available information from laboratory and pen studies, field studies, control programs, reported incidents, and toxicokinetics also indicates that a variety of avian and mammalian predators and scavengers are potentially at risk from consuming animals poisoned with some of these rodenticides.

The assessment focuses on the potential primary and secondary risks to birds and nontarget mammals posed by applications of these 9 rodenticides (11 baits) to control rats and mice in and around buildings (commensal use) and in field and other outdoor settings to control various rodent and other small mammalian pests. Risk is a function of exposure and hazard (toxicity), and data are available to estimate toxicity based on laboratory acute and secondary-hazard tests. However, typical use information used to estimate nontarget organism exposure, such as amount of active ingredient or formulated product applied per unit area, is not available for commensal uses. Thus, exposure estimates are largely based on the amount of active ingredient available per kilogram of the formulated bait (mg ai/kg bait). An assumption is made in most OPP/EFED risk assessments that birds and nontarget mammals are likely to be exposed to the pesticide via consumption of contaminated foods. This assumption is well established for rodenticides, for which ingestion of the formulated bait is the route of exposure.

Refining the exposure assessment to establish a quantitative measure of likelihood of exposure and effects would require a much more extensive data set than registrants have submitted for their rodenticides and for the nontarget species potentially at risk. The Agency provided the preliminary risk assessment to rodenticide registrants in October, 2001 and posted it in the EDocket on EPA's website for public comments from January 29 to May 30, 2003. No additional data or relevant information to refine the exposure assessment has been provided by the registrants or other stakeholders. Nevertheless, the existence of substantial incident data along with liver-residue analysis confirms that birds and nontarget mammals are being exposed and adversely affected by applications of rodenticide baits. The fact that numerous species of birds and mammals, including predators and scavengers, have been found exposed to these baits indicates that both primary and secondary exposures are occurring.

The risk conclusions are based both on the lines of evidence of the available data and comparative analysis modeling. Each rodenticide is ranked or categorized and compared to the other rodenticides according to the following criteria: (1) overall potential risk; (2) potential

primary risk to birds; (3) potential primary risk to nontarget mammals; (4) potential secondary risk to avian predators and scavengers; and (5) potential secondary risk to mammalian predators and scavengers. Conclusions are presented below.

- Brodifacoum and difethialone stand out as the two rodenticides posing the greatest potential overall risk to birds and nontarget mammals, followed by bromadiolone and diphacinone. Zinc phosphide also ranked high for overall risk based on the comparative analysis modeling, primarily because of high potential primary risks.

- Brodifacoum, difethialone, and zinc phosphide pose the greatest potential primary risks to birds that eat bait. A single zinc phosphide or brodifacoum bait pellet provides more than an LD50 dose for a small bird. In contrast, a small bird would need to eat more than twice its body weight in bait pellets to ingest a comparable dose of a first-generation anticoagulant in a single feeding.

- Rodenticide baits are formulated to be lethal to small mammals, and they are not selective to the target species. All baits pose a high potential primary risk to nontarget mammals that eat bait. However, the first-generation anticoagulants likely pose less risk to mammals that only occasionally feed on 1 or just a few bait pellets, because they are more rapidly metabolized and generally must be eaten for several days to provide a lethal dose.

- Brodifacoum and difethialone pose the greatest potential risks to avian predators and scavengers that feed on target or nontarget animals poisoned with bait. The available data indicate that the first-generation anticoagulants are less hazardous than the more highly toxic and persistent second-generation anticoagulants.

- Mammalian predators and scavengers are at risk from feeding on animals poisoned with anticoagulant baits. Although the non-anticoagulant rodenticides appear to be much less hazardous to secondary consumers, confirmatory data are still needed to make this assumption for bromethalin and cholecalciferol baits.

- The available toxicokinetic data indicate that the second-generation anticoagulants are considerably more persistent in animal tissues than are the first-generation anticoagulants, and bioaccumulation may increase whole-body residues with repeat feedings.

- More than 300 documented wildlife incidents attest to exposure of birds and nontarget mammals, including endangered species, to some rodenticides, especially brodifacoum (244 incidents). Brodifacoum residue has been detected in liver tissue of 27 of 32 endangered kit foxes screened for rodenticide residues from 1999 to 2003. Birds in which rodenticides are most frequently detected include owls, hawks, eagles, and crows; mammals include wild canids and felids, tree squirrels, raccoons, deer, and others.

- The U. S. Fish and Wildlife Service issued a Biological Opinion in 1993 that includes reasonable and prudent alternatives and measures for protection of 29 mammalian and 11 avian threatened or endangered species potentially at risk from exposure to 8 of these rodenticides. These issues will be addressed by OPP's Endangered Species Protection Program.

- Adverse effects of possible sublethal exposure are unknown, and avian and mammalian reproduction studies are needed to establish a no-observable-adverse-effects concentration (i.e., "toxicity threshold") for each rodenticide.

A number of factors contribute uncertainty to the assessment. Those that appear to contribute the most uncertainty are: (1) missing data, including acute, chronic, and secondary toxicity as well as retention of some active ingredients in the liver, blood, and other body tissues; (2) the variable quality and quantity of existing data on metabolism and retention times in rodents and nontarget species; (3) specific use information by formulation, including typical amounts applied by use site, seasonally, and annually; distances applied from buildings; amounts used in rural versus urban areas; use by Certified Applicators versus homeowners and other non-certified applicators; and other such relevant information; (4) information on the number and species of birds and nontarget mammals frequenting baited areas and their likelihood of their finding and consuming bait or poisoned primary consumers in the various use areas; (5) methods to determine liver concentration(s) and total body burdens of rodenticide that would corroborate death or even if such a cause-effect relationship is appropriate (e.g., the "threshold of toxicity" concentration); (6) not accounting for the impacts of sublethal effects on reproduction and nontarget mortality (e.g., clotting abnormalities, hemorrhaging, stress factors including environmental stressors, such as adverse weather conditions, food shortages, and predation); (7) not accounting for bioaccumulation of repeated sublethal exposures to bait or poisoned rodents utilized as food by predators and scavengers; and (8) lack of incident reporting.

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Potential Risks of Nine Rodenticides to Birds and Nontarget Mammals: a Comparative Approach

Presented here is the Agency's assessment of rodenticide risks to birds and nontarget mammals. The 9 rodenticides include those addressed in the Reregistration Eligibility Decisions (REDs) for the Rodenticide Cluster (brodifacoum, bromadiolone, chlorophacinone, diphacinone, bromethalin; EPA 1998a), Zinc Phosphide (EPA 1998b), and Warfarin and its Sodium Salt (EPA 1991a). Difethialone and cholecalciferol, which are not subject to the current reregistration process but are alternative compounds for rat and mouse control, also are included. All 9 rodenticides are available to the public "over the counter" as grain-based food baits for control of commensal rats and mice, predominantly the Norway rat (*Rattus norvegicus*), roof rat (*R. rattus*), and house mouse (*Mus musculus*), in and around buildings, transport vehicles, and inside sewers. Some products, mostly "restricted-use" (i.e., available only to Certified Applicators) products containing zinc phosphide, chlorophacinone, or diphacinone, also are available for control of various rodent and other small mammal pests in field and other outdoor settings.

The purpose of this assessment is to evaluate potential primary and secondary risks of each rodenticide and to compare and rank them among compounds. The Agency's concern about risks to birds and nontarget mammals is based on several factors, including (1) the high acute toxicity of these rodenticide baits, which are designed to be lethal to small mammals; (2) risk estimates, based on available exposure and toxicity data, that exceed Agency levels of concern (LOCs); (3) mortality of birds and nontarget mammals exposed to rodenticide baits or poisoned prey in laboratory, pen, and field settings; (4) retention time of residues in body tissues of primary consumers, and (5) numerous reported incidents that indicate exposure of numerous nontarget species, including avian and mammalian predators and scavengers. Rodenticide baits are formulated to be lethal to rodents and a few other small mammals, and they are not selective to target species. Many factors influence which nontarget animals might be exposed to baits, but many birds and mammals are attracted to seeds and grains and are likely to consume grain-based baits. A few commensal baits also contain flavorizers such as fish, molasses/peanut butter, or apple, and some field baits are formulated with foods other than grains (ground meat, canned or dry meat-based pet foods, fruits, vegetables) that might appeal to carnivores and omnivores. Rodenticide baits also pose potential secondary risks, because predators and scavengers are likely to be attracted to dead or dying rats, mice, and poisoned nontarget animals.

Risk is a function of exposure and hazard (toxicity). Data are available to estimate toxicity based on laboratory acute-toxicity and secondary-hazard tests. Use information, such as amount of active ingredient or formulated product applied per unit area per application, is typically used to estimate nontarget organism exposure but is not available for most rodenticide uses. Therefore, exposure estimates are largely based on the amount of active ingredient available per kilogram of grain-bait formulation (mg ai/kg bait, or ppm ai). See the "*Exposure*" section under

"*Use and Exposure Considerations*" for additional discussion of the differences in estimating expected environmental concentrations (EECs) for rodenticide food baits versus other types of pesticide applications (e.g., foliar sprays).

Risk conclusions are presented in tabular and graphical form based on two analyses of the available data. One analysis is a ranking of potential risks of each rodenticide based on a comparative analysis model. That methodology is explained in more detail in the "*Comparative analysis model*" section of the assessment and in Appendix C. The other analysis uses a lines-of-evidence approach in which the available quantitative and qualitative information is evaluated and each rodenticide assigned a rating of high, moderate, or low for primary risk to birds, primary risk to mammals, secondary risk to birds (avian predators and scavengers), and secondary risk to mammals (mammalian predators and scavengers). For primary risks, the amount of bait and number of bait pellets that need to be eaten to provide an LD50 dose (i.e., dose expected to be lethal to 50% of the individuals in a population) are calculated for 3 size classes (25 g, 100 g, 1000 g) of birds and mammals. Dietary risk quotients that compare the amount of toxicant (ppm ai) in a bait to the dietary toxicity (LC50) of the rodenticide also are used as a comparative index of primary risk. For secondary risks, these methods cannot be used, because LD50 and LC50 data are not available for predatory species of birds and mammals. Consequently, assessments of secondary risk are made based on mortality and other adverse effects reported in laboratory and field studies and operational control programs, incident reports, toxicokinetic data, and residues reported in primary consumers. This approach is in accord with EPA's risk-assessment guidelines (EPA 1998c), which assert that professional judgement or other qualitative evaluation techniques are appropriate for ranking risks into categories such as low, medium, and high when exposure and effects data are limited or are not easily expressed in quantitative terms. A lines-of-evidence approach for improving field-study interpretation also has been advocated by the Avian Effects Dialogue Group (Rymph 1994).

The information used in this assessment was obtained from studies submitted to the Agency in support of registration/reregistration, from published literature and personal communications, and from the Agency's Ecological Incident Information System (EIIS). For some rodenticides, few data are available other than acute oral (LD50) and dietary toxicity (LC50) values for the Agency's required test species: northern bobwhite (*Colinus virginianus*), mallard (*Anas platyrhynchos*), and laboratory rat (*R. norvegicus*). The quality and quantity of data available on metabolism and retention times in rodents and secondary toxicity to nontarget birds and mammals vary among the rodenticides, but the available data are sufficient to identify the most persistent and hazardous compounds.

Modes of action

The anticoagulant rodenticides are vitamin-K antagonists that disrupt normal blood-clotting mechanisms and induce capillary damage (Pelfrene 1991). Death results from hemorrhage, and exposed animals may exhibit increasing weakness prior to death. Behavior also may be affected (Cox and Smith 1992). The anticoagulants are typically grouped into "first-generation" (warfarin, chlorophacinone, diphacinone) and "second-generation" (brodifacoum, bromadiolone,

difethialone) compounds. Second-generation anticoagulants tend to be more acutely toxic than are the first-generation anticoagulants, and they are retained much longer in body tissues of primary consumers. They generally provide a lethal dose after a single feeding, although death is usually delayed 5 to 10 days and animals continue feeding. In contrast, the first-generation compounds, because they are less acutely toxic and more rapidly metabolized and/or excreted, generally must be ingested for several days to provide a dose lethal to most individuals. Diphacinone and chlorophacinone may kill some animals in a single feeding, but multiple feedings are generally needed for sufficient population control (Timm 1994). The structural relationships of these rodenticides and some of their physical/chemical properties are presented in Attachment A.

The non-anticoagulant rodenticides belong to 3 chemical classes that differ from one another and the anticoagulants in their mode of action. They can provide a lethal dose from a single feeding but are much less likely than the anticoagulants to be retained in toxicologically significant amounts in body tissues of primary consumers. Bromethalin, a diphenylamine, is a neurotoxicant that causes respiratory arrest from inadequate nerve impulse transmission after fluid build-up and demyelination inside the central nervous system (Spaulding and Spannring 1988, Hyngstrom et al. 1994). Further feeding is inhibited after ingestion of a lethal dose, and death typically occurs within 2 days. Zinc phosphide is an inorganic compound whose toxicity results from liberation of phosphine gas from reaction of the active ingredient with water and acid in the stomach (Hyngstrom et al. 1994). Death can occur within a few hours of ingestion. Cholecalciferol is a sterol (vitamin D_3). Its ingestion results in hypercalcemia from mobilization of calcium from bone matrix into blood plasma (Pelfrene 1991). Death can occur 3 to 4 days after a single feeding.

Terms and definitions

Dietary toxicity test: To support registration of a pesticide, the Agency's Office of Pesticides Program (OPP), Environmental Fate and Effects Division (EFED), requires 2 avian dietary (LC50) studies: one using northern bobwhite chicks as test animals and the other using mallard ducklings (40 CFR §158.490 Wildlife and Aquatic Organisms Data Requirements, Guideline Reference No. 71-2). The dietary test consists of a 5-day exposure period during which toxicant is added to the birds' diet at 5 concentrations using 10 test animals (5 males, 5 females) per concentration. The exposure period is followed by a 3-day observation period; however, because death is delayed for several days after exposure to an anticoagulant, the post-treatment observation period has been extended 15 days or more for those compounds. The test material is the technical grade of the active ingredient.

Dietary toxicity testing is not usually conducted for mammals, although the Agency may require a wild-mammal toxicity test (40 CFR §158.490 Wildlife and Aquatic Organisms Data Requirements, Guideline Reference No. 71-3) if deemed necessary. Because rodenticides are formulated to be lethal to mammals and the Agency requires efficacy testing for all rodenticide end-use products (40 CFR §158.640 Product Performance Data Requirements, Guideline Reference No. 96-10 and 96-12), EFED has not required a wild-mammal toxicity test for any of

the rodenticides. However, EFED has found reports for laboratory-rat dietary tests for 5 rodenticides tested by the Agency's former Toxicology Unit, Chemical and Biological Investigations Branch. During 1980 and 1981, McCann et al (1981) developed a short-term dietary LC50 test for small mammals. They exposed 5-male and 5-female immature albino Norway rats (Wistar strain) per test concentration to dry diet offered *ad libitum* and treated with one of 17 chemicals pesticides, mostly organophosphate and carbamate pesticides. The tests consisted of a 5-day acclimation period, a 5-day exposure period, and a post-treatment observation period lasting at least 9 days. Following submission of the paper for publication, testing continued and included 5 rodenticides: brodifacoum, bromadialone, chlorphacinone, diphacinone, and warfarin. Results of these tests were not published but the test reports are available, and multiple studies exist for each of those 5 rodenticides.

LC50: Median lethal concentration. A statistically estimated dietary concentration expected to be lethal to 50% of the test animals. The LC50 is expressed in ppm. The 95% confidence intervals are reported when available.

Acute oral toxicity test: For individual pesticides, EFED requires one acute oral (LD50) test for birds, using either the northern bobwhite or the mallard as the test species (40 CFR §158.490 Wildlife and Aquatic Organisms Data Requirements, Guideline Reference No. 71-1). Data are available for both species for some rodenticides. The toxicant is orally administered via capsule or gavage in a single dose to adult animals. The test required by the Agency includes 5 concentrations, with 10 test animals (5 males, 5 females) per concentration. Unless otherwise noted, the test material is the technical grade of the active ingredient. OPP's Health Effects Division (HED) also requires acute oral testing with the laboratory rat (40 CFR §158.340 Toxicology Data Requirements, Guideline Reference No. 81-1) and sometimes has data for other mammals (e.g., laboratory mouse, dog). EFED uses these data in the mammalian risk assessment.

LD50: Median lethal dose. A statistically estimated oral dose expected to be lethal to 50% of the test animals. The LD50 is expressed in mg of active ingredient per kg of body weight of animal. The 95% confidence intervals are reported when available.

> ***Note:*** Some LD50 values for birds and mammals were obtained from the literature. These are considered supplemental data, because the test concentrations, number of animals tested, and confidence intervals often are not reported or may not meet Agency test guideline requirements. Calculations of risk quotients and estimates of ingestion of active ingredient from bait consumption utilize the toxicity data reviewed and accepted by the Agency.

Primary Risk: Risk to target or nontarget organisms that consume bait.

Secondary Risk: Risk to predatory or scavenging birds or mammals that feed on target or nontarget animals that ate bait.

Dietary Risk Quotient (RQ): An index of exposure to dietary toxicity (LC50), where exposure is expressed as the amount of rodenticide in food (ppm ai in bait for primary exposure or in target species for secondary exposure). Risk presumptions are based on whether or not RQs exceed OPP's Levels of Concern. RQs do not quantify risk, but they are useful for comparing risks among alternative compounds (ECOFRAM 1999).

Level of Concern (LOC): A presumption of risk is made if an RQ equals or exceeds the Agency's LOCs: 0.5 for acute risk to non-endangered species and 0.1 for acute risk to endangered species. Additionally, an RQ that equals or exceeds 0.2 triggers consideration of "restricted-use" classification to mitigate acute risk.

***A note on scientific names*:** The scientific name of a species is provided after the first mention of its common name in the text. A complete list of common and scientific names of the birds and mammals referred to in the document is included in Attachment B.

Comparative analysis model

A comparative analysis model also is used to rank and compare potential primary and secondary risks. The underlying methodology is a simple multi-attribute rating technique, or SMART (Goodwin and Wright 1998). SMART is adapted for comparing potential risks among rodenticides based on a number of measure-of-effect values for primary and secondary risk to birds and mammals. Each type of risk is quantitatively evaluated by the following measures of effect:

Primary risk to birds:	dietary RQ (mean value if more than one dietary RQ available); inverse of the number of bait pellets needed for a 100-g bird to ingest an LD50 dose in a single feeding
Primary risk to mammals:	inverse of the number of bait pellets needed for a 100-g mammal to ingest an LD50 dose in a single feeding
Secondary risk to birds:	mean % mortality from secondary toxicity studies; retention time (days) of active ingredient in the blood; retention time (days) of active ingredient in the liver
Secondary risk to mammals:	mean % mortality from secondary toxicity studies; retention time (days) of active ingredient in the blood; retention time (days) of active ingredient in the liver

Retention time is not a direct measure of effect for secondary risk to birds and mammals, but it is an important contributing factor. The combination of mean % mortality from secondary laboratory toxicity studies, which characterizes the secondary toxicity from short-term exposures, and available data on retention time in both blood and liver, which indicates how long

toxic levels can persist in target animal tissues, can characterize the secondary risk to birds and mammals.

When faced with a number of alternatives and a number of types of risk with measures of effect, SMART prescribes the following: (1) each alternative rodenticide is rated on each measure of effect; (2) each measure of effect is assigned a measure of importance to the risk assessor; and (3) a summary score for each alternative rodenticide is calculated as a weighted average of the ratings, where the weights represent the relative importance of the measure of effect for each type of risk. The higher the resultant summary score, the higher the potential risk for that rodenticide.

The following basic equation is used to calculate the summary values for the risk comparison:

$$\text{Summary Value}_{(\text{scale from 0 to 10})} = \sum f(ME_i)(ME_{max})^{-1} \times f(\text{Weight}) \left(\sum \text{Weights}\right)^{-1} \times (10)$$

where "ME_i" is the measure of effect value for a rodenticide and "ME_{max}" is the maximum ME for all rodenticides; "Weight" is the importance value, from 10 to 0, placed on each measure of effect, with high = 10 to 6.67, medium = 6.68 to 3.33, and low = 3.34 to 0; "$\sum$Weights" is the sum of all the weights for all the measures of effect. All measures of effect, except two, are assigned a "high" (10 out of 10) measure of importance for the rodenticide analysis. The half-life in blood and liver are each given a weight of "low" (2.5 out of 10) for analyzing secondary risks to birds and mammals, so that the overall importance of the persistence data (2.5 x 4=10) equals but does not exceed that of the mortality data.

A sensitivity analysis also is performed to evaluate how changes in each measure-of-effect value could affect the overall summary risk results. Each measure-of-effect value is separately decreased and increased by 50% (154 variations). To further examine the robustness of the rankings, selected high and low summary risk values are subsequently changed by up to $\pm$99%. Further details of the SMART analysis, including the input values for measures of effects, are presented in Attachment C.

The methodology used in the comparative analysis model is similar to that used in the Agency's "Comparative Analysis of Acute Risk From Granular Pesticides" (EPA 1992) and "A Comparative Analysis of Ecological Risks from Pesticides and Their Use: Background, Methodology, Case Study" (EPA 1998d); both were reviewed by a FIFRA Scientific Review Panel. Concerning the latter analysis, the Panel noted the many scientific uncertainties in the method, yet agreed that it was a useful screening tool that provides an estimate of relative risk. The Panel made a number of helpful suggestions to improve the utility of the method, most of which are included here. In this analysis, a risk quotient (RQ), calculated as the ratio of toxicant potentially ingested to the inherent toxicity of the rodenticide, is used to compare potential primary risks to birds and nontarget mammals. RQs are compared among rodenticide baits based on the amount of bait and number of bait pellets that birds or nontarget mammals of various sizes would need to eat to ingest an acute oral (LD50) dose. Dietary data (LC50) also are available, and RQs based on bait concentration and avian dietary toxicity are compared

among the rodenticides. As noted by the Ecological Committee on FIFRA Risk Assessment Methods (ECOFRAM 1999), RQs do not quantify risk but are useful for comparisons among alternative compounds. EPA's "Guidelines for Ecological Risk Assessment" (EPA/630/R-95/002F, 1998c) also notes that quotients provide an efficient, inexpensive means of identifying high- or low-risk situations that can allow risk management decisions to be made without the need for further information.

Use and Exposure Considerations

This assessment focuses on the potential primary and secondary risks to birds and nontarget mammals posed by applications of these 9 rodenticides to control rats and mice in and around buildings (commensal uses) and elsewhere outdoors (field uses) to control rodents and certain other mammalian pests. As previously noted, rodenticide products for field use (except those for underground baiting of pocket gophers and moles) are currently registered as "restricted-use" or restricted-use classification is being imposed during reregistration. This classification provides increased protection of birds and nontarget mammals, because baits may only be applied by a Certified Applicator or someone directly supervised by a Certified Applicator. These applicators are trained to closely follow label use directions and restrictions that may help limit exposure, and thus risk, to nontarget organisms. However, even with this increased protection, there remains a potential risk to nontarget organisms from these uses since the rodenticides are lethal to birds and mammals, are not selective, and their grain-based bait formulations may be highly attractive to many nontarget organisms.

Product labels for commensal uses specify that applicators should comply with the following *DIRECTIONS FOR USE*:

> "Apply bait in locations out of reach of children, pets, domestic animals and nontarget wildlife, or in tamper-resistant bait stations. These stations must be resistant to destruction by dogs and by children under 6 years of age, and must be used in a manner that prevents such children from reaching into bait compartments and obtaining bait. If bait can be shaken from stations when they are lifted, units must be secured or otherwise immobilized. Even stronger bait stations are needed in areas open to hoofed livestock, raccoons, bears, or other potentially destructive animals, or in areas prone to vandalism."

To what extent applicators comply with these use directions or even use bait stations is unclear. As noted in Pesticide Regulation (PR) Notice 94-7 (EPA 1994), "Nonprofessional users (i.e., the "general public") often apply baits in open containers or in ready-to-use, non-protective, packaging. Bait stations typically are not offered for sale at the outlets where nonprofessional users buy rodenticides. Attempts to market ready-to-use (bait-filled) protective rodenticide bait stations to the general public have not been reported as commercially successful ventures." Tamper-resistant or stronger bait stations exclude mammals larger than adults of the target species, because the entrance holes to the bait compartment are designed to be no larger than necessary. However, mammals smaller than the target species can enter bait stations and feed on bait and are at risk. Because target species leave bait stations after feeding, bait stations likely

have little if any impact on secondary exposure of predators and scavengers that feed on dead or dying rodents.

The commensal use in and around buildings is common to all 9 rodenticides. However, difethialone and bromadiolone can be applied only inside of buildings and similar manmade structures in non-urban areas. Indoor applications likely reduce primary exposure of nontarget organisms. Nevertheless, rats or mice that eat bait, especially an anticoagulant bait, do not die for several days after ingesting a lethal dose. Because these target species may move outdoors before dying, some predators and scavengers might still be exposed as a result of indoor application.

Field uses involve a variety of bait applications, including broadcasting, spot-baiting, or application of bait in some type of bait station. Depending on the use, broadcasting is done by hand, ground-based mechanical spreader, or by air. Some, but not all, broadcast applications limit the number of treatments that can be made and specify an interval between applications. Some uses also allow spot baiting, in which bait is placed by hand in small pile or scattered across smaller areas (e.g., bare ground around burrow openings) at a treatment site. Bait stations should be covered or enclosed. For some uses an uninterrupted supply of bait is maintained for 1 to 4 weeks, whereas for others no time interval is specified. Bait stations are usually placed on the ground in areas frequented by the target species, such as by burrow openings, runways, or feeding areas. Floating bait stations are used for some target species (e.g., muskrats). In some situations, customized bait stations have been developed to exclude nontarget species that are smaller than individuals of the target species. Elevated and "T" bait stations have been developed to reduce exposure of some nontarget species, such as deer mice (Erickson et al. 1990) and kangaroo rats (California Department of Pesticide Regulations http://www.cdpr.ca.gov/docs/es/espdfs/baitsta1.pdf http://www.cdpr.ca.gov/docs/es/espdfs/baitsta2.pdf).
More research is warranted to devise means of selectively applying baits to protect nontarget species while adequately maintaining efficacy against target species.

For control of pocket gophers and moles in lawns, golf courses, and other noncrop areas, bait is applied in subsurface runways or deeper underground tunnels and is not exposed on the ground surface. Hand baiting is done using a mechanical probe or similar device to locate an underground runway. Bait is inserted through the probe hole, and the hole is then sealed with sod or a stone. In some situations a mechanical burrow-builder is used by a Certified Applicator to construct artificial pocket-gopher burrows into which bait is mechanically inserted at 4- to 5-foot intervals.

Exposure

Exposure is an integral component of ecological risk. Many factors influence which nontarget animals might be exposed to rodenticide baits. They include the species found in and around treatment areas, species' food habits and foraging behavior, home range, propensity to feed in and near human buildings, bait availability (e.g., quantity, how applied, where applied, when applied), and other such factors. However, there is no doubt that many birds and nontarget mammals are attracted to and will consume grain-based foods. Additionally, many nontarget predators and scavengers feed on rats, mice or other target species. They are not likely to avoid feeding on rats, mice, voles, ground squirrels, or other animals that have eaten bait.

EFED's exposure assessment for the rodenticides differs from that for most other pesticides. For foliar-applied pesticides, EECs on potential food items (grasses, seeds, insects) of birds and mammals are extrapolated from field-residue data compiled by Hoerger and Kenaga (1972) as modified by Fletcher et al. (1994). The maximum EEC on avian and mammalian food items is 240 ppm on short grass, 135 ppm on broadleaf plants and insects, and 15 ppm on seeds for every 1.0 lb ai applied per acre. EECs for granular formulations or soil-applied sprays are typically based on the number of LD50s applied per square foot. For each specific crop or use site, EECs depend on the label-specified application rate (lb ai/acre), number of applications, interval between applications, and the application method. However, for a rodenticide, the bait itself is the potential food item of concern. Thus, the amount of active ingredient in the formulated bait is used as the EEC. This information is used to estimate the amount of bait and number of bait pellets that birds and mammals of various sizes need to consume in a single feeding to obtain a dose expected to be lethal to 50% of the individuals in the population (i.e., LD50 dose). Estimates of food-ingestion rates (g dry matter per day) were determined from established allometric equations presented in EPA's Wildlife Exposure Factors Handbook (EPA 1993). The concentrations of active ingredient in the bait pellets are also used to estimate initial dietary exposure (mg ai per kg in bait) used to calculate avian and mammalian dietary risk quotients.

These estimates of acute primary exposure of nontarget organisms are not appropriate for estimates of secondary exposure. Secondary exposure estimates are considerably more complex and require consideration of residues in tissues of target organisms that are commonly consumed by predators and scavengers, as well as knowledge of what residue level will result in mortality or adverse chronic effects. Moreover, it is important to know how long the residue persists in body tissues. A number of laboratory tests using avian and mammalian predators or scavengers are available to assess mortality from secondary exposure resulting from consumption of prey animals that had been exposed to rodenticides. Design and methodology vary among studies, adding unknown variability to the results and analysis. Pending development of standard methods and testing requirements for such studies, these tests provide the best data available. The mean percent (%) mortality for these bird and mammal laboratory tests are used to estimate both secondary exposure and hazard. Because retention time in tissues consumed by scavengers and predators is an important factor in estimating secondary exposure and potential risk, available retention times (half-life in days) of rodenticide in liver and blood are also factored into secondary exposure and risk estimates. A discussion of residue levels in tissues of target species

is included in the assessment. Uncertainties remain in establishing levels indicative of mortality or other adverse effects in nontarget organisms.

In most pesticide assessments the assumption is made that nontarget birds and mammals are likely to be exposed to the pesticide without attempting to establish a quantitative measure of this likelihood. This assumption is used in this assessment for these 9 rodenticides and 11 bait formulations. The existence of substantial incident data along with liver residues corroborates the assumption that nontarget birds and mammals are exposed and adversely affected by the use these rodenticide baits. The fact that numerous species have been found exposed to these rodenticide formulations, including predators and scavengers, indicates that both primary and secondary exposure occurs.

Target species, use sites, and rodenticide usage

Control of commensal rats and mice is the predominant use of most of the rodenticides. Most products for rat and mouse control are formulated as grain-based pellets or, for sewer use, as paraffinized food blocks. Several rodenticides also are registered for field and other outdoor uses (Table 1). Zinc phosphide is used to control ground squirrels (*Spermophilus* spp.), prairie dogs (*Cynomys* spp.), pocket gophers (Geomyidae), and moles (Talpidae) in addition to commensal rats and mice. Most are pellets or grain baits, but meat (ground meat, canned dog or cat food, dry meat-based pet food), sunflower seed, and fruit or vegetable (carrots, sweet potatoes, dandelions, alfalfa, beet tops, cabbage, potatoes, grapes, mulberry, apricots, figs, nuts, apples, pears) baits also are used against some target species. Nine states also have individual state registrations (FIFRA §24c Special Local Need [SLN]) for using zinc phosphide to control a variety of localized rodent (e.g., voles, tree squirrels, kangaroo and other rats, deer mice, muskrats, nutria) and jackrabbit pests. Brodifacoum and bromethalin are or have been used under emergency exemptions (FIFRA §18) to control introduced rats on U. S. islands in the Pacific Ocean. Twenty-three states have SLNs for chlorophacinone and/or diphacinone, mostly to control meadow voles (*M. pennsylvanicus*) and/or pine voles (*M. pinetorum*) in orchards or ground squirrels in rangeland or other uncultivated areas. Other limited uses include control of mongooses (*Herpestes auropunctatus*) in Hawaii, voles in small-grain crops in Washington, and a variety of other rodent pests and jack rabbits (*Lepus* spp.) in California. New Mexico uses cholecalciferol to control rock squirrels (*Spermophilus variegatus*).

Table 1. Commensal and Field Uses of Rodenticides in the United States (adapted from EPA 1998a,b)

Rodenticide	Date ai registered	Commensal uses	Field and other outdoor uses	mg ai/kg bait (ppm)
Second-generation anticoagulants				
Brodifacoum	1979	Rat and mouse control in and around buildings, transport vehicles, and inside sewers	Restricted-use applications for rat control on some oceanic islands (FIFRA §24c Special Local Needs [SLN] or FIFRA §18 emergency exemption)	50 25 (Anacapa Island, CA)
Difethialone	1995	Rat and mouse control in and around buildings in urban areas; limited to indoor use in non-urban areas	None	25
Bromadiolone	1980	Rat and mouse control in and around buildings, transport vehicles, and inside sewers in urban areas; limited to indoor use in non-urban areas	None	50
First-generation anticoagulants				
Chlorophacinone	1971	Rat and mouse control in and around buildings and inside sewers	Control of pocket gophers and moles in underground burrows; SLNs for control of pine and/or meadow voles in orchards (17 states), ground squirrels in rangeland and around burrows (8 states), jack rabbits (CA, OR), and a variety of other field rodents (e.g., deer mice, woodrats, muskrats) in CA	50 100 (some field uses) other[a]

Rodenticide	Date ai registered	Commensal uses	Field and other outdoor uses	mg ai/kg bait (ppm)
Diphacinone	1960	Rat and mouse control in and around buildings and inside sewers	Control of pocket gophers in underground burrows; SLNs for control of pine and/or meadow voles in orchards (16 states), ground squirrels in rangeland and around burrows (6 states), a variety of other field rodents (e.g., deer mice, woodrats, muskrats) and jack rabbits in CA, various field rodents in several other states, rat control on oceanic islands (HI, AK), and mongoose control (HI)	50 100 (some field uses) other[a,b]
Warfarin	1950	Rat and mouse control in and around buildings	Deer mouse and white-footed mouse control in and around buildings and in bait stations in other areas such as parks and woodlots	250 other[b]
Others (non-anticoagulants)				
Bromethalin	1984	Rat and mouse control in and around buildings, transport vehicles, and inside sewers	Restricted-use application for rat control on an oceanic island (emergency exemption)	100
Zinc phosphide	1940s	Rat and mouse control in and around buildings[a]	For control of a wide variety of field rodents (e.g., ground squirrels, prairie dogs, voles, rats, kangaroo rats, deer mice, moles, pocket gophers) in various sties, including rangeland, uncultivated areas, orchards, turf, forage, sugarcane, and other sites; 9 states also have SLNs for use against various rodents at local use sites	20,000 10,000 (CA only)
Cholecalciferol	1984	Rat and mouse control in and around buildings and inside transport vehicles	SLNs for control of rock squirrels (NM); also roof rats on an oceanic island (CA)	750

[a] chlorophacinone (0.2% ai), diphacinone (0.2% ai), and zinc phosphide (10% ai) tracking powders are registered for indoor use and inside burrows along building foundations; all are restricted-use products

[b] sodium salts of diphacinone and warfarin are registered for use in water baits for indoor use only

Adequate information quantifying usage of rodenticide baits is lacking. EPA obtains data on the amount of each product produced annually, and the Rodenticide Registrants Task Force (RRTF) provided some limited information on the pounds of active ingredient produced or imported in 1996 and 1997 for 4 of the 9 rodenticides (Kaukeinen et al. 2000). However, these data provide no information on when, where, or how the products are used and thus provide little relevant information for assessing exposure and risk. The RRTF data are difficult to interpret, because they lump containers and placement units, even though containers differ, often considerably, from placement units. A placement for commensal rodents is defined on product labels as 3 to 16 oz of bait for rats and 0.25 to 0.5 oz of bait for mice. In contrast, containers can hold anywhere from several to many individual rat or mouse placements. The problem with lumping these units together is illustrated in Table 2. Both brodifacoum and bromadiolone, for example, are formulated as 0.005% ai food baits solely for commensal rat and mouse control. The data for 1996 indicate that 395 lb ai of brodifacoum was formulated into more than 40 million "container/placement units" (i.e., 3 oz bait per container/placement unit), whereas 233 lb ai of bromadiolone was formulated into few more than 275,000 container/placement units (i.e., 271 oz bait per container/placement unit). Such differences also occur for 1997 and for chlorophacinone and diphacinone. Refining the exposure assessment would necessitate much better information for each rodenticide, including the amount of bait applied annually and seasonally; geographically by state or region; in field settings versus in and around buildings; in urban versus suburban and rural locales; indoor versus outdoor placements; applications for rats versus those for mice; use by the general public versus that by Certified Applicators; proportion of bait placements made in tamper-resistant bait stations; and, for chlorophacinone and diphacinone, use of 0.005% versus 0.01% ai baits.

Table 2. Amount of Bait and Number of "Container/Placement Units" For Four Anticoagulant Rodenticides in 1996 and 1997 (adapted from Kaukeinen et al. 2000). Information was not provided for difethialone, warfarin, or the non-anticoagulants.

Anticoagulant[a]	Year	lb ai[b]	oz bait[c]	no. containers/ placement units[b]	oz bait per container/ placement unit
Brodifacoum	1996	395	126,400,000	40,895,724	3
	1997	441	141,120,000	44,144,456	3
Bromadiolone	1996	233	74,560,000	275,376	271
	1997	164	52,480,000	294,706	178
Diphacinone	1996	486	155,520,000	1,551,161	100
	1997	608	194,560,000	2,860,419	68
Chlorophacinone	1996	1608	514,560,000	21,552	23,875
	1997	2677	856,640,000	18,360	46,658

[a] brodifacoum and bromadiolone are registered only for control of commensal rats and mice; diphacinone and chlorophacinone are registered for commensal rats and mice and are also used for control of field rodents in rangelands, orchards, and other settings

[b] data from Kaukeinen et al. 2000

[c] based on 0.005% ai food baits

Primary-hazards Data

Birds

Acute-oral and dietary toxicity: The available acute-oral and dietary toxicity data for birds are presented in Tables 3, 4, and 5. LC50 values for the northern bobwhite and mallard, required test species for EPA/OPP avian guideline studies, are used in calculating dietary RQs. The bobwhite or mallard LD50 also is used to calculate the amount of bait and number of rat-bait pellets that birds of various sizes need to eat to ingest a dose lethal to 50% of the individuals in the population. Some toxicity data also are available for other species for some rodenticides. Most of those values (e.g., Godfrey 1986) were determined using fewer test concentrations and fewer test animals per concentration than are required for EPA guideline studies. EFED considers these values as supplemental data that provide additional characterization of avian toxicity.

Table 3. Acute Oral and Dietary Toxicity of Second-generation Anticoagulants to Birds

Rodenticide/ Species	LD50, mg/kg (95% CI)	LC50, ppm (95% CI)	Reference
Brodifacoum			
Northern bobwhite		0.8 (0.1-4.7)	EPA 1998a
Mallard	0.26 (0-0.8)	2.0 (0.8-4.8)	EPA 1998a
Laughing gull		0.7	ICI 1979a
Laughing gull		1.6 (0.8-3.3)	ICI 1979b
Canada goose	<0.75[a]		Godfrey 1986
Black-backed gull	<0.75[a]		Godfrey 1986
Purple gallinule	0.95		Godfrey 1986
California quail	3.3		Godfrey 1986
Mallard	4.6		Godfrey 1986
Black-billed gull	<5[a]		Godfrey 1986
Ring-necked pheasant	10		Godfrey 1986
Australasian harrier	10		Godfrey 1986
Blackbird	>3[b]		Godfrey 1986
Hedge sparrow	>3[b]		Godfrey 1986
House sparrow	>6[b]		Godfrey 1986
Difethialone			
Northern bobwhite	0.26 (0.17-0.40)	0.56 (0.16-1.91)	EFED[c]
Mallard		1.4 (0.7-5.1)	EFED[c]
Bromadiolone			
Mallard		158 (7-762)	EPA 1998a
Mallard		440 (229-847)	EPA 1998a
Northern bobwhite	138 (81-235)	37.6 (9-85)	EPA 1998a
Northern bobwhite	170 (115-261)		EPA 1998a

[a] the lowest concentration tested
[b] the highest concentration tested
[c] OPP/EFED Toxicity Database

Table 4. Acute Oral and Dietary Toxicity of First-generation Anticoagulants to Birds

Rodenticide/ Species	LD50, mg ai/kg (95% CI)	LC50, ppm (95% CI)	Reference
Chlorophacinone			
Mallard		172 (75-498)	EPA 1998a
Northern bobwhite	258 (167-356)	56 (22-105)	EPA 1998a
Ring-necked pheasant	>100		Clark 1994
Red-winged blackbird	430		Clark 1994
Diphacinone			
Mallard	3158 (1605-6211)	906 (187-35,107)	EPA 1998a
Northern bobwhite	400 < LD50 <2000	>5000	EPA 1998a
Warfarin			
Mallard	620	890 (480-1649)	EFED[a]
Northern bobwhite	>2150	625 (300-1303)	EFED[a]
Chicken (domestic)	942		Bai and Krish-nakumari 1986

[a] OPP/EFED Toxicity Database

Table 5. Acute Oral and Dietary Toxicity of non-Anticoagulant Rodenticides to Birds

Rodenticide/ Species	LD50, mg ai/kg (95% CI)	LC50, ppm (95% CI)	Reference
Bromethalin			
Northern bobwhite	4.6 (3.6-5.8)	210 (150-280)	EPA 1998a
Northern bobwhite	11.0 (9.3-13.1)		EPA 1998a
Mallard		620 (460-820)	EPA 1998a
Chicken (domestic)	8.3		HED[a]
Zinc phosphide			
Northern bobwhite	12.9 (12.0-13.9)	469 (356-546)	EPA 1998b
Mallard	35.7 (11.8-108)	1285 (1026-1620)	EFED[b]
Mallard	67.4 (56.3-80.9)	2885 (1970-4329)	EPA 1998b
Mallard	13		CDFG 1962[c]
White-fronted goose	7.5		CDFG 1962[c]
Snow goose	8.8		CDFG 1962[c]
Ring-necked pheasant	8.8		CDFG 1962[c]
Canada goose	12.0		CDFG 1962[c]
California quail	13.5		CDFG 1962[c]
Gray partridge	26.7		Janda and Bosseova 1970
Ring-necked pheasant	26.7		Janda and Bosseova 1970
Red-winged blackbird	23.7		Clark 1994
Mourning dove	34.3		CDFG 1962[c]
Horned lark	47.2		EFED[b]
Golden eagle	>20		EFED[b]
Cholecalciferol			
Northern bobwhite		528[d]	EFED[b]
Mallard	>600[d]	1190[d]	EFED[b]

[a] OPP/HED Toxicity Database
[b] OPP/EFED Toxicity Database
[c] cited in Johnson and Fagerstone 1994
[d] values for cholecalciferol have been adjusted, based on the purity of test material (30% ai); reported values for the 30% ai test material are LD50 >2000 mg/kg; northern bobwhite LC50 = 1744 (1233-2516); and mallard LC50 = 3926 (2631-9890)

Feeding studies: Several studies are available that provide additional information for characterizing hazards of rodenticide baits fed to birds. Some of these provide useful comparative information among different rodenticides tested under the same test protocol. For example, Lund (1981) fed 0.005% ai brodifacoum, 0.005% ai bromadiolone, and 0.025% ai warfarin baits to adult leghorn chickens (*Gallus gallus*). Two anticoagulants (coumatetralyl and difenacoum) not registered in the U. S. also were tested. Four hens per anticoagulant were individually presented with a choice of bait or untreated chicken food for up to 15 days; survivors were observed for an additional 2 weeks. All 4 hens fed brodifacoum bait died within 6 to 12 days (Table 6). Bromadiolone bait resulted in the deaths of 2 of 4 hens. No deaths or signs of toxicity occurred in 3 hens that ate warfarin bait (1 other hen refused to eat bait).

Christopher et al. (1984) also examined the hazards of several anticoagulant baits to 3-week-old leghorn chickens. Brodifacoum bait (0.005% ai) was given to 4 groups (6 chicks per group) on alternate days for 1, 2, 3, or 4 feedings. Bromadiolone bait (0.005% ai) was presented to 3 groups (6 chicks per group) on alternate days for 1, 2, or 3 feedings. Warfarin bait (0.025% ai) was fed to 2 groups (6 chicks per group) for either 3 or 21 consecutive days. Results are comparable to those reported by Lund (1981). Twelve (50%) of the 24 birds fed brodifacoum bait died (Table 7), whereas all birds survived after feeding on bromadiolone bait (18 birds) or warfarin bait (12 birds).

Two other studies provide additional information help on the hazard of brodifacoum bait to birds. Ross et al. (1979a,b) exposed 10 northern bobwhites and 10 ring-necked pheasants (*Phasianus colchicus*) to 0.005% brodifacoum pellets for 14 days. Six bobwhite and 6 pheasants died after feeding ad lib. on a choice of pellets or untreated food. ICI Americas, Inc. (1981) also reported deaths of several pheasants exposed to 50 ppm brodifacoum pellets broadcast in a pen study.

Two laboratory studies provide supplemental data on the primary hazard of warfarin to birds. Crabtree and Robison (1952) maintained chukar (*Alectoris chukar*) on a diet of warfarin bait for 30 consecutive days with no deaths. Jones and Townsend (1978; cited in Townsend et al.1981) reported no mortality of Japanese quail (*Coturnix coturnix*) fed 8 mg ai/kg/day of warfarin for 14 days.

Johnson and Fagerstone (1994) reviewed primary hazard information for zinc phosphide. They indicate that some birds are repelled by zinc phosphide and others may regurgitate bait. Spotted doves (*Streptopelia chinensis*), for example, reportedly regurgitated treated seeds about 1 hour after ingestion (Hilton et al. 1972, Pank et al. 1972). However, some laughing doves (*Streptopelia senegalensis*) died about 2 hours after eating treated bait, even though they had regurgitated bait about 20 minutes after ingestion (Siegfried 1968). In another study, 14 of 15 red-winged blackbirds (*Agelaius phoeniceus*) died after feeding for 48 hours on a 1:1 mixture of treated (2% ai) and untreated cracked corn (Schafer et al. 1970).

Table 6. Adverse Effects of Five Anticoagulant Baits Fed to Adult Leghorn Chickens for up to 15 Days (adapted from Lund 1981)

	Avg. intake per bird[a]			
Anticoagulant	bait (g)	ai (mg/kg)	Mortality	Adverse effects
Brodifacoum (0.005% ai)	362 (252-443)	10.5 (7.1-15.0)	4/4	death from day 6
Bromadiolone (0.005% ai)	496 (329-684)	12 (5.9-16.9)	2/4	loss of appetite; hemorrhage from day 6
Warfarin (0.025% ai)	922 (584-1232)	149 (132-171)	0/3	none
Coumatetralyl[b] (0.03% ai)	594 (313-820)	107 (79-137)	2/4	loss of appetite from day 8; hemorrhage
Difenacoum[b] (0.005% ai)	611 (458-835)	19 (13.5-28.3)	2/4	loss of appetite; hemorrhage from day 5

[a] range is given in parenthesis

[b] coumatetralyl and difenacoum are not registered in the U. S.

Table 7. Adverse Effects of Three Anticoagulant Baits Fed to 3-week-old Leghorn Chickens for 1 to 21 Days (adapted from Christopher et al. 1984)

Anticoagulant	No. feedings[a]	Avg. bait intake (g)	mg ai/kg	Mortality	Adverse effects
Brodifacoum (0.005% ai)	1	15.5	11.0	1/6	1 death on day 4;1 bird sick on day 12 but recovered
	2	30.0	21.0	1/6	1 death on day 7;1 bird sick on day 6 but recovered
	3	42.8	28.9	5/6	mortality from days 7-16; 1 bird sick on day 5 (sporadic bleeding) had not recovered by end of test (day 21)
	4	43.8	20.9	5/6	mortality from days 5-15; 1 bird sick on day 4 (sporadic bleeding) had not recovered by end of test (day 21)
Bromadiolone (0.005% ai)	1	13.2	12.1	0/6	none
	2	29.5	22.1	0/6	1 bird sick on day 17 but recovered
	3	13.2	36.9	0/6	1 bird sick on day 16 did not recover by end of test (day 21)
Warfarin (0.025% ai)	3	49.4	183.7	0/6	none
	21	305.3	1092.2	0/6	bleeding in 1 bird on days 12-16 but survived

[a] brodifacoum and bromadiolone baits were offered ad lib. on alternate days; warfarin bait was fed ad lib. for either 3 or 21 consecutive days

Other studies indicate that zinc phosphide bait poses a hazard to some birds, although some species may be less susceptible than others. Janda and Bosseova (1970) reported deaths of gray partridges that consumed as few as 6 to 9 treated (2.5% ai) wheat kernels, and ring-necked pheasants died after consuming as few as 18 to 25 kernels. The California Department of Fish and Game (CDFA 1962) reports that about 260 to 310 treated zinc phosphide grains (1% ai) provides an LD50 dose for geese, and a 5-lb goose is capable of ingesting as many as 6400 kernels in one feeding (Keith and O'Neill unpubl.; cited in Johnson and Fagerstone 1994). Ramey et al. (1994) exposed ring-necked pheasants and California quail (*Callipepla californica*) to 2% zinc phosphide bait in 0.2-ha alfalfa enclosures. Based on necropsy results, 16 (62%) of 26 pheasants died from consuming bait. None of the 26 California quail died. Glahn and Lamper (1983) exposed 12 Canada geese (*Branta canadensis*) and 12 white-fronted geese (*Anser albifrons*) to 1% zinc phosphide bait applied in hay cover crops in California. The geese, held in portable enclosures that were moved daily, were allowed to feed for 4 days. Four (33%) Canada geese died. All white-fronted geese survived, which the authors attributed to their developing an aversion to bait after ingesting sublethal doses during the first 2 days of exposure.

Avian reproduction/sublethal effects: No guideline data are currently available for any of the rodenticides. OPP will be requiring avian reproduction tests with the mallard and northern bobwhite to fulfill this guideline requirement (40 CFR §158.490 Wildlife and Aquatic Organisms Data Requirements, Guideline Reference No. 71-4). EFED notes that there is a published abstract reporting the deaths of 2 turkey vulture (*Cathartes aura*) offspring that were fed brodifacoum-poisoned mice by their parents (Borst et al. 2000). The possibility exists that young animals may be more susceptible to rodenticide poisoning than are adults (see also the section on "*Mammalian reproduction/sublethal effects*"). EFED will assess the potential for adverse reproductive and chronic effects when the guideline studies become available.

Mammals

Acute-oral and dietary toxicity: The available acute-oral and dietary toxicity data for mammals are presented in Tables 8, 9, and 10. Laboratory-rat or mouse LD50 values are used to calculate the amount of formulated bait and number of bait pellets that nontarget mammals of various sizes need to eat to ingest a dose lethal to 50% of the individuals in the population. Data for other species provide additional characterization of mammalian toxicity and indicate that rodenticides are not selective for the target species. Some dietary data also are available for the laboratory rat for 5 of the anticoagulants, and these data are used to calculate dietary RQs. Additionally, as previously noted, all registered rodenticide products have been tested under Agency guideline requirements and proven efficacious in killing target species.

Warfarin toxicity values deserve special mention. LD50 values for the laboratory rat vary markedly among warfarin studies in the EPA/EFED toxicity database, ranging from 2.5 to 680 mg/kg. Jackson and Ashton (1992) cite values ranging from 14 to 186 mg/kg and Hone and Mulligan (1982; cited in Buckle 1994) values from 1.5 to 323 mg/kg. According to Meehan (1984; cited in Buckle 1994), the most reliable estimates now place the LD50 for the Norway rat as somewhere between 10 and 20 mg/kg. Discrepancies might exist due to difference in strain

and gender of the rats and in the carrier used to administer the dose. Poché and Mach (2001) also suggest that the degradation rate of warfarin in the gastrointestinal tract (GIT) of rats probably depends on the variation of bacterial species present and their abundance.

Table 8. Acute Oral Toxicity of Second-generation Anticoagulants to Mammals

Rodenticide/ Species	LD50, mg ai/kg (95% CI)	LC50, ppm (95% CI)	Reference
Brodifacoum			
Laboratory rat		0.53 (0.45-0.68) 0.55 (0.45-0.68) 0.55 (0.45-0.68) 0.57 (0.53-0.61) 0.85 (0.67-1.06)	EPA unpublished data[a]
Laboratory rat	0.41% (0.35-0.50) 0.56& (0.47-0.66)		EPA 1998a
Rat	0.39		HED[b]
Mouse	0.4		HED[b]
Vole	0.2 (0.11-0.32)	1.4 (0.77-2.0)	HED[b]
Richardson's ground squirrel	0.13 (0.06-0.19)		Baril and Pallister 1981[c]
Possum	0.17		Godfrey 1985
Pine vole	0.36 (0.22-0.59)		Byers 1978
Meadow vole	0.72 (0.53-0.98)		Byers 1978
Dog	0.25-1.0		HED[b]
Rabbit	0.29		HED[b]
Pig	<2.0		HED[b]
Guinea pig	2.7		HED[b]
Mink	9.2 (0-19.5)		Ringer and Aulerich 1978
Cat	~25		HED[b]
Sheep	>25		HED[b]

Rodenticide/ Species	LD50, mg ai/kg (95% CI)	LC50, ppm (95% CI)	Reference
Difethialone			
Laboratory rat	0.55 (0.53-0.57)		HED[b]
Rat	0.4-0.8		HED[b]
Laboratory mouse	1.29 (0.73-1.85)		HED[b]
Roof rat	0.38		Lorgue et al.[d]
House mouse	0.47		Lorgue et al.[d]
Norway rat (wild)	0.29-0.51		Lorgue et al.[d]
Hare	0.75		Lorgue et al.[d]
Pig	2-3		Lorgue et al.[d]
Dog	4		Harling et al. 1986[f]
Dog	11.8 (6.6-21.2)		HED[b]
Cat	>16		Lorgue 1986[e]
Bromadiolone			
Laboratory rat		0.92 (0.54-1.13) 1.49 (1.21-2.06) 1.79 (1.57-2.06) 1.99 (1.62-2.27)	EPA unpublished data[a]
Laboratory rat	0.56-0.84[f]		EPA 1998a
Laboratory mouse	1.75 (0.2-3.3)		HED[b]
Pine vole	3.9 (2.3-6.8)		Byers 1978
Rabbit	1		HED[b]
Dog	8.1		Poché 1988
Cat	>25		HED[b]

[a] the 5 dietary tests for brodifacoum and 4 dietary tests for bromadiolone were conducted at EPA's former Toxicology Unit, Beltsville, MD; methodology follows that described in McCann et al. 1981
[b] OPP/HED Toxicity Database
[c] cited in Matschke et al. 1983
[d] cited in Lechevin and Poché 1988
[e] cited in LiphaTech 1997
[f] an LD50 could not be statistically determined from the data but was estimated to be between these two test concentrations

Table 9. Acute Oral Toxicity of First-generation Anticoagulants to Mammals

Rodenticide/ Species	LD50, mg/kg (95% CI)	LC50, ppm (95% CI)	Reference
Chlorophacinone			
Laboratory rat		1.14 (1.02-1.36) 1.14 (0.98-1.35) 1.26 (1.11-1.47) 1.26 (0.97-1.64)	EPA unpublished data[a]
Laboratory rat	6.2 3.1% (1.5-6.7) 11.0& (6.5-18.5)		HED[b]
Laboratory rat	0.95 (5-day dose @ 0.19/day)		Jackson and Ashton 1992
Norway rat (wild)	0.80 (5-day dose @ 0.16/day)		Jackson and Ashton 1992
House mouse	1.0 6		Hone and Mulligan 1982[c]
Laboratory mouse	5.95 (5-day dose @ 1.19/day) 1.90% 17.40&		Jackson and Ashton 1992
Deer mouse	0.49		Clark 1994
Deer mouse	1.0-3.75[d]		Schafer and Bowles 1985
Norway rat	5.0		Clark 1994
Pine vole	14.2 (11.4-17.6)		Byers 1978
Roof rat	15.0		Clark 1994
Dog	50-100		Labe and Lorgue 1977
Diphacinone			
Laboratory rat		2.08 (1.57-2.76) 2.55 (1.79-3.19)	EPA unpublished data[a]
Laboratory rat	2.5% (1.3-3.4) 2.1& (1.5-2.9)		HED[b]
Laboratory rat	7.0 (5.2-9.5)		HED[b]
Laboratory rat	1.05 (5-day dose @ 0.21/day)		Jackson and Ashton 1992

Rodenticide/ Species	LD50, mg/kg (95% CI)	LC50, ppm (95% CI)	Reference
Norway rat (wild)	1.75 (5-day dose @ 0.35/day)		Jackson and Ashton 1992
Laboratory rat	1.9		Gaines 1969
House mouse	141-340		Hone and Mulligan 1982[c]
Laboratory mouse	7.05 (5-day dose @ 1.41/day) 2.10% 14.15&		Jackson and Ashton 1992
Meadow vole	14.0 (8.8-22.1)		Byers 1978
Pine vole	57.0 (34.4-94.3)		Byers 1978
Mongoose	0.2		EPA 1998a
Coyote	0.6		EPA 1998a
Dog	0.88		Kosmin and Barlow 1976[e]
Dog	3.0-7.5		Mount and Feldman 1983[e]
Dog	5-15		Lisella et al. 1971[e]
Cat	14.7		Clark 1994
Cat	5-15		Lisella et al. 1971[e]
Rabbit	35		Clark 1994
Warfarin			
Laboratory rat		4.41 (3.43-5.64) 5.43 (4.23-7.00) 5.91 (4.66-7.51) 6.03 (4.45-8.20)	EPA unpublished data[a]
Laboratory rat	2.5-5.0		WARF Institute 1977[f]
Laboratory rat	2.5-20		Til et al. 1974[f]
Laboratory rat	3		Gaines 1969
Laboratory rat	35.7% 41.9&		EPA 1982
Laboratory rat	323%[g] 58&[g]		Hagan and Radomski 1953[f]

Rodenticide/ Species	LD50, mg/kg (95% CI)	LC50, ppm (95% CI)	Reference
Laboratory rat	450-680% <10&		WARF Institute 1977[f]
Laboratory rat	100%[g] 8.7&[g]		Back et al. 1978[f]
Laboratory rat	1.65 (5-day dose @ 0.33/day)		Jackson and Ashton 1992
Norway rat (wild)	2.20 (5-day dose @ 0.44/day)		Jackson and Ashton 1992
Laboratory mouse	374[g]		Hagan and Radomski 1953[f]
Laboratory mouse	11.00 (5-day dose @ 2.20/day) 4.35% 40.00&		Jackson and Ashton 1992
Rabbit	800[g]		Hagan and Radomski 1953[f]
Cat	2.5-20		HED[a]
Dog	20-50		USFWS[h]
Dog	200-300[g]		Hagan and Radomski 1953[f]

[a] the 5 dietary tests for brodifacoum and 4 dietary tests for bromadiolone were conducted at EPA's former Toxicology Unit, Beltsville, MD; methodology follows that described in McCann et al. 1981
[b] OPP/HED Toxicity Database
[c] cited in Hyngstrom et al. 1994
[d] an approximate lethal dose (ALD); the ALD is estimated from an acute oral test that uses too few concentrations and test animals to statistically derive an LD50
[e] cited in LiphaTech 1997
[f] cited in EPA 1981
[g] values are for sodium warfarin
[h] cited in Papworth 1958

Table 10. Acute Oral Toxicity of non-Anticoagulant Rodenticides to Mammals

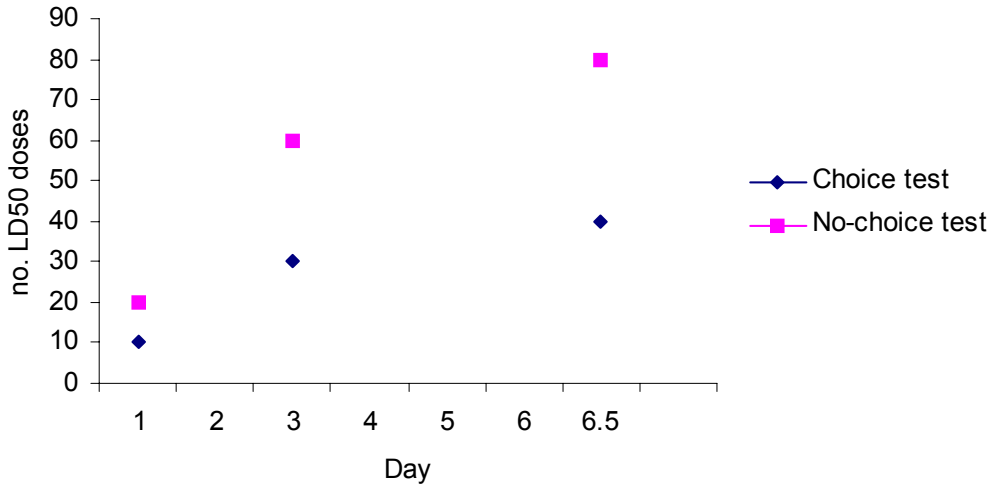
Rodenticide/ Species	LD50, mg ai/kg (95% CI)	Reference
Bromethalin		
Laboratory rat	10.7% 9.1&	HED[a]
Roof rat	6.6	Jackson et al. 1982
Mouse	5.3% 8.1&	HED[a]
Mouse	35.9% 28.9&	HED[a]
Rabbit	2.4% 2.0&	HED[a]
Dog	4.8	HED[a]
Cat	18	HED[a]
Zinc phosphide		
Norway rat (wild)	21 (13-34)	EPA 1998b
Rat	30 (20-45)	HED[a]
Rat	40	HED[a]
Roof rat	2.9-40	EPA 1998b
Polynesian rat	23	EPA 1998b
Deer mouse	40.5	Clark 1994
Deer mouse	42[b]	Schafer and Bowles 1985
Meadow vole	18	EPA 1998b
Nutria	5.5	EPA 1998b
Pocket gopher	6.8	EPA 1998b
Banner-tailed kangaroo rat	8	Clark 1994
Black-tailed prairie dog	18	EPA 1998b
Muskrat	29.9	Evans et al. 1966[c]
California ground squirrel	33.1	EPA 1998b
Black-tailed jack rabbit	8.2	EPA 1998b
Dog	40[b]	Matschke and LaVoie 1976[c]
Cat	40[b,c]	Matschke and LaVoie 1976[c]

Rodenticide/ Species	LD50, mg ai/kg (95% CI)	Reference
Kit fox	93 (62-140)	Schitoskey 1975
Cholecalciferol		
Laboratory mouse	26[d]	HED[a]
Laboratory rat	42 (33-53)[e]	HED[a]
Dog	88[e]	Marshall 1984

[a] OPP/HED Toxicity Database
[b] an approximate lethal dose (ALD); the ALD is estimated from an acute oral test that uses too few concentrations and test animals to statistically derive an LD50
[c] cited in Johnson and Fagerstone 1994
[d] the value is adjusted, based on the purity of the test material (62.5%)
[e] the purity of the test material was not reported

Other toxicity information: ICI Americas, Inc. (1978b) provided some pertinent information on the approximate number of LD50 doses captive wild Norway rats consumed in their food (50 ppm brodifacoum bait) at various times until death, which averaged 6.5 days. The rats (sample size not specified) were either offered bait only or a choice of bait and untreated food. The rats in the no-choice group consumed an average of approximately 20 LD50 doses after 1 day of feeding and 80 LD50 doses by death (Figure 1). Rats offered a choice of bait or untreated food still consumed enough bait to have ingested an average of 40 LD50 doses at death.

Figure 1. Average number of LD50 doses consumed by captive wild Norway rats offered 50 ppm brodifacoum bait in no-choice (bait only) or choice (bait and untreated food) feeding tests (after ICI Americas, Inc. 1978b)



Some information is available to characterize the primary hazard of rodenticide bait to dogs and other nontarget species. Mackintosh et al. (1988) reported that some dogs have died after consuming as few as 8 brodifacoum (Talon) pellets. Lechevin and Poché (1988) indicate that 400 g of 0025% ai difethialone bait is the maximum amount tolerated by 10-kg dogs. In a study in which 2 dogs were exposed to a 0.025% ai warfarin bait, 1 died after feeding for 7 days on 12 g of bait daily and the other after feeding on 4.8 g of bait daily for 12 days (Prier and Derse 1962). Marsh (1985) calculated that an LD50 dose to a 10-lb dog could be provided with 23 g of brodifacoum bait, 85 g of diphacinone bait, 369 g of warfarin bait, and 1000 g of bromadiolone bait. Gunther et al. (1988) fed cholecalciferol bait to 4 dogs as a follow-up to an investigation of 2 dogs that died after consuming cholecalciferol bait. Two dogs were given a single meal containing approximately 540 g of bait (20 mg ai/kg) and 2 were given half that amount. All 4 dogs became lethargic, weak, and anorectic within 48 hours and all died 65 to 77 hours after treatment. These findings suggest that cholecalciferol bait may present more of a hazard to dogs than the LD50 of 88 mg ai/kg would suggest.

Dubock and Kaukeinen (1978) reported the following nontarget-hazards data for brodifacoum: "The deer mouse *Peromyscus maniculatus* completely succumbed (20/20 mortality) in a 1-day no-choice feeding test with 50 ppm brodifacoum (Marsh, unpublished)." and "100% mortality has been obtained against the ground squirrel *Spermophilus beecheyi* when offered 50 ppm brodifacoum bait no choice for 1, 2 or 3 days (Marsh, unpublished)."

Mammalian reproduction/sublethal effects: EFED typically utilizes the rat two-generation reproduction test to assess reproductive risks to mammals. This study (40 CFR §158.340 Toxicology Data Requirements, Guidelines Reference No. 83-4) is required by HED to support registration of pesticides with food uses or where use of the product is likely to result in human exposure over a significant portion of the human lifespan. This study is not currently available for any of the 9 rodenticides. HED also requires other subchronic/chronic studies, but most (e.g., dermal, inhalation, oncogenicity, neurotoxicity) provide measurement endpoints not relevant to assessing risk to nontarget mammals other than humans.

Some evidence exists that sublethal doses can have adverse effects. The Warfarin RED (EPA 1991a) notes that warfarin is a teratogen, and product labels are required to warn that "Exposure to warfarin during pregnancy should be avoided. Warfarin may cause harm to the fetus, including possible birth defects." The Rodenticide Cluster RED (EPA 1998a) reports developmental toxicity (e.g., vaginal bleeding, hypotonicity) in rats and rabbits exposed to bromadiolone at about two orders of magnitude less than the LD50 dose. In brodifacoum studies, internal hemorrhage and significantly prolonged prothrombin time of rabbits was reported for those dosed during gestation at about two orders of magnitude less than the LD50 dose. More recently, Munday and Thompson (2003) detected brodifacoum in two dog pups that died a few hours after birth. Of 13 pups from a single litter, eight were born dead or died within 48 hours of birth. Three puppies that died shortly after birth were necropsied. Two exhibited hemorrhage in the thoracic and peritoneal cavities, intestinal serosa, and meninges, and brodifacoum was detected in the liver of both puppies. The mother did not have any clinical signs of coagulopathy before or subsequent to whelping, and the authors suggest that fetuses may be more susceptible to brodifacoum than are adults.

Secondary-hazards Data

Birds

The available laboratory studies indicate that major differences occur among the rodenticides in their secondary hazard to birds, with brodifacoum displaying the greatest hazard and chlorophacinone and the non-anticoagulants the least. Thirty-one studies are cited in which raptors or avian scavengers were exposed to rodenticide in whole or ground carcasses, usually those of rats or mice, or in fortified meat. Second-generation anticoagulants were tested in 15 studies, first-generation-anticoagulants in 13 studies, and non-anticoagulants in 6 studies (note: some studies included more than one rodenticide group). Most prey animals were fed treated bait, although some were orally dosed. Most studies involved only 1 rodenticide but often more than 1 raptor or scavenger species was tested. Mortality is a measurement endpoint in all studies.

Some studies also report signs of toxicosis (e.g., bleeding, prolonged blood-coagulation time, abnormal behavior, regurgitation) in surviving test animals, and that information is included if reported. Although exposure scenarios, test species, and the number of test animals vary among the studies, collectively they provide sufficient information to characterize secondary hazards from short-term exposure. The studies are summarized and tabulated below. Two studies merit additional attention, because they test different rodenticides against the same test species under the same test conditions, and are discussed in more detail in the section "*Comparative anticoagulant studies*".

Second-generation anticoagulants: Some data are available for brodifacoum and bromadiolone but none for difethialone. Brodifacoum was tested in 11 studies involving 8 species. Of 149 individuals exposed to brodifacoum-poisoned prey, 63 (42%) individuals died (Table 11). Mortality occurred in 11 of 20 barn owls (*Tyto alba*), 6 of 6 red-tailed hawks (*Buteo jamaicensis*) and red-shouldered hawks (*Buteo lineatus*), 13 of 65 American kestrels (*Falco sparverius*), 1 of 4 Eurasian harriers (*Circus pygargus*), and 32 of 50 laughing gulls (*Larus atricilla*). No deaths occurred in 4 golden eagles (*Aquila chrysactos*) tested by Marsh and Howard (1978), but 3 bled externally. Some studies did not report whether signs of toxicosis were observed in surviving birds or not. In those studies that examined survivors for signs of toxicosis, such as external bleeding, internal hemorrhaging, and/or prolonged blood-coagulation time, about one-third of the survivors visually examined or necropsied exhibited symptoms of toxicity.

In contrast to brodifacoum, secondary exposure to bromadiolone caused the deaths of only 9 (8%) of 118 individuals in 5 studies (Table 12) that tested great-horned owls (*Bubo virginianus*), barn owls, red-tailed hawks, and Eurasian buzzards (*Buteo buteo*). Survivors also exhibited fewer signs of intoxication than did survivors in brodifacoum studies. Grolleau et al. (1989) reported bleeding in some of the 27 Eurasian buzzards that survived feeding on bromadiolone-poisoned voles for 3 days but reported no signs of intoxication in 59 survivors exposed for only 1 or 2 days. No signs of intoxication are reported by Poché (1988) or Mendenhall and Pank (1980) in 12 raptors (barn owls and red-tailed hawks) that survived feeding on bromadiolone-treated rodents for 3 to 10 days. Wyllie (1995) reported increased blood coagulation time in 6 barn owls fed bromadiolone-poisoned mice for 6 days, but coagulation times returned to normal within 10 days; all owls survived, and no evidence of hemorrhaging was seen.

Table 11. Secondary Hazards of Brodifacoum to Birds in Laboratory Studies

Predator/ scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of brodifacoum toxicity[a]	Reference
Barn owl	rats fed choice of 0.002% bait[b] and untreated food for 5 days	1-2	1	1	0	0	Mendenhall and Pank 1980
			3	2	2	no survivors	
			6	1	1	no survivors	
			8	2	2	no survivors	
Barn owl	mice fed 0.002% bait[b] for 1 day	3	1	6	4	nr	Newton et al. 1990 and Wyllie 1995
		2	3	2[c]	0	nr	
		2	6	2[c]	0	2 (eb/ct)	
Barn owl	mice fed 0.005% bait for 1-2 days	enough to provide 50-220 µg ai per day	15	4	1	3 (eb/ih)	Gray et al. 1994
Barn owl	rats fed 0.005% bait	4 total	5-7	4	1	0	Lee 1994[d]
Red-tailed hawk	rats fed 0.005% bait for 3 days	limited[e]	4	4	4	no survivors	Marsh and Howard 1978
Red-shouldered hawk	mice fed 0.005% bait for 3 days	limited[e]	4	2	2	no survivors	Marsh and Howard 1978
Golden eagle	rats fed 0.005% bait for 3 days	limited[e]	4	4	0	3 (eb)	Marsh and Howard 1978
American kestrel	voles fed 0.005% bait for 3 days	1	2	10	0		Savarie and LaVoie 1979
		1	6	10	4	(ct)	
American kestrel	ground vole tissue at 5 concentrations: 0.3 ppm	ad lib.	5	8	0	nr	LaVoie 1990
	0.8 ppm		5	8	1	nr	
	1.6 ppm		5	8	0	nr	
	3.2 ppm		5	8	0	nr	
	6.0 ppm		5	8	4	nr	

Predator/ scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of brodifacoum toxicity[a]	Reference
Eurasian buzzard	mice fed 0.005% bait	5	6	5	4	1 (bl)	Lutz 1987[d]
Australasian harrier	rabbit dosed at 6.5 mg ai/kg	1	1	4	1	nr	Godfrey 1985
Laughing gull	ground, spiked rat tissue at 5 concentrations: 0.72 ppm	ad lib.	5	5	3	0	ICI Americas, Inc. 1979a
	1.62 ppm		5	5	5	no survivors	
	3.41 ppm		5	5	5	no survivors	
	7.26 ppm		5	5	5	no survivors	
	14.0 ppm		5	5	5	no survivors	
Laughing gull	ground, spiked rat tissue at 5 concentrations: 0.13 ppm	ad lib.	5	5	0	0	ICI Americas, Inc. 1979b
	0.34 ppm		5	5	1	0	
	0.84 ppm		5	5	0	1 (eb)	
	2.10 ppm		5	5	4	0	
	5.26 ppm		5	5	4	0	

[a] eb = external bleeding; ih = internal hematoma; bl = bleeding (unspecified); ct = increased blood coagulation time; nr = not reported

[a] registered baits are 0.005% ai

[c] the 2 owls that survived the initial 1-day exposure were subsequently re-exposed for 3 days and again for 6 days; the owls were allowed to recover for 75 to 79 days between exposure periods

[d] cited in Joermann 1998

[e] the amount of food offered to the raptors was "limited" to prevent overindulgence on any given day

Table 12. Secondary Hazards of Bromadiolone to Birds in Laboratory Studies

Predator/scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of bromadiolone toxicity[a]	Reference
Barn owl	rats fed choice of 0.005% bait or untreated food for 5 days	1-2	1	1	0	0	Mendenhall and Pank 1980
			3	2	0	0	
			6	1	0	0	
			10	2	1	0	
Barn owl	mice fed commercial bait (% ai not reported) and allowed to die	2-3	6	6	0	(ct)[c]	Wyllie 1995
Barn owl	rats fed 0.005% bait	4	5-7	4	1	nr	Lee 1994[d]
Eurasian buzzard	voles fed 0.01% bait[b]	1	1	40	0	0	Grolleau et al. 1989[d]
			1+1[e]	10	1	0	
			2	10	0	0	
			3	30	2	some (bl)	
Eurasian buzzard	mice fed 0.005% bait	?	10	4	3	1 (ct)	Lutz 1986[d]

[a] eb = external bleeding; ih = internal hematoma; bl = bleeding (unspecified); ct = increased blood coagulation time; nr = not reported

[b] rat and mouse baits registered in the U. S. are 0.005% ai

[c] coagulation time returned to normal within 10 days; no signs of hemorrhage in any individuals

[d] cited in Joermann 1998

[e] a second 1-day exposure period occurred 10 days after the first exposure

Only a few studies provide information on the residue level in the prey species offered to the secondary consumer. In those studies, the experimenter often manipulated residue levels to provide a known concentration or range of concentrations (e.g., ICI Americas, Inc. 1979a,b; LaVoie 1990; Gray et al. 1994). Additional information on whole-body residues in target species exposed to second-generation anticoagulants is provided in Table 13. Note that animals collected in the field were exposed to bait for an undetermined number of days. Some laboratory studies used bait concentrations different from that in baits registered in the U. S. and some exposed the primary consumer for only 1 day (e.g., Newton et al. 1990, Poché 1988).

Two residue studies indicate that the amount of whole-body residue in the target species is related to the amount of active ingredient in the bait. Kaukeinen (1982) provides mean tissue residue levels in voles exposed to brodifacoum bait in the laboratory. Separate groups of males and females were exposed for 4 days to 50 ppm bait or 10 ppm bait. Residues are 5.21 ppm and 2.17 ppm for males and females, respectively, exposed to 50 ppm bait but only 0.53 ppm and 0.40 ppm, respectively, for those exposed to 10 ppm bait. In field trials for vole control in orchards, Merson et al. (1984) collected voles 1 to 7 days after bait application. Two collections of voles exposed to 0.005% ai bait had mean whole-body residues of 2.07 ppm and 4.07 ppm, whereas those exposed to 0.001% ai bait had a mean residue level of 0.35 ppm.

Table 13. Second-generation Anticoagulant Residue Levels in Primary Consumers

Rodenticide	mg ai/kg bait	Target species	Site	Sample size	Days exposed	Whole-carcass residue (ppm)	Reference
Brodifacoum	50	rat	field	50	unknown	most <7; some up to 11-13	Kaukeinen 1993
Brodifacoum	50	rat	field	6	unknown	2.7 (0.1-6.6)	ICI 1979c
Brodifacoum	50	rat	field	4 ♀ 3 ♂ 3 juv.	unknown	7.08 (3.92-9.17) 5.61 (1.39-12.19) 8.63 (1.77-25.97)	Howald 1997
Brodifacoum	50	vole	field	74	1-7	4.07 ± 0.20 (SE)	Merson et al. 1984
Brodifacoum	50	vole	field	62	1-7	2.07 ± 0.17 (SE)	Merson et al. 1984
Brodifacoum	50	vole	laboratory	15 ♀ 15 ♂	4 4	5.21 ± 2.06 (sd) 2.17 ± 1.17 (sd)	Kaukeinen 1982
Brodifacoum	25[a]	deer mouse	field	10	4-9	2.71 (0.68-4.25)	Howald et al. 2001
Brodifacoum	20[a]	mouse	laboratory	?	3	2.21	Anonymous 1981[b]
Brodifacoum	20[a]	mouse	laboratory	10	1	0.44	Newton et al. 1990
Brodifacoum	10[a]	vole	laboratory	15 ♀ 15 ♂	4 4	0.53 ± 0.24 (sd) 0.40 ± 0.20 (sd)	Kaukeinen 1982
Brodifacoum	10[a]	vole	field	43	1-7	0.35 ± 0.03 (SE)	Merson et al. 1984
Difethialone	25	rat	laboratory	20	3	2.0 ± 0.51(sd)	Goldade et al. 2001
Bromadiolone	50	rat	laboratory	6	1	2.08	Poché 1988
Bromadiolone	50	mouse	laboratory	10	1	2.29	Poché 1988
Bromadiolone	50	rat	field	16	unknown	1.92	Poché 1988
Bromadiolone	50	mouse	field	6	unknown	1.17	Poché 1988

Rodenticide	mg ai/kg bait	Target species	Site	Sample size	Days exposed	Whole-carcass residue (ppm)	Reference
Bromadiolone	50	ground squirrel	field	16	unknown	0.49	Poché 1988
Bromadiolone	100[a]	vole	laboratory	?	1	6.5-6.75	Grolleau et al. 1989
Bromadiolone	100[a]	vole	laboratory	?	3	8.7-10.9	Grolleau et al. 1989
Bromadiolone	100[a]	vole	laboratory	?	3	5.8	Grolleau et al. 1989
Bromadiolone	150[a]	vole	field	44	≤3	0.91 (0.05-2.97)	Delley and Joseph 1985[c]
Bromadiolone	150[a]	vole	laboratory	12	≤3	0.11 (0.04-0.19)	Delley and Joseph 1985[c]

[a] brodifacoum and bromadiolone baits registered in the U. S. are 0.005% ai
[b] cited in Joermann 1998
[c] cited in Saucy et al. (2001)

First-generation anticoagulants: Mortality in studies with the 3 first-generation anticoagulants ranged from 0 to 9%. No mortality occurred in 8 chlorophacinone studies with 112 individuals from 9 species (Table 14). Birds tested included 28 carrion crows (*Corvus corone*), 20 Eurasian buzzards, 20 American kestrels, 20 black-billed magpies, 10 red-tailed hawks, 6 white storks (*Ciconia ciconia*), 4 tawny owls (*Strix aluco*), 2 barn owls, and 2 great horned owls. Some survivors showed signs of intoxication, mostly prolonged blood-coagulation time. About 9% mortality was recorded in 3 diphacinone studies with 34 individuals (Table 15). Test species were barn owls, great horned owls, saw-whet owls (*Aegolius acadicus*), golden eagles, and American crows (*Corvus brachyrhynchos*). Thirteen (42%) of the survivors displayed some signs of toxicity. In 4 warfarin studies, 2 (9%) of 23 individuals died (Table 16); no adverse signs were reported in the survivors. Whole-body residues in target species exposed to chlorophacinone, diphacinone, and warfarin are presented in Table 17.

Table 14. Secondary Hazards of Chlorophacinone to Birds in Laboratory Studies

Predator/scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of chlorophacinone toxicity[a]	Reference
Barn owl	rats fed choice of 0.005% bait or untreated bait for 5 days	1-2	10	2	0	0	Mendenhall and Pank 1980
Black-billed magpie	rats fed 0.005% bait for 5 days	ad lib.	5	20	0	0	Baroch 1997
American kestrel	voles fed 0.01% bait until dead	1	21	10	0	10 (eb/ih)	Radvanyi et al. 1988
		1 every 3 days	61	10	0	10 (eb/ih)	
Red-tailed hawk	voles fed 10 g 0.005% bait daily for up to 9 days	2	6	5	0	0	Askham and Poché 1992
Great horned owl	voles fed 10 g 0.005% bait daily for up to 9 days	2	6	1	0	0	Askham and Poché 1992
Red-tailed hawk	voles fed 0.005% bait for up to 9 days	2	6	5	0	0	Askham 1988
Great horned owl	voles fed 0.005% bait for up to 9 days	2	6	1	0	0	Askham 1988
Tawny owl	mice fed 0.0075% bait[b]	ad lib.	10	4	0	(ct)	Riedel et al. 1991[c]
Eurasian buzzard	mice fed 0.0075% bait[b]	ad lib.	7	4	0	(ct)	Riedel et al. 1991[c]
			10	6	0	(ct)	
			5+5+5[d]	3	0	(ct)	
			40	3	0	(ct)	
Eurasian buzzard	mice fed 0.0075% bait[b]	4	7	4	0	0	Anonymous 1978[c]
Carrion crow	mice fed 0.0075% bait[b]	ad lib.	10	4	0	(ct)	Riedel et al. 1991[c]
Carrion crow	mice fed 0.0075% bait[b]	3-4	3	12	0	0	Sterner 1978[c]
			5	12	0	0	

Predator/scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of chlorophacinone toxicity[a]	Reference
White stork	mice fed 0.0075% bait[b]	ad lib. (treated	3	3	0	1 or 2 (ct)	Sterner 1981[c]
		/untreated)	14	3	0	1 or 2 (ct)	

[a] eb = external bleeding; ih = internal hematoma; bl = bleeding (unspecified); ct = increased blood coagulation time; nr = not reported
[b] baits registered in the U.S. are either 0.005% or 0.01% ai
[c] cited in Joermann 1998
[d] the 3 5-day treatment periods are separated by 3 days when the birds were fed untreated mice

Table 15. Secondary Hazards of Diphacinone to Birds in Laboratory Studies

Predator/scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of diphacinone toxicity[a]	Reference
Great horned owl	mice fed choice of 0.01% bait or untreated food for 10 days	2	5	3	2	1 (ct)	Mendenhall and Pank 1980
Saw-whet owl	mice fed choice of 0.01% bait or untreated food for 10 days	2	5	1	1	no survivors	Mendenhall and Pank 1980
Barn owl	rats fed choice of 0.005% bait or untreated food for 5 days	ad lib.	10	2	0	0	Mendenhall and Pank 1980
American crow	rats fed 0.005% bait until death	1	1	10	0	0	Massey et al. 1997
		1-2[b]	6	11	0	5 (eb/ct)	
Golden eagle	meat laced at 2.7 ppm ai	454 g	5	4	0	4 (eb/ct)	Savarie et al. 1979
			10	3	0	3 (eb/ct)[c]	

[a] eb = external bleeding; ih = internal hematoma; bl = bleeding (unspecified); ct = increased blood coagulation time; nr = not reported
[b] offered 1 rat per crow for 5 days and 2 rats per crow on day 6
[c] general weakness of all eagles was observed after 5 days

Table 16. Secondary Hazards of Warfarin to Birds in Laboratory Studies

Predator/scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of warfarin toxicity[a]	Reference
Tawny owl	mice fed bait for 3 days	1 every other day	90 28	4 2[c]	0 0	0 0	Townsend et al. 1981
Black-billed magpie	rats fed 0.05% bait[b] for 4-7 days	ad lib.	5	14	0	0	March 1997
Barn owl	rats fed 0.005% bait[b]	4 total	5-7	4	2	nr	Lee 1994[d]
Eurasian buzzard	rat/mouse	ad lib.	18	1	0	nr	Telle 1955[d]

[a] eb = external bleeding; ih = internal hematoma; bl = bleeding (unspecified); ct = increased blood coagulation time; nr = not reported
[b] rat and mouse baits registered in the U.S. are 0.025% ai
[c] the 2 owls had previously been exposed for 90 days; untreated mice were offered for 3 weeks preceding the second test
[d] cited in Joermann 1998

Table 17. First-generation Anticoagulant Residue Levels in Primary Consumers

Rodenticide	mg ai/kg bait	Target species	Site	Sample size	Days exposed	Whole-carcass residue (ppm)	Reference
Chlorophacinone	100	ground squirrel	field	10	unknown	1.27 ± 0.56 (sd)	Baroch 1996b
Chlorophacinone	75[b]	mouse	laboratory	?	3	6.0	Riedel et al. 1991[a]
Chlorophacinone	50	ground squirrel	field	10	unknown	0.57 ± 0.27 (sd)	Baroch 1996a
Chlorophacinone	50	ground squirrel	field	10	unknown	0.52 + 0.31(sd)	Baroch 1996b
Chlorophacinone	50	rat	laboratory	5	5	0.47 (0.21-0.93)	Baroch 1997
Chlorophacinone	50	rat	laboratory	4	5	0.45 (0.18-0.81)	Ahmed et al. 1996
Chlorophacinone	50	vole	laboratory	10	≤9	3.2	Askham and Poché 1992
Chlorophacinone	50 or 100[c]	ground squirrel	field	62	unknown	0.264	Primus et al. 2001
Chlorophacinone	50 or 100[c]	vole	field	3	unknown	1.58 (0.26-4.1)	Primus et al. 2001
Chlorophacinone	50	mouse	laboratory	?	3	5.8	Anonymous 1981[a]
Chlorophacinone	50 or 100[c]	pocket gopher	field	8	unknown	0.518	Primus et al. 2001
Chlorophacinone	50 and 100[d]	ground squirrel	field	53	unknown	0.93	Goodall et al. 2002
Diphacinone	50	ground squirrel	field	10	unknown	1.4 (0.6-3.4)	Baroch 1994a
Diphacinone	50	ground squirrel	field	7	unknown	0.9 (0.48-1.89)	Baroch 1994b
Diphacinone	100	ground squirrel	field	10	unknown	1.4 (0.6-2.6)	Baroch 1994a
Diphacinone	50 and 100[d]	ground squirrel	field	76	unknown	0.98	Goodall et al. 2002
Warfarin	200[e]	mouse	laboratory	17	3	2.95 ± 0.26 (SE)	Townsend et al. 1984
Warfarin	67[e]	rabbit	laboratory	nr	35	104	Aulerich et al. 1987
Warfarin	50[e]	mouse	laboratory	62	3	1.63 ± 0.1 (SE)	Townsend et al. 1981

Rodenticide	mg ai/kg bait	Target species	Site	Sample size	Days exposed	Whole-carcass residue (ppm)	Reference
Warfarin	50[e]	mouse	laboratory	18	3	1.58 ± 0.1 (SE)	Townsend et al. 1984
Warfarin	25[e]	rabbit	laboratory	nr	35	82	Aulerich et al. 1987
Warfarin	10[e]	mouse	laboratory	15	3	0.42 ± 0.04 (SE)	Townsend et al. 1984

[a] cited in Joermann 1998
[b] chlorophacinone baits registered in the U. S. are either 0.005% or 0.01% ai
[c] carcasses were collected in the field in CA, where both 50 ppm and 100 ppm chlorophacinone baits are registered
[d] the study did not allow distinguishing among ground squirrels exposed to 50 ppm and 100 ppm baits
[e] warfarin baits registered in the U. S. are 0.025% ai

Comparative anticoagulant studies: Some of the most meaningful studies for comparing hazards are those in which more than one rodenticide was tested by the same researchers under the same test conditions and with the same test species. Any adverse effects observed can more readily be attributed to differences among the rodenticides than to differences potentially confounded from utilizing different exposure scenarios or test species. The 2 studies summarized below indicate that brodifacoum has greater secondary toxicity to birds than do other anticoagulants tested, including bromadiolone, difenacoum and flocoumafen (both second-generation anticoagulants not registered in the U. S.), diphacinone, chlorophacinone, and fumarin (a first-generation compound no longer registered in the U.S.).

Mendenhall and Pank (1980) compared secondary hazards of 3 second-generation and 3 first-generation anticoagulants to barn owls. Six owls per rodenticide were exposed for either 1, 3, 6, or 10 days to rats fed with either brodifacoum (20 ppm bait), bromadiolone (50 ppm bait), or difenacoum (50 ppm). The exposed rats had been offered free choice of bait (5 to 13 g daily) or laboratory chow for 10 days; thus, none were forced to eat bait. An additional 2 owls per rodenticide were exposed for 10 days to rats fed with either diphacinone (50 ppm), chlorophacinone (50 ppm), or fumarin (250 ppm). Six of the 18 owls exposed to second-generation anticoagulants died, whereas none of the 6 owls offered first-generation anticoagulant-poisoned rats exhibited any signs of intoxication. Brodifacoum-fed rats accounted for 5 of the 6 owl deaths, even though the concentration of active ingredient in the bait fed to the rats is less than the 50 ppm in baits registered for rat and mouse control. The other mortality occurred in 1 of 2 owls exposed to bromadiolone-fed rats for 10 days. The amount of anticoagulant residue in the rats offered to the owls was not determined.

Wyllie (1995) and Newton et al. (1990) reported on toxic effects to barn owls fed mice exposed to brodifacoum (6 owls), bromadiolone (6 owls), or 2 other anticoagulants (difenacoum, flocoumafen). The mice had been fed bait (no choice) for a single day and allowed to die, which took 2 to 11 days. Dead mice were then offered to the owls in 3 phases, each phase separated by a recovery period lasting at least 75 days. In phase I, each owl was offered 3 mice for 1 day only. Surviving owls were offered 6 mice each during a 3-day period in phase II and 12 mice each during a 6-day period in phase III. Mortality, evidence of external bleeding, and delays in blood-coagulation times were monitored. Four of the 6 owls fed brodifacoum-exposed mice died within 6 to 17 days of phase I. Both survivors also survived feeding on poisoned mice in phases II and III, but both exhibited bleeding from the mouth, feet, and newly-grown feathers for up to 30 days, and blood-coagulation times did not reach normal until 16 to 78 days after treatment. In contrast, none of the owls exposed to bromadiolone-poisoned mice died or exhibited signs of hemorrhaging, and blood coagulation times returned to normal 4 to 6 days after treatment.

Others (non-anticoagulants): The few studies available for the non-anticoagulant rodenticides indicate few adverse secondary effects. Five studies are available for zinc phosphide (Table 18). Test birds included 2 great horned owls, 3 spotted eagle owls (*Bubo africanus*), 3 kestrels (*Falco tinnunculus*), 3 bald eagles (*Haliaeetus leucocephalus*), 3 black vultures (*Coragyps atratus*), 3 carrion crows, a magpie, and a jay. None of the 19 birds died, but signs of intoxication were noted in several individuals. Roosting-behavior irregularities were noted in 2 owls exposed to poisoned voles for 3 days (Bell and Dimmick 1975), and 3 bald eagles fed poisoned nutria (*Myocastor coypus*) for 4 to 5 weeks regurgitated some prey (Evans et al. 1966; cited in Johnson and Fagerstone 1994). In the only study available for cholecalciferol (Table 19), no adverse effects were observed in 2 turkey vultures and 1 red-tailed hawk exposed to rats fed for 1-day with 0.075% ai bait (Marsh and Koehler 1991). Each bird was offered 1 large or 2 small rats daily for 10 days. No hazard data are available for bromethalin.

Some whole-body residue data are available for zinc phosphide but none was found for cholecalciferol or bromethalin. Sterner et al. (1998) reported a mean whole-body residue of 0.42 ($\pm$ 0.68) mg ai per vole for 6 voles each offered 5 oat-groat particles treated with 2% zinc phosphide. Mean particle weight was 23 mg, resulting in individual voles being offered only about 0.12 g of bait. In an earlier study (Sterner and Maudlin 1995), whole-body residues averaged 1.73 mg ai per vole (range = 0.31 to 4.95 mg ai) in voles offered bait ad libitum. Almost all zinc phosphide detected in carcasses apparently was in undigested bait in the GIT. Matscke and Andrews (1990) recovered only 8.9% of the amount of 2% ai bait ingested by voles, and 99.9% of that was in the GIT, especially the stomach. Only 0.1% of that recovered was detected in the kidneys, gall bladder, liver, and spleen combined, and none was detected in the lungs, heart, or in muscle. Tkadlec and Rychnovsky (1990) also reported that 99% of the zinc phosphide residue they detected in voles was in the GIT.

Table 18. Secondary Hazards of Zinc Phosphide to Birds in Laboratory Studies

Predator/scavenger (p/s)	Prey offered to p/s	No. prey of red daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of zinc phosphide toxicity	Reference
Great horned owl	voles fed bait (86.94 mg ai/kg)	ad lib.	3	2	0	2[a]	Bell and Dimmick 1975
Spotted eagle owl	gerbils fed 3-4 treated kernels (2% ai)	1	5 10 40	1 1 1	0 0 0	0 0 0	Siegfried 1968[b]
Kestrel	voles fed 5% bait[c]	1	3	3	0	0	Tkadlec and Rychnovsky 1990
Bald eagle	nutria fed 275 g bait (% ai not reported)	13-28 total per bird	28-35	3	0	3[d]	Evans et al. 1966[e]
Black vulture	nutria fed bait (% ai not reported)	not reported	10-11	3	0	0	Evans et al. 1966[e]
Carrion crow	mice fed 2.5% bait[c]	2-4	7	3	0	0	Anonymous 1980[b]
Magpie	mice fed 2.5% bait[c]	2-4	7	1	0	0	Anonymous 1980[b]
Jay	mice fed 2.5% bait[c]	2-4	7	1	0	0	Anonymous 1980[b]

[a] irregular roosting behavior was reported
[b] cited in Joermann 1998
[c] baits registered in the U. S. are 2% ai
[d] regurgitated prey
[e] cited in Johnson and Fagerstone 1994

Table 19. Secondary Hazards of Cholecalciferol to Birds in Laboratory Studies

Predator/scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of cholecalciferol toxicity[a]	Reference
Turkey vulture	rats fed 0.075% ai bait for 1 day	1 large or 2 small	10	2	0	0	Marsh and Koehler 1991
Red-tailed hawk	rats fed 0.075% ai bait for 1 day	1 large or 2 small	10	1	0	0	Marsh and Koehler 1991

Mammals

Laboratory tests indicate that the second-generation anticoagulants, as well as chlorophacinone and diphacinone, present a hazard to mammalian predators and scavengers. Thirty-three studies were found in which mammalian predators or scavengers were exposed to rodenticide in whole or ground carcasses, usually rats or mice, or in spiked meat. Second-generation anticoagulants were tested in 8 studies, first-generation-anticoagulants in 15 studies, and non-anticoagulants, mainly zinc phosphide, in 13 studies. Collectively, these studies provide sufficient information to characterize short-term secondary hazards for most of the rodenticides. Three studies in which different rodenticides were tested against the same test species under the same test conditions are discussed in more detail in the section *"Comparative anticoagulant studies*".

Second-generation anticoagulants: Mortality of 8 (42%) of 19 individuals (foxes, mustelids, domestic dogs) occurred in 4 brodifacoum studies (Table 20). Test subjects included 5 red foxes (*Vulpes vulpes*) and gray foxes (*Urocyon cinereoargenteus*), 4 mongooses (*Herpestes auropunctatus*), 4 weasels (*Mustela* sp.), and 6 domestic dogs. Signs of toxicity are reported for most survivors. In 4 bromadiolone studies (Table 21), 6 (23%) of 26 test animals died, including coyotes (*Canis latrans*), mongooses, and an ermine (*Mustela erminea*). Bleeding was observed in all 10 ermine that survived being fed 1 bromadiolone treated vole per day for 3 to 5 days, but not in 5 coyotes or 4 stone martens fed treated ground squirrels or mice for periods ranging from 1 to 5 days. No comparable secondary-hazard studies are available for difethialone. Goldade et al. (2001) estimated a chronic LD50 for European ferrets (*Mustela putorius furo*) fed difethialone-fortified dog food at various concentrations. The chronic LD50 of 760 mg ai/kg was estimated from cumulative daily food intake, difethialone concentration, and individual bird body weights, but only 2 ferrets were exposed to each test concentration and the duration of exposure was not specified.

First-generation anticoagulants: Laboratory studies indicate that chlorophacinone and diphacinone present a hazard to mammalian predators and scavengers. In 8 chlorophacinone studies, 32 (58%) of 55 individuals died, including 7 of 8 mongooses, 3 of 7 coyotes, 1 of 4 red foxes, 18 of 35 ferrets, and 3 of 4 weasels (Table 22). In 3 diphacinone studies, 19 (58%) of 33 test animals died after feeding on rodents fed diphacinone, liver tissue from owls fed diphacinone, or fortified meat. Species affected included mink (*Mustela vison*), mongooses, ermine, deer mice, rats, and dogs (Table 23). Warfarin appears to be less hazardous than other anticoagulants. In 7 studies, only 9 (9%) of 100 individuals died after eating warfarin-treated rodents (Table 24). Dead animals included 3 mink, 3 least weasels (*Mustela nivalis*), and 3 dogs.

Table 20. Secondary Hazards of Brodifacoum to Mammals in Laboratory Studies

Predator/scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of brodifacoum toxicity[a]	Reference
Red fox and Gray fox	rats dosed at 15 mg ai/kg[b]	400 g	1	2	0	2 (eb/ih)	ICI Americas, Inc. 1978a
			3	1	1	no survivors	
			4	2	1	1 (eb/ih)	
Mongoose	rats fed 0.002% bait[c] for 5 days	1	1	1	0	nr	Pank and Hirata 1976
			3	1	1	no survivors	
			6	1	0	nr	
			10	1	0	nr	
Weasel	mice fed 0.002% bait[c]	ad lib.	16-52	4	4	no survivors	Anonymous 1981[d]
Dog (domestic)	rats dosed at 15 mg ai/kg[b]	650 g	1-4	6	1	4 (eb/ih)	ICI Americas, Inc. 1978b

[a] eb = external bleeding; ih = internal hematoma; bl = bleeding (unspecified); ct = increased blood coagulation time; nr = not reported
[b] the rats were dosed to simulate feeding on 0.005% bait
[c] registered baits are 0.005% ai
[d] cited in Joermann (1998)

Table 21. Secondary Hazards of Bromadiolone to Mammals in Laboratory Studies

Predator/scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of bromadiolone toxicity[a]	Reference
Mongoose	rats fed 0.005% bait for 5 days	1	1	1	0	nr	Pank and Hirata 1976
			3	1	1		
			5	1	1		
			6	1	1		
Coyote	ground squirrels fed 15 g of 0.01% bait[b] for 3 days	1	5	7	2	0[c]	Marsh and Howard 1986
Ermine	voles fed 0.01% bait[b]	1	3	8	0	8 (bl)	Grolleau et al. 1989[d]
			5	3	1	2 (bl)	
Stone marten	mice fed 0.005% bait	8	1	2	0	0	Lund and Rasmussen 1986[d]
			4	2	0	0	

[a] eb = external bleeding; ih = internal hematoma; bl = bleeding (unspecified); ct = increased blood coagulation time; nr = not reported

[b] rat and mouse baits registered in the U. S. are 0.005% ai

[c] 2 coyotes stopped feeding for 8 and 16 days, which was attributed to bromadiolone intoxication; both resumed feeding and survived

[d] cited in Joermann 1998

Table 22. Secondary Hazards of Chlorophacinone to Mammals in Laboratory Studies

Predator/scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of chlorophacinone toxicity[a]	Reference
Mongoose	rats fed 0.005% bait for 5 days	1	1	1	0	nr	Pank and Hirata 1976
			3	1	1	no survivors	
			5	2	2	no survivors	
			6	1	1	no survivors	
			7	1	1	no survivors	
			9	1	1	no survivors	
			10	1	1	no survivors	
Coyote	ground squirrels fed 15 g of 0.01% bait for 6 days[b]	1	5	7	3	0	Marsh and Howard 1986
Red fox	mice fed 0.0075% bait[c]	20 total	4	1	1[d]	no survivors	Bachhuber and Beck 1988[e]
European ferret	rats fed 0.005% bait for 5 days	ad lib.	5	20	11	nr	Ahmed et al. 1996
European ferret	prairie dogs fed 25 g of 0.0025% bait daily for 6 days[c]	4 (1 every other day)	8	6	5	nr	Fisher and Timm 1987
European ferret	voles/mice fed 0.0075% bait[c]	5 total	4	2	1[f]	(ct)	Bachhuber and Beck 1988[e]
European ferret	muskrats fed 0.005% bait	ad lib.	4	2	0	1 (bl)	Jobsen 1978[e]
			8	1	1	no survivors	
European ferret	voles fed 0.0075% bait[c]	ad lib.	3	4	0	(ct)	Anonymous 1983[e]
Weasel	mice fed 0.005% bait	ad lib.	90	4	3	0	Anonymous 1981[e]

[a] eb = external bleeding; ih = internal hematoma; bl = bleeding (unspecified); ct = increased blood coagulation time; nr = not reported
[b] ground squirrels were fed no-choice for 3 days followed by 3 days in which they had a choice of bait or untreated laboratory chow
[c] baits registered in the U.S. are either 0.005% or 0.01% ai
[d] individual was sacrificed but considered 'dead' based on coagulation index
[e] cited in Joermann 1998
[f] individual recovered from moribund state after administration of antidote, but assumed 'dead' without antidote treatment

Table 23. Secondary Hazards of Diphacinone to Mammals in Laboratory Studies

Predator/scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of diphacinone toxicity[a]	Reference
Mink	nutria fed 0.01% carrot bait for up to 10 days	ad lib.	5-18	3	3	no survivors	Evans and Ward 1967
Mongoose	rats fed 0.005% bait for 5 days	1	1	1	0	nr	Pank and Hirata 1976
			3	1	1	no survivors	
			5	2	2	no survivors	
			6	1	1	no survivors	
			7	1	1	no survivors	
			8	1	1	no survivors	
			10	1	1	no survivors	
Ermine	deer mice fed 0.01% bait for 10 days	2	5	2	1	nr	Pank and Hirata 1976
Striped skunk	deer mice fed 0.01% bait for 10 days	2	5	5	0	nr	Pank and Hirata 1976
Deer mouse	liver from diphacinone-poisoned owls	1 g daily	7	4	1	3 (ct)	Pank and Hirata 1976
Rat	meat containing 0.5 ppm ai	ad lib.	6	8	4	nr	Savarie et al. 1979
Dog (domestic)	nutria fed 0.01% carrot bait for up to 10 days	ad lib.	6-10	3	3	no survivors	Evans and Ward 1967

[a] eb = external bleeding; ih = internal hematoma; bl = bleeding (unspecified); ct = increased blood coagulation time; nr = not reported

Table 24. Secondary Hazards of Warfarin to Mammals in Laboratory Studies

Predator/scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of warfarin toxicity[a]	Reference
Mink	nutria fed 0.025% bait for at least 7 days	ad lib.	8-15	3	3	no survivors	Evans and Ward 1967
Mink	rabbits fed 25 or 67 ppm ai bait[b] for 5 weeks	ad lib.	28	50	0	0	Aulerich et al. 1987
Least weasel	mice fed 0.001% bait,	ad lib.	90	2	0	2 (ct)	Townsend et al. 1984
	0.005% bait,		29-90	2	1	1 (ct)	
	or 0.02% bait for 3 days		12-57	2	2	no survivors	
European ferret	prairie dogs fed 0.05% bait[b] for 15 days	1	7	10	0	0	Carlet and Mach 1997
European ferret	prairie dogs fed 0.05% bait[b] for 5 days	ad lib.	5	10	0	0	Mach 1998
Raccoon	rats fed 0.025% bait for 5 days	1	5	8	0	0	EPA 1982
		3	5	10[c]	0	0	
Dog (domestic)	nutria fed 0.025% bait for at least 7 days	ad lib.	8-16	3	1	2 (eb/ct)	Evans and Ward 1967
Dog (domestic)	mice fed 0.025% bait,	4-10	56	4	0	0	Prier and Derse 1962
	0.05% bait;	10	56	1	0	0	
	mice dosed with 2.5 mg ai;	1	56	1	0	0	
	10 mg ai;	1	25	1	1	no survivors	
	40 mg ai	1	17	1	1	no survivors	

[a] eb = external bleeding; ih = internal hematoma; bl = bleeding (unspecified); ct = increased blood coagulation time; nr = not reported

[b] registered baits are 0.025% ai

[c] the 10 test animals included the 8 individuals from the first trial plus 2 additional untested individuals

Comparative anticoagulant studies: Marsh and Howard (1986) conducted a pen study to determine if ground squirrels fed either bromadiolone or chlorophacinone pose a secondary hazard to coyotes. The ground squirrels were fed either 0.01% ai bromadiolone bait or 0.01% ai chlorophacinone bait for 5 consecutive days. Each coyote (7 per rodenticide) was offered 1 dead ground squirrel per day for 5 days and observed for 30 days posttreatment. Three coyotes died after feeding on the dead ground squirrels previously fed chlorophacinone. All 7 coyotes fed dead ground squirrels previously fed bromadialone survived, although 2 consumed very little of their normal food rations for 8 to 16 days after treatment.

Pank and Hirata (1976) fed poisoned rats to mongooses to examine possible secondary hazards of anticoagulant rodenticides. The rats were fed for 5 days with baits that included 0.002% ai brodifacoum, 0.005% ai bromadiolone, 0.005% ai chlorophacinone, and 0.005% ai diphacinone. One rat per day was offered to mongooses for periods ranging from 1 to 10 days. Exposure to rats fed either chlorophacinone or diphacinone resulted in deaths of 7 of 8 mongooses exposed for 3 to 10 days. Three of four mongooses fed rats that were previously fed bromadiolone were killed, however only 1 mongoose death (of 4 tested) was attributed to brodifacoum. It is noteworthy that although baits registered for rat and mouse control are 50 ppm bromadiolone, the bait used to feed the rats in this study was only 20 ppm.

Evans and Ward (1967) demonstrated that feeding on nutria for several days or more can pose a hazard to minks and dogs when these nutria have been previously been fed diphacinone and warfarin. In this study the rodenticide exposed nutria, with skin, head, tail, feet, and intestines removed, were fed to 3 commercial mink and 3 mongrel dogs. All mink and dogs died within 5 to 17 days of the secondary exposure to diphacinone. The 3 mink exposed to warfarin died within 8 to 15 days. Two of the 3 dogs survived exposure to warfarin for 16 days, although both had bloody feces and one became lethargic.

Others (non-anticoagulants): Fewer secondary-hazard testing has been done with the non-anticoagulant rodenticides, but the available data indicate considerably less hazards than for the anticoagulants. Only 3 (4%) of 77 test animals (foxes, dogs, ferrets, weasels, domestic cats, mink, mongooses) died after feeding on rodents poisoned with zinc phosphide in 10 studies (Table 25). Some regurgitation of prey was reported in animals that died and in some survivors that consumed GI tracts of zinc phosphide-poisoned rodents (Evans 1965, Schitoskey 1975, Hill and Carpenter 1982, Tkadlec and Rychnovsky 1990). Some animals learned to avoid eating the GI tract. In 2 cholecalciferol studies, 18 dogs and 12 feral house cats consumed either poisoned ground rats or brushtail possums (*Trichosurus vulpecula*) for up to 5 days with no deaths, although some reversible signs of toxicosis were reported in the dogs (Table 26). In one study with bromethalin, 4 dogs survived with no observed adverse effects after feeding for 14 days on rats that were poisoned for 1 day (Table 27).

Table 25. Secondary Hazards of Zinc Phosphide to Mammals in Laboratory Studies

Predator/scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of zinc phosphide toxicity	Reference
Red fox and Gray fox	voles fed bait (86.94 mg ai/kg)	ad lib.	3	4	0	2[a]	Bell and Dimmick 1975
Kit fox	kangaroo rats dosed at 480 mg/rat	1 1	1 3	1 2	0 0	1[b] 2[b]	Schitoskey 1975
Dog (domestic)	poisoned nutria carcasses or organs	varied or not reported	varied from 1 to 150 days	8	1	2[b]	Evans 1965
Least weasel	voles fed 5% bait[c]	1	3	2	0	0	Tkadlec and Rychnovsky 1990
Cat (domestic)	voles fed 5% bait[c]	7-11	1-2	2	1	1[b]	
Cat (domestic)	poisoned nutria carcasses or liver	ad lib.	1-10	3	1	2[b]	Evans 1965
Mink	prairie dogs fed 2% ai bait	200 g	30	5	0	0	Tietjen 1976
Mink	poisoned nutria	ad lib.	10 20	3 2	0 0	0 0	Evans 1965
Mongoose	rats fed bait (% ai not reported)	10 total	5-10	4	0	0	Pank 1972
Mongoose	rats fed 1% ai bait[c]	5-7 total	35	2	0	0	Doty 1945[d]
Siberian ferret	rats fed 2% bait or orally dosed at 40, 80, or 160 mg/rat	1 rat every other day	10	16	0	13[e]	Hill and Carpenter 1982
European ferret	organs or carcass from prairie dogs fed 2% bait	ad lib.	3	20	0	0	Matschke and Andrews 1990

Predator/scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of zinc phosphide toxicity	Reference
European ferret	mice	3-4	1	3	0	0	Ueckermann 1982[f]

[a] feeding-behavior irregularities were reported
[b] some prey regurgitated if stomach contents consumed; no other ill effects were observed
[c] baits registered in the U. S. are 2% ai
[d] cited in Johnson and Fagerstone 1994 and Evans 1965
[e] some altered blood chemistry (hemoglobin, globulin, cholesterol, triglycerides) and prey regurgitation was reported
[f] personal communication to G. Joermann (Joermann 1998)

Table 26. Secondary Hazards of Cholecalciferol to Mammals in Laboratory Studies

Predator/scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of cholecalciferol toxicity	Reference
Cat (domestic)	brushtail possums dosed with 20 mg ai/kg	ad lib.	5	12	0	0	Eason et al. 1996
Dog (domestic)	brushtail possums poisoned with an LD95 dose in cereal bait	1	1	4	0	0	Eason et al. 2000
			2	2	0	0	
			5	12	0	12[a]	

[a] partial anorexia and varying degrees of lethargy from day 4 to 14 after dosing; all recovered

Table 27. Secondary Hazards of Bromethalin to Mammals in Laboratory Studies

Predator/scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of bromethalin toxicity	Reference
Dog (domestic)	ground meat from rats fed 0.005% ai bait for 1 day	600 g	14	4	0	0	van Lier 1981

Potential Primary Risks

Birds

The amount of bait and number of rat-bait pellets (0.2 g each) that birds of various sizes need to eat in a single feeding to obtain a dose expected to be lethal to 50% of the individuals in the population (i.e., LD50 dose) are estimated from the acute oral toxicity for the northern bobwhite or mallard. Estimates of food-ingestion rates (g dry matter per day) are determined from allometric equations in Nagy (1987; cited in EPA 1993): 6.1 g for a 25-g passerine, 9.6 g for a 100-g non-passerine, and 53.9 g for a 1000-g non-passerine. A 25-g passerine can potentially ingest an LD50 dose by consuming 0.02 g zinc phosphide bait (<1 pellet), 0.13 g brodifacoum bait (<1 pellet), 0.26 g difethialone bait (<2 pellets), or 1.2 g (6 pellets) of bromethalin bait (Table 28). Larger non-passerines need to consume more pellets to obtain an LD50 dose but could potentially do so. In contrast, 25- to 1000-g birds would need to eat 100 or more pellets to ingest an LD50 dose of bromadiolone, chlorophacinone, diphacinone, warfarin, or cholecalciferol.

Most of the rodenticide baits, but especially brodifacoum, difethialone, and zinc phosphide, exceed the Agency's LOC for avian dietary risk (Table 29). The Agency presumes potential acute risk when the dietary RQ equals or exceeds 0.5 for non-endangered species and 0.1 for endangered species. Brodifacoum, difethialone, and zinc phosphide exceed the LOC for non-endangered species by 86- to 126-fold for the northern bobwhite and 14- to 50-fold for the mallard. The exceedances are even higher for endangered species.

Table 28. Comparative Risk to Birds From a Single Feeding of Rodenticide, Based on the Amount of Bait Needed to Ingest an LD50 Dose (i.e., a dose lethal to 50% of the individuals in a population)

Rodenticide	mg ai/kg in bait	LD50[a] (mg ai/kg)	25-g passerine			100-g non-passerine			1000-g non-passerine		
			bait (g)	% of daily food intake[b]	no. bait pellets[c]	bait (g)	% of daily food intake	no. bait pellets	bait (g)	% of daily food intake	no. bait pellets
Second-generation anticoagulants											
Brodifacoum	50	0.26	0.13	2.1	0.6	0.52	5.4	2.6	5.2	9.6	26
Difethialone	25	0.26	0.26	4.3	1.3	1.04	10.8	5.2	10.4	19.3	52
Bromadiolone	50	138	69	>100	345	276	>100	1380	2760	>100	>1000
First-generation anticoagulants											
Chlorophacinone	50	258	129	>100	645	516	>100	2580	5160	>100	>1000
Chlorophacinone	100	258	64.5	>100	322	258	>100	1290	2580	>100	>1000
Diphacinone	50	>400	200	>100	1000	800	>100	4000	8000	>100	>1000
Diphacinone	100	>400	100	>100	500	400	>100	2000	4000	>100	>1000
Warfarin	250	620	62	>100	310	248	>100	1240	2480	>100	>1000
Others (non-anticoagulants)											
Bromethalin	100	4.6	1.2	18.8	6	4.6	47.9	23	46	85.3	230
Zinc phosphide	20,000	12.9	0.02	0.3	<0.1	0.07	0.7	0.3	0.7	1.2	3.2
Cholecalciferol	750	>600	20	>100	100	80	>100	400	800	>100	4000

[a] the LD50 values used in the calculations are from northern bobwhite or mallard acute-oral toxicity studies required by the Agency to support pesticide registration (see Tables 3, 4, and 5); ">" values are assumed to be "=" values for the calculations

[b] food ingestion rates (g dry matter per day) are based on the allometric equations of Nagy 1987 (cited in EPA 1993): 6.1 g for a 25-g passerine, 9.6 g for a 100-g non-passerine, and 53.9 g for a 1000-g non-passerine

[c] assuming a bait pellet weighs 0.2 g (information provided by Syngenta Crop Protection, Inc., Greensboro, NC)

Table 29. Avian Dietary Risk Quotients. RQs ≥0.5 (for non-endangered species) or ≥ 0.1 (for endangered species) Exceed the Agency's Level of Concern for Acute Risk to Birds.

Rodenticide	mg ai/kg in bait	Test species	LC50[a] (ppm)	Dietary RQ[b]
Second-generation anticoagulants				
Brodifacoum	50	northern bobwhite	0.8	63
		mallard	2.0	25
Difethialone	25	northern bobwhite	0.5	50
		mallard	1.4	18
Bromadiolone	50	northern bobwhite	37.6	1.4
		mallard	158	0.3
First-generation anticoagulants				
Chlorophacinone	50	northern bobwhite	56	0.9
		mallard	172	0.3
Chlorophacinone	100	northern bobwhite	56	1.8
		mallard	172	0.6
Diphacinone	50	northern bobwhite	>5000	n/a
		mallard	906	<0.1
Diphacinone	100	northern bobwhite	>5000	n/a
		mallard	906	0.1
Warfarin	250	northern bobwhite	625	0.4
		mallard	890	0.3
Others (non-anticoagulants)				
Bromethalin	100	northern bobwhite	210	0.5
		mallard	620	0.2
Zinc phosphide	20,000	northern bobwhite	469	43
		mallard	2885	7
Cholecalciferol	750	northern bobwhite	528	1.4
		mallard	1190	0.6

[a] LC50 values used to calculate the dietary RQs are from dietary toxicity studies required by the Agency to support pesticide registration (see Tables 3, 4, and 5)

[b] RQ = ppm ai in bait/LC50; RQs are not calculated when the LC_{50} value categorizes the active ingredient as practically nontoxic (i.e., LC50 >5000 ppm) to the test species

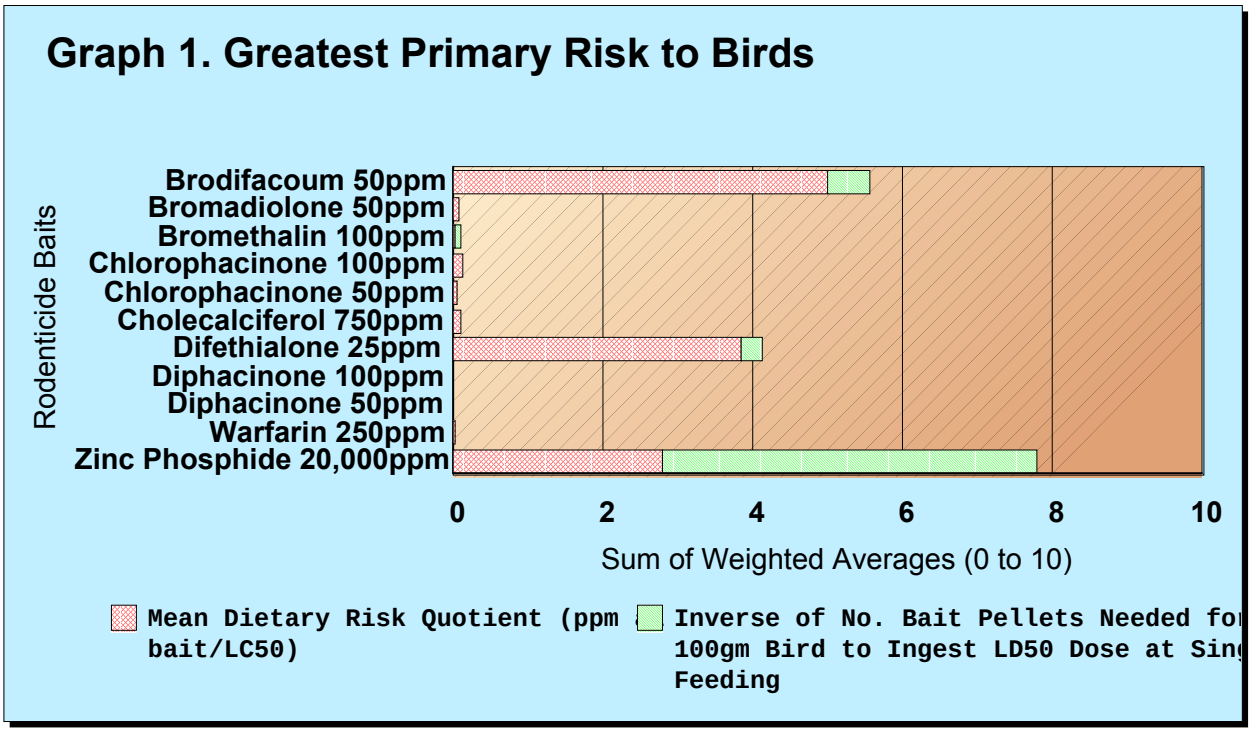
Based on the comparative analysis model, zinc phosphide, brodifacoum, and difethialone stand out as the rodenticides posing the greatest potential primary risk to birds. This result is based on two measures of effect: mean dietary RQ (ppm bait/LC50) and the number of bait pellets needed for a 100-g bird to ingest an LD50 dose in a single feeding. In order to correctly calculate the weighted averages, the inverse of the number of bait pellets needed for a 100-g bird to ingest an LD50 dose in a single feeding was calculated and used in the comparative analysis model. The sum of the weighted average values for all the rodenticides is tabulated in the 'Summary values' column in Table 30 and also is depicted in Figure 2. Brodifacoum has higher summary risk values than difethialone for both measures of effect. The mean dietary RQ appears to be the most significant measure of effect leading to the conclusion that brodifacoum poses greater potential risk to birds than either difethialone or zinc phosphide and that difethialone poses greater potential risk to birds than does zinc phosphide.

Table 30. Comparative Analysis Model Results for Primary Risk to Birds

Rodenticide	mg ai/kg bait	Measure-of-effect values		Summary values
		Mean dietary RQ[a]	Inverse of the LD50 dose for a 100-g bird (no. bait pellets)[b]	
Brodifacoum	50	44.00	0.38	5.58
Bromadiolone	50	0.85	0.00	0.10
Bromethalin	100	0.35	0.04	0.10
Chlorophacinone	100	1.20	0.00	0.14
Chlorophacinone	50	0.60	0.00	0.07
Cholecalciferol	750	1.00	0.00	0.12
Difethialone	25	34.00	0.19	4.15
Diphacinone	100	0.10	0.00	0.01
Diphacinone	50	0.10	0.00	0.01
Warfarin	250	0.35	0.00	0.04
Zinc Phosphide	20,000	24.75	3.33	7.81

[a] from Table 29
[b] from Table 28

Figure 2. Comparative Analysis Model Summary Values For Primary Risk to Birds



Primary risk to birds also is analyzed by an alternative approach, using an HD_5(50%) reference value to calculate the amount of bait needed to provide an LD50 dose to a 100-g bird instead of the LD50 values for bobwhite quail or mallard ducks. The HD_5(50%) is the 5% tail of the avian LD50 toxicity distribution calculated with 50% probability of overestimation (Mineau et al.2001). The authors believe that the *"approach of using reference values based on species specific extrapolation factors represents the most unbiased attempt to date to compare the toxicity of pesticides for which many data points are available with those about which we know very little."* Utilizing the HD_5(50%) reference value, rather than the LD50, does not change the rankings (see Attachment C for more details, including reference values for the rodenticides and a graphical comparison of the summary measures of effect for each of the 2 approaches).

Findings from experimental studies conducted in field or other outdoor settings, along with information obtained during operational programs, provide useful data linking exposure to adverse effects in birds. Zinc phosphide, chlorophacinone, and diphacinone are registered for field and other outdoor uses, and brodifacoum has been used to control introduced rats on some U. S. oceanic islands. Such uses often allow broadcast or other unprotected applications (e.g., spot-baiting) that exposes bait to birds that might be attracted to grain pellets or treated grains (e.g., corn, wheat, oats).

Howald et al. (1999) reported nontarget effects to birds during a brodifacoum rat-control program on Langara Island, Canada. Thirteen common ravens (*Corvus corax*) were found dead 12 to 47

days after baiting began, and all had brodifacoum residue (0.985 to 2.522 ppm) in their liver. Remains of 7 other ravens also were found but not analyzed. At least 8 bait stations were raided by ravens, which either reached into the stations and pulled out bait blocks or tipped the stations to roll out the bait, even though the stations were secured. Some of the ravens also fed on poisoned rats. Brodifacoum also was detected in a pooled sample of 3 northwestern crows (*C. caurinus*) collected 12 days after the start of baiting.

Brodifacoum also was detected in song sparrows (*Melospiza melodia*) collected by shotgun on Langara Island (Howald 1997). Residue levels of 0.643 and 0.567 ppm were detected in 2 of 4 pooled liver samples (2 to 3 individuals per sample) and 0.058 ppm in 1 pooled sample (4 individuals) analyzed for whole-body residue. It is not known how the sparrows were exposed or whether any died. They may have consumed bait crumbs found scattered around bait stations and along rat runways but also might have eaten invertebrates that fed on bait. Howald (1997) also found that snails (*Vespericola* sp., *Haplotrema* sp.) and banana slugs (*Ariolimax* sp.) commonly fed on brodifacoum bait and may pose a risk to birds and nontarget mammals that consume them.

Godfrey (1985) cited an incident at an aviary where several birds (avocets, pittas, plovers, finches, thrushes, warblers, crakes, honey creepers) died after being exposed to brodifacoum. Brodifacoum concentrations of 0.081 to 1.69 ppm were reported in tissues of dead birds. Because bait was applied in bait stations, it was assumed that the birds were exposed by feeding on pavement ants and cockroaches that had eaten bait.

Brodifacoum baits (20 ppm or 50 ppm) are used for field control of rats and brushtail possums in New Zealand, and much useful information on nontarget risks has been reported. However, because of increased concerns about nontarget mortality and movement of brodifacoum through the food chain, its use is being reviewed and curtailed in many areas in New Zealand (Eason and Murphy 2001). The following studies provide further information on primary risks to birds, based on mortality reported during field studies or operational control programs.

Eason and Spurr (1995) reviewed the impacts of brodifacoum baiting on nontarget birds during baiting programs in New Zealand, where bait is applied in bait stations (50 ppm cereal-based wax blocks) or aerially broadcast (20 ppm pellets) in a single application. They report mortality of a wide range of bird species, including 33 indigenous species or subspecies and 8 introduced species or subspecies, and presume most resulted from primary exposure. Populations of indigenous rails (weka, *Gallirallus australus*; pukeko, *Porphyrio porphyrio*) monitored during rodenticide baiting operations were severely reduced: "For example, the entire population of western weka on Tawhitinui island were exterminated by consumption of Talon® 50WB intended for ship rats, which they obtained by reaching into bait stations, by eating baits dropped by rats, and by eating dead or dying rats (Taylor 1984)." On another island, 80 to 90% of the Stewart Island weka population was killed by baits applied for Norway rats. Aerial application of 0.002% bait on two other islands reduced a weka population by about 98% and a pukeka population by >90%. Numbers of quail, blackbirds, sparrows, and myna were markedly reduced on another island. Some other species suffered no apparent adverse effects.

Dowding et al. (1999) found numerous dead birds after an aerial baiting operation to eradicate rats and mice and reduce rabbit numbers on Motuihe Island, New Zealand. Brodifacoum bait (20 ppm) was applied twice, with 9 days between applications. Nontarget species were monitored, including pukeka (3 groups of 98 birds), a flock of 52 paradise shelduck (*Tadorna variegata*), 8 New Zealand dotterels (*Charadrius obscurus*), and 14 variable oystercatchers (*Haematopus unicolor*). There was no evidence that dotterels or oystercatchers were adversely affected, but mortality of pukeko and shelduck was 49% and 60%, respectively. Birds of 10 species were found dead. The liver from each of 29 dead birds of 10 species was analyzed. All livers contained brodifacoum residue, with mean levels per species ranging from 0.56 to 1.43 ppm. Chaffinch (*Fringilla coelebs*), North Island robin (*Persica australis longipes*), North Island weka, and North Island saddleback (*Philesturnus carunculatus rufusater*) also were found dead after a brodifacoum baiting on Mokoia Island, New Zealand (Stephenson et al.1999).

Eason and Spurr (1995) report that invertebrates have been observed eating brodifacoum bait, and residues were detected in beetles collected in bait stations in New Zealand. Invertebrates have different blood-clotting mechanisms than vertebrates and may not be affected by anticoagulants, but insectivorous animals feeding on the contaminated invertebrates might be at risk. Robertson et al. (1999) monitored brown kiwis (*Apteryx mantelli*) potentially at risk from brodifacoum applications in bait stations placed for possum control. Although there was no evidence that adult kiwi died as a result of the applications, including 55 that were radio-tagged, brodifacoum was detected at levels of 0.01 to 0.18 ppm in 3 of 4 chicks found dead from unknown causes. The authors speculated that the chicks may have obtained bait or may have eaten invertebrates that ingested bait. The death of an endangered Seychelles magpie-robin (*Copsychus sechellarum*) on Fregate Island, Seychelles, was likely due to its feeding on insects that had taken brodifacoum baits from bait stations (Thorsen et al. 2000). Loss of bait, attributed mostly to consumption by millipedes, crabs, and skinks, averaged 17% per night.

Hegdal (1985) conducted a study in Washington to examine risks to game birds from a 0.005% ai diphacinone bait applied for vole control in orchards. Most orchards were treated twice, with 20 to 30 days between treatments, at an average rate of 12.9 kg/ha (11.5 lb/acre). Telemetry was used to monitor the fate of 52 ring-necked pheasants, 18 California quail, and 30 chukar potentially exposed to the bait. About half of the quail and all chukar were pen-raised and had been released into the orchards. Dead game birds and other animals found were necropsied and any available tissue collected for residue analysis. Eight of 30 pheasants, 9 of 15 quail, and 1 of 10 chukar collected by the researchers or shot by hunters contained diphacinone residue in the liver. Bait made up as much as 90% of crop contents of some birds. No residue was detected in 4 passerines collected 31 to 73 days after treatment. The author concluded that risk to game birds in orchards appeared to be low but emphasized that substantial quantities of bait were eaten and longer-term behavioral and physiological effects, such as susceptibility to predation, need to be considered along with direct mortality in order to evaluate potential hazards from exposure.

Some information on potential nontarget risks was gained during field studies conducted to assess the efficacy of 0.01% ai and 0.005% ai diphacinone and chlorophacinone baits against California ground squirrels inhabiting rangeland (Baroch 1994 a,b; 1996a,b). For each of these rodenticides,

trials included separate spot-baiting applications with 0.01% ai and 0.005% ai grain baits and a trial in which 0.005% ai grain bait was only available in bait stations. Searches for nontarget carcasses were made on and around treated plots after baiting. One dead dove and 2 dead roadrunners (*Geococcyx californicus*) were found on treatment plots, but there was no evidence that these birds had eaten any bait.

Hegdal and Gatz (1977) evaluated risks to nontarget wildlife from zinc phosphide bait (2% ai) broadcast by ground or air at rates of 5 to 10 lb per acre for vole control in Michigan orchards. Carcass searches were made across 672 of 950 treated acres in the 2 weeks after treatment. Bird carcasses recovered included 1 blue jay (*Cyanocitta cristata*) and 1 of 5 radio-equipped pheasants. Northern bobwhite were observed, and some were seen feeding on bait, but no carcasses were found.

Ramey et al. (1998) examined risk to radio-collared ring-necked pheasants from zinc phosphide baiting in alfalfa fields in California. Pheasants were rarely found in fields when bait was applied after the alfalfa was cut. The pheasants preferred other habitats at this time, and none died as a result of the baiting. Results were somewhat confounded by the use of some pen-reared pheasants, most of which were quickly taken by predators.

Johnson and Fagerstone (1994) reviewed a number of field studies conducted to evaluate primary effects of zinc phosphide on nontarget wildlife for the following uses: prairie dogs, ground squirrels, and jackrabbits on rangeland; California ground squirrels and rats on ditch banks; voles and rats in orchards; and rats in sugarcane. They also note that some information on nontarget hazards has also been gathered for use against voles in alfalfa and muskrats and nutria in wetlands. They concluded: "Although field studies to determine effects of zinc phosphide on nontarget wildlife have generally found no significant effects, under certain circumstances operational zinc phosphide applications have resulted in mortality of nontarget wildlife."

Quy et al. (1995) observed small song birds, especially chaffinches, that had difficulty flying and appeared to be ill during a rat-control operation with calciferol bait in the United Kingdom. A number of dead birds were found; all had abnormally high calcium deposits in their kidneys, suggesting calciferol toxicosis.

Nontarget mammals

The amount of bait and number of rat-bait pellets that nontarget mammals of various sizes need to eat in a single feeding to obtain an LD50 dose (i.e., the dose expected to be lethal to 50% of the individuals in the population) is estimated from the acute oral toxicity for the laboratory rat. Estimates of food-ingestion rates (g dry matter per day) are determined from allometric equations in Nagy (1987; cited in EPA 1993): 3.8 g for a 25-g rodent, 8.3 g for a 100-g rodent, and 68.7 g for a 1000-g mammal. A 25-g rodent can potentially ingest an LD50 dose by consuming less than 1 g (~5 pellets) of most baits, and a single pellet of zinc phosphide or brodifacoum can provide this dose (Table 31). Larger mammals also are potentially at risk if they eat baits of most of these rodenticides. For warfarin, there is some uncertainty that a single feeding would be lethal to most individuals, because warfarin is reported to require multiple feedings over a period of a few days to be efficacious (Papworth 1958, Jackson and Ashton 1992, Timm 1994).

Dietary RQs are calculated for brodifacoum, bromadiolone, and the 3 first-generation anticoagulants (Table 32). RQs cannot be determined for difethialone and the 3 non-anticoagulants, because dietary data are not available. The RQs exceed the LOC 48- to 188-fold for non-endangered mammals and 240- to 943-fold for endangered mammals. This indicates a significant risk to nontarget mammals that feed on any of these baits.

Based on the comparative analysis model, zinc phosphide is ranked as the rodenticide posing the greatest potential primary risk to nontarget mammals, with brodifacoum ranked a distant second, and warfarin and bromadiolone an even more distant third and fourth. The results are based on a single measure of effect: the number of bait pellets needed for a 100-g mammal to ingest an LD50 dose in a single feeding. In order to correctly calculate the weighted averages, the inverse of the number of bait pellets needed for a 100-g mammal to ingest an LD50 dose in a single feeding was calculated and used in the comparative analysis model. The sum of the weighted average values for all the rodenticides is tabulated in the ‘Summary values' column in Table 33 and presented graphically in Figure 3.

Table 31. Comparative Risk to Mammals From a Single Feeding of Rodenticide, Based on the Amount of Bait Needed to Ingest an LD50 Dose (i.e., a dose lethal to 50% of the individuals in a population)

Rodenticide	mg ai/kg in bait	LD50[a] (mg ai/kg)	25-g rodent			100-g rodent			1000-g mammal		
			bait (g)	% of daily food intake[b]	no. bait pellets[c]	bait (g)	% of daily food intake	no. bait pellets	bait (g)	% of daily food intake	no. bait pellets
Second-generation anticoagulants											
Brodifacoum	50	0.4	0.2	5.2	1	0.8	9.6	4	8	11.6	40
Difethialone	25	0.55	0.56	14.7	2.8	2.2	26.5	11	22	32	110
Bromadiolone	50	0.7	0.35	9.2	1.8	1.4	16.2	7	14	20.4	70
First-generation anticoagulants											
Chlorophacinone	50	6.2	3.1	81.6	15.5	12.4	>100	62	124	>100	620
Chlorophacinone	100	6.2	1.6	42	8	6.2	74.7	31	62	90.2	310
Diphacinone	50	2.3	1.2	31.6	6	4.6	55.4	23	46	67	230
Diphacinone	100	2.3	0.6	15.8	3	2.3	27.7	11.5	23	33.5	115
Warfarin	250	3	0.3	7.9	1.5	1.2	14.5	6	12	17.5	60
Others (non-anticoagulants)											
Bromethalin	100	9.9	2.5	65.8	12.5	9.9	119	49.5	99	>100	495
Zinc phosphide	20,000	21	0.03	0.7	0.13	0.1	1.2	0.5	1	1.5	5
Cholecalciferol	750	42	1.4	36.8	7	5.6	67.5	28	56	81.5	280

[a] the LD50 values used in the calculations are from laboratory rat or mouse acute-oral toxicity studies required by the Agency to support pesticide registration (see Tables 6, 7, and 8); the tabulated value is provided as an average if the LD50 differed between male and female

[b] food ingestion rates (g dry matter per day) are based on the allometric equations of Nagy 1987 (cited in EPA 1993): 3.8 g for a 25-g rodent, 8.3 g for a 100-g rodent, and 68.7 g for a 1000-g mammal

[c] assuming a bait pellet weighs 0.2 g (information provided by Syngenta Crop Protection, Inc., Greensboro, NC)

Table 32. Mammalian Dietary Risk Quotients. RQs ≥0.1 (endangered species) or ≥0.5 (non-endangered species) Exceed the Agency's Level of Concern for Acute Risk to Mammals.

Rodenticide	mg ai/kg in bait	Test species	LC50[a] (ppm)	Dietary RQ[b]
Second-generation anticoagulants				
Brodifacoum	50	laboratory rat	0.53	94.3
Bromadiolone	50	laboratory rat	0.92	54.3
First-generation anticoagulants				
Chlorophacinone	50	laboratory rat	1.14	43.8
Chlorophacinone	100	laboratory rat	1.14	87.7
Diphacinone	50	laboratory rat	2.08	24.0
Diphacinone	100	laboratory rat	2.08	48.1
Warfarin	250	laboratory rat	4.41	56.7

[a] LC50 values used to calculate the dietary RQs are from dietary toxicity studies conducted by the Agency's former Toxicology Section (see Tables 6 and 7); mammalian dietary data are not available for difethialone, bromethalin, zinc phosphide, and cholecalciferol

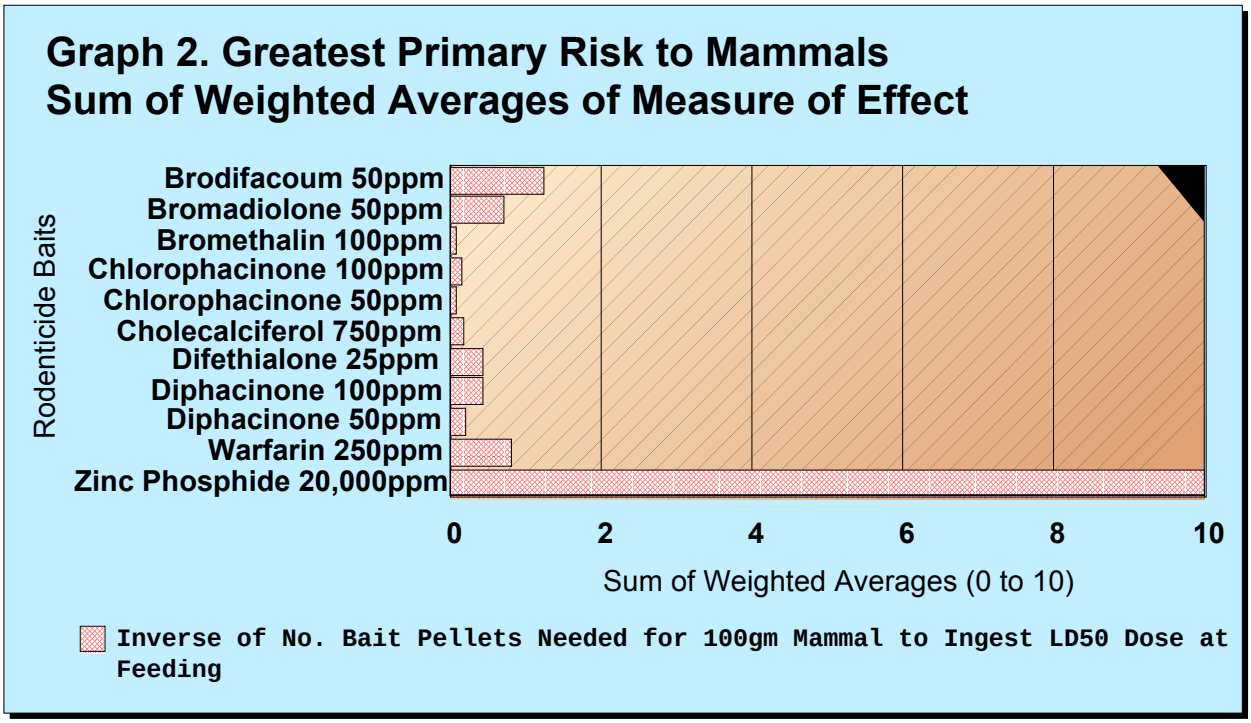
[b] RQ = ppm ai in bait/LC50

Table 33. Comparative Analysis Model Results for Primary Risk to Nontarget Mammals

Rodenticide	mg ai/kg bait	Inverse of the LD50 dose for a 100-g rodent (no. bait pellets)[a]	Summary value
Brodifacoum	50	0.25	1.25
Bromadiolone	50	0.14	0.71
Bromethalin	100	0.02	0.10
Chlorophacinone	100	0.03	0.16
Chlorophacinone	50	0.02	0.08
Cholecalciferol	750	0.04	0.18
Difethialone	25	0.09	0.45
Diphacinone	100	0.09	0.43
Diphacinone	50	0.04	0.22
Warfarin	250	0.17	0.83
Zinc Phosphide	20,000	2.00	10.00

[a] from Table 31

Figure 3. Comparative Analysis Model Summary Values For Primary Risk to Nontarget Mammals



The little information available on primary risk to mammals in the field has mostly come from animals found dead or moribund on treatment plots during efficacy trials and from an operational control program on a Canadian island. Howald (1997) reported that dusky shrews (*Sorex monticolus*) entered bait stations and fed on brodifacoum bait during a rat-control program on a Canadian island. By day 20 of baiting, shrews had eaten bait in 80% of the 42 rat bait stations. The shrew population declined sharply but rebounded to about half the prebaiting level after baiting stopped in 1994; however, shrew numbers declined further when baiting resumed in 1995. The long-term impact of baiting on the shrew population is unclear. No difference in population size was found pre- and post-baiting on a larger, adjacent island.

Some information on nontarget risks was gained during studies conducted to assess the efficacy of 0.01% ai and 0.005% ai chlorophacinone and diphacinone baits against California ground squirrels inhabiting rangeland. Baroch (1996a,b) applied chlorophacinone bait by spot-baiting or in bait stations, and treatment plots were searched periodically for target and nontarget carcasses . Thirty-six nontarget deer mice, San Joaquin pocket mice (*Perognathus inornatus*), and woodrats were found dead; based on the presence of blue dye incorporated into the bait and/or signs of internal or external hemorrhaging, mortality of 31 (86%) mice was attributed to the baiting. Four dead desert cottontails (*Sylvilagus auduboni*) and 2 dead Botta's pocket gophers (*Thomomys*

bottae) also were collected, but there was no evidence that these had been exposed to bait. In another study designed to assess the efficacy of chlorophacinone and diphacinone baits, some small mammals, especially kangaroo rats (*Dipodomys* spp.), were found dead on treated plots (Salmon et al. 2002). Collectively, these studies indicate that some small nontarget mammals will be killed when these baits are applied for controlling ground squirrels.

Comparative Toxicokinetics: Absorption, Metabolism and Excretion of Anticoagulants

Considerable differences exist in absorption, metabolism and excretion of the anticoagulants, which may have important consequences for both primary and secondary risk. A compound that is rapidly metabolized or excreted from a primary consumer may result in a lesser risk than one that bioaccumulates with repeated sublethal exposure, even if repeated exposure occurs weeks or even months after initial exposure (Eason and Murphy 2000). Those compounds more rapidly cleared from the body are less likely to pose such long-term risk. The available information indicates that the second-generation anticoagulants are much more persistent in animal tissue than are the first-generation anticoagulants. Data also suggest that brodifacoum may be more persistent than either difethialone or bromadiolone. Few data exist for the non-anticoagulants but, based on lack of toxicity in secondary tests, apparently they are not retained in toxicologically significant amounts in animal tissues.

Most of the available information is from studies that examined elimination and retention following a single, sublethal oral dose of anticoagulant. In a baiting situation, however, rats or mice will not die for several days or more after ingesting a lethal dose and may continue consuming bait. A wild Norway rat may ingest as many as 80 brodifacoum LD50 doses if feeding only on bait and as many as 40 LD50 doses if offered a choice of bait or untreated food (ICI Americas, Inc. 1978b). In a situation of repeat exposure for several days or more, anticoagulant may circulate in the blood at higher levels and for a longer time than suggested by studies in which only a single, sublethal dose was administered (Belleville 1981).

Elimination of anticoagulants from the body is sometimes described as rapid (e.g., Poché 1986, Kaukeinen et al. 2000). However, such characterizations usually refer to the rapid excretion of unbound or unabsorbed material being excreted principally in feces during the first few days after administration. Alternatively, it may refer to the clearance from the blood as compared with tissue retention. Rather than concentrating on the amount of anticoagulant excreted, risk assessments should focus on the material retained in the body after single and multiple exposures. The studies summarized below indicate the differences among these compounds and their potential to bioaccumulate with repeat exposure.

Second-generation anticoagulants

Second-generation compounds are not readily metabolized, and the major route of excretion of unbound compound is through the feces. After absorption, high concentrations circulate in the blood and are rapidly established in the liver and other tissues. Half-lives in the blood of rats are 1.0 to 1.4 days for bromadiolone and 6.5 days for brodifacoum (Table 34). Elimination from liver is much slower and biphasic, with a very prolonged terminal phase. It is apparent from the studies discussed below that a proportion of any ingested dose of a second-generation anticoagulant bound in the liver, kidney, or pancreas remains in a stable form for some time and is only very slowly excreted.

Hawkins et al. (1991) administered brodifacoum and bromadiolone to rats in a single oral dose of 0.2 mg ai/kg. Elimination was biphasic, with half-lives of 63 days for brodifacoum and 17 days for bromadiolone in the initial 28 days and 282 and 318 days, respectively, in the terminal phase. These differences are not statistically significant, but mean liver concentrations of brodifacoum were significantly higher for brodifacoum throughout the study (Table 35).

Bratt and Hudson (1979) found that radiolabeled brodifacoum was rapidly and almost completely absorbed when administered to rats in a single oral dose (0.25 mg ai/kg). After 10 days, about 11 to 14% had been eliminated in urine and feces, but 74.6% of the dose was still retained in body tissues. Almost half the dose administered was detected in the carcass and skin, with lesser amounts in the liver (22.8%), pancreas (2.3%), kidney (0.8%), spleen (0.2%), and heart (0.1%). The estimated half-life of brodifacoum in rat tissues was estimated to be 150 to 200 days.

Batten and Bratt (1987) orally dosed male rats with a single dose of radiolabeled brodifacoum at doses of either 0.02. 0.15, or 0.35 mg ai/kg. The highest concentration of radioactivity in the liver was found 1 day after dosing, but 21 to 34% of the dose was still detected after 13 weeks and >11% after 104 weeks (Table 36). The elimination half-life for the 2 lowest doses was 350 days. For rats dosed at 0.35 mg ai/kg, a near-lethal dose (LD50 = 0.39 to 0.56 mg ai/kg), elimination from the liver was biphasic and consisted of a rapid phase (days 1 to 4) in which the half-life was approximately 4 days and a slower phase (days 28 to 84) in which the half-life was 128 days. Two rats dosed at that level died during the study. Signs of brodifacoum toxicosis were observed in some survivors. Some dosed rats also had gained less body-weight and displayed signs of internal hemorrhage when dissected.

Table 34. Persistence of Second-generation Anticoagulants in Blood and Liver

Anticoagulant	Species	Dose (mg ai/kg)	No. doses	Blood $t_{1/2}$[a] (days)	Liver retention[a,b] (days)	Reference
Brodifacoum	rat	0.02 or 0.15 0.35	1 1		350[c] ($t_{1/2}$) 128[d] ($t_{1/2}$)	Batten and Bratt 1990
Brodifacoum	rat	0.2	1		282 ($t_{1/2}$)	Hawkins et al. 1991
Brodifacoum	rat	0.25	1		150-200 ($t_{1/2}$)	Bratt and Hudson 1979
Brodifacoum	rat	0.06	4 (at weekly intervals)		136 ($t_{1/2}$)	Belleville 1991
Brodifacoum	rat	0.35	1		130 ($t_{1/2}$)	Parmar et al. 1987
Brodifacoum	rat			6.5	>80	Bachmann and Sullivan 1983[e]
Brodifacoum	possum	0.1	1	20-30	>252	Eason et al. 1996
Brodifacoum	rabbit			2.5		Breckenridge et al. 1985[e]
Brodifacoum	sheep	0.2 or 2.0	1		>128	Laas et al. 1985
Brodifacoum	dog			6		Woody et al. 1992[e]
Brodifacoum	dog			0.9-4.7		Robben et al. 1998[e]
Brodifacoum	human			0.7-1.5		Weitzel et al. 1990[e]
Difethialone	rat	0.5	1	2.3	126 ($t_{1/2}$) (175%, 98&)	Belleville 1986
Difethialone	rat	0.06	4 (at weekly intervals)		74 ($t_{1/2}$)	Belleville 1991
Difethialone	dog			2.2-3.2		Robben et al. 1998[e]

Anticoagulant	Species	Dose (mg ai/kg)	No. doses	Blood $t_{1/2}$[a] (days)	Liver retention[a,b] (days)	Reference
Bromadiolone	rat	0.2	1		318 ($t_{1/2}$)	Hawkins et al. 1991
Bromadiolone	rat	0.93	1	1.0-1.1	170 ($t_{1/2}$)	Parmar et al. 1987
Bromadiolone	rat	0.8	1	1.1		Kamil 1987[e]
		3.0	1	2.4		
Bromadiolone	sheep	2.0	1		256	Nelson and Hickling 1994[e]

[a] $t_{1/2}$ for plasma and liver is the elimination half-life ($-phase)
[b] liver retention is expressed as either the time period for which residues persist or as the elimination half-life
[c] the elimination half-life of 350 days is for a single oral dose of 0.02 or 0.15 mg ai/kg; elimination was not biphasic
[d] the elimination half-life of 128 days is the terminal phase for a single oral dose of 0.035 mg ai/kg; elimination was biphasic
[e] cited in Eason et al. (2001)

Table 35. Hepatic Concentrations of Brodifacoum and Bromadiolone in Rats Administered a Single Oral Dose of 0.2 mg ai/kg (adapted from Hawkins et al. 1991)

Days after dosing	Brodifacoum (ppm)	Bromadiolone (ppm)
1	1.107 ± 0.038	0.983 ± 0.049
7	1.078 ± 0.088	0.844 ± 0.051
14	1.121 ± 0.077	0.727 ± 0.098
50	0.838 ± 0.075	0.440 ± 0.042
100	0.679 ± 0.061	0.366 ± 0.026
200	0.539 ± 0.028	0.282 ± 0.041

Table 36. Percentage of a Single Dose of Brodifacoum Retained in the Liver for up to 104 Weeks (adapted from Batten and Bratt 1987)

Time after dosing	% of dose retained per group		
	0.02 mg ai/kg	0.15 mg ai/kg	0.35 mg ai/kg
Day 1	47.3	29.7	28.9
Week 4	39.2	37.1	23.5
Weeks 12-13	34.0	31.7	21.2
Week 65	16.0	15.4	-
Week 104	11.8	11.7	-

Based on those findings, the authors conclude that the existence of biphasic kinetics in the liver for brodifacoum has two important consequences. "Firstly the fast and slow phases can each be characterized by a half-life estimation. It is apparent however that the half-life quoted (approximately 4 days) using data from the fast initial phase of the elimination from the liver can give a misleading impression of the potential persistence of an anticoagulant. If lethal doses were used, tissue concentrations could only be measured prior to death and since this would occur during the rapid elimination phase the subsequent slow phase of elimination would not be apparent. This probably explains why data for bromadiolone, a structurally similar anticoagulant to brodifacoum suggest that this substance is rapidly eliminated from rats (Poché 1986). Secondly, the concentration of radioactivity in the liver at the beginning of the terminal phase is independent of the dose and therefore when expressed as a percentage of the dose decreases as the dose increases. This can give a misleading impression with regard to the size of the residue present."

Parmar et al. (1987) also reported biphasic elimination of radio-labelled brodifacoum and bromadiolone from rat liver. The initial phase occurred from days 2 to 8 after dosing, followed by a prolonged terminal phase when the elimination half-lives were 130 and 170 days for brodifacoum and bromadiolone, respectively. However, the results were presented only in an abstract with too few details provided to adequately evaluate the results reported.

Belleville (1991) orally dosed rats with 0.06 mg ai/kg brodifacoum or difethialone on 4 occasions at weekly intervals. After 6 months, 21% of the total brodifacoum dose and 7% of the total difethialone dose was retained in hepatic tissue (Table 37). Hepatic half-lives calculated for the 158 days after the final dose (days 22 to 180) were 136 days for brodifacoum and 74 days for difethialone.

Table 37. Hepatic Concentrations in Rats Dosed at 0.06 mg ai/kg on Days 0, 7, 14, and 21 (adapted from Belleville 1991)

Time after initial dose	Brodifacoum (ppm)	Difethialone (ppm)
22 days	2.01 $\pm$ 0.15	1.28 $\pm$ 0.15
49 days	1.50 $\pm$ 0.48	0.84 $\pm$ 0.15
77 days	0.98 $\pm$ 0.32	0.49 $\pm$ 0.08
4 months	0.85 $\pm$ 0.15	0.35 $\pm$ 0.07
6 months	0.87 $\pm$ 0.16	0.29 $\pm$ 0.08

Studies in species other than rats also indicate that brodifacoum can be retained in animal tissue for a very long time. Eason et al. (1996) detected brodifacoum residue 9 months after administration of a sublethal dose of 0.1 ppm in possums. Laas et al. (1985) examined retention of brodifacoum in sheep tissues and its excretion via feces after a single, sublethal oral dose of either 0.2 or 2.0 mg ai/kg to 14 sheep. Sheep were sacrificed periodically 2 to 128 days after dosing and liver, carcass, and fat tissues analyzed for residue. Brodifacoum was detected in the liver after 128 days, at concentrations of 0.64 and 1.07 mg ai/kg dry weight (equivalent to 0.22 and 0.36 mg ai/kg wet weight), respectively, for the 2 doses. Residue also was detected for up to 8 days in fat and up to 15 days in the carcass. Bromadiolone was detected for 256 days in the liver of sheep that received a sublethal dose of 2 mg ai/kg (Nelson and Hickling 1994). Breckenridge et al. (1985) reported a plasma elimination half-life of about 2.5 days for rabbits dosed with brodifacoum, and Woody et al. (1992) observed an elimination half-life for brodifacoum in serum of 6± 4 days in four dogs. The plasma half-life of brodifacoum determined in three human patients with severe bleeding disorders was found to be approximately 16–36 days (Weitzel et al. 1990).

First-generation anticoagulants

Although fewer data are available for the first-generation anticoagulants (Table 38), the available information indicates they are generally less persistent in the blood and body tissues. Belleville (1981) orally administered radio-labeled chlorophacinone to rats with either a single dose of 1 to 1.26 mg ai/rat (~4 to 6 mg ai/kg) or 3 daily doses of 1.43 mg ai/rat (~6 to 7 mg ai/kg). The compound was rapidly absorbed and metabolized; 90% was excreted within 48 h and 100% within 4 days. Elimination was almost totally via the feces; <1% was via urine and CO_2. The $t_{1/2}$ in blood was 9.8 h, with the maximum concentration attained after 4 to 8 h. The maximum blood concentration in rats that received 3 doses was 1.8 to 3.7 times higher than that from rats receiving a single dose. Concentrations in body tissues after 4 h and 48 hours were highest in liver, but chlorophacinone also was present in kidneys, lungs, heart, muscle, fat, and other parts of the carcass (Table 39).

Yu et al. (1982) studied the metabolism and disposition of diphacinone in rats and mice. In rats given a single oral dose of radiolabeled diphacinone at either 0.18 or 0.4 mg ai/kg, about 70% of the dose was eliminated in feces and 10% in urine within 8 days, whereas about 20% of the dose was retained in body tissues. Mice given a single dose of 0.6 mg ai/kg eliminated most diphacinone within 4 days, and only 7% was retained in body tissues. In both rats and mice, most radioactivity (59 to 69%) was detected in the liver and the kidneys (9 to 12%). Radioactivity also was detected in the brain, heart, spleen, lungs, blood, muscle, fat, and gonads. Several major metabolites were identified, and parent diphacinone in excreta and liver accounted for only about 20% of the dose. In another study, cattle that received a single injection of 1 mg ai/kg had almost constant residue concentrations in liver and kidney at 30, 60, and 90 days after dosing (Bullard et al. 1976). The plasma half-life in humans is reported to be 15 to 20 days (WHO 1995).

Table 38. Persistence of First-generation Anticoagulants in Blood and Liver

Anticoagulant	Species	Dose (mg ai/kg)	No. doses	Blood $t_{1/2}$[a] (days)	Liver retention[a,b] (days)	Reference
Diphacinone	cattle	1.0	1		>90	Bullard et al. 1976
Diphacinone	human			15-20		WHO 1995
Chlorophacinone	rat	4-5	1	0.4		Belleville 1981
Warfarin	rat			0.7 (%) 1.2 (&)		Pyrola 1968[c]
Warfarin	rabbit			0.2		Breckenridge et al. 1985[c]
Warfarin	possum			0.5		Eason et al. 1999
Warfarin	human	0.5-100	1	0.6-2.4		O'Reilly et al. 1963[c]
Warfarin	pig				30-40	O'Brien et al. 1987[c]

[a] $t_{1/2}$ for plasma and liver is the elimination half-life ($-phase)
[b] liver retention is expressed as either the time period for which residues persist or as the elimination half-life
[c] cited in Eason et al. (2001)

Table 39. Chlorophacinone Residue in Rats 4 and 48 hours After an Oral Dose of 1.26 mg ai per Rat (adapted from Belleville 1981)

Tissue	µg ai/g (ppm)	
	4 h after dosing	48 h after dosing
Liver	31.1	2.9
Kidney	6.6	1.2
Lung	4.5	0.4
Heart	3.1	0.2
Muscle (thigh)	2.0	0.1
Fat	1.2	0.7
Carcass	5.2	0.3

Diaz and Whitacre (1976) orally dosed rats with diphacinone (0.32 mg ai/kg/day) for 1 or 2 days. Rats dosed for 2 days were sacrificed 72 h after the second dose and those dosed for 1 day were sacrificed after 48 h. In rats dosed for 2 days, about 45% of the total dose administered was excreted (86% in feces, 14% in urine) and 25% was retained in body tissues 72 h after the last dose. The remaining 30% of the dose was not recovered. The body tissues retaining the most diphacinone at 96 h were the hide and tail, liver, intestine, blood, and the carcass (Table 40). In rats dosed for 1 day and sacrificed after 48 h, about 5% of the dose was excreted and 61% retained; the remained was not recovered.

In contrast to other anticoagulants, especially the second-generation compounds, warfarin is extensively metabolized and the major route of excretion is in the urine. Limited data exist regarding persistence of warfarin in the liver. O'Brien et al. (1987; cited in Eason et al. 2001) found comparatively rapid clearance of warfarin in pigs, with concentrations declining to very low levels after approximately 30 days. Meehan (1984) states that approximately half the warfarin consumed by a rat remains in the body after 6 hours. Thijssen (1995) cites a half-life of 7 to 10 days in animal tissue, and Ford (1993; cited in Poché and Mach 2001) reported a half-life of 42 hours in the gastro-intestinal tract. EPA (1982) noted that only 7.6% of the warfarin consumed in bait by 11 rats remained in the carcass after a 5-day feeding period. According to Machlin (1984; cited in Poché and Mach 2001), warfarin concentrates in the liver, but the adrenal glands, lungs, bone marrow, kidneys, and lymph nodes also contain measurable amounts. Breckenridge et al. (1985) reported a plasma elimination half-life of 5.6 hours in rabbits. O'Reilly et al. (1963) reported that the mean half-life varied from 24 to 58 hours for disappearance of warfarin from the plasma of human volunteers given a single oral dose of 0.5 to 100 mg ai/kg; no dose-dependent effect on half-life was apparent over this range of doses.

Table 40. Percentage of Diphacinone Retained by Rats Dosed For 1 or 2 Days With 0.32 mg ai/kg (adapted from Diaz and Whitacre 1976)

Organ	% of total dose retained[a]	
	48 h after 1 dose	72 h after 2 doses
Intestine	22.1	4.1
Liver	19.4	5.4
Hide and tail	10.9	6.5
Carcass	3.9	3.8
Blood	1.8	4.0
Muscle	0.8	0.4
Kidney	0.7	0.3
Testis	not reported	0.8
Lung	0.5	0.2
Fat	0.2	0.4
Heart	0.1	0.2
Spleen	0.1	0.1
Brain	<0.1	<0.1

[a] because only 66-70% of the total dose was recovered, percentages in tissues are likely to be higher than the values tabulated

Potential Secondary Risks

Birds

Qualitative assessments of potential secondary risks are based on mortality and other adverse effects reported in secondary-hazards tests, information obtained from field studies and operational control programs, toxicokinetic data, residue levels reported in primary consumers, and incidents. Much of the data are presented in preceding sections of this assessment. It can be difficult to extrapolate from laboratory data to wild birds in the field, because of factors such as animal behavior and environmental conditions. However, laboratory tests are not necessarily overly conservative as argued by some registrants. As discussed in the *Final Report of the Avian Effects Dialogue Group, 1988-1993* (AEDG; Rymph 1994), even sublethal effects seen in controlled laboratory conditions might result in decreased survival or reproduction in the field where animals also are exposed to other stressors, and such effects often are overlooked in the risk assessment process. The AEDG notes that "Decreases in the survival or reproduction of birds following acute or chronic pesticide exposures that would be sublethal in the laboratory may result from alterations in physiological condition, motor function and behavior."

Additional information also is available to demonstrate that exposure to rodenticide baits can have adverse effects. Information from field studies and control program is presented below, and incident data that help characterize secondary risks are discussed in an "*Incident Data: Birds and Nontarget Mammals*" section later in the document. Data gaps exist for some of the rodenticides, but some marked differences in potential secondary risk are apparent among the compounds.

Based on the available feeding studies, brodifacoum poses the greatest potential secondary risk to birds. In 11 secondary-hazard studies that exposed 149 raptors or scavengers to brodifacoum-poisoned prey, 42% of exposed birds died. Many survivors exhibited signs of intoxication, including bleeding. Moreover, mortality via secondary exposure is not limited to laboratory tests but has also been widely reported in field studies and brodifacoum control programs (see below). Brodifacoum residue also has been detected in the liver of numerous dead owls, eagles, hawks, and corvids (see Attachment D). Potential risks of difethialone cannot be adequately characterized until secondary-hazard data are available. However, based on its similarity to brodifacoum in chemical structure (Attachment A), physical and chemical properties, acute toxicity profile for birds (Table 3) and mammals (Table 8), and retention times in animal tissue (Table 34), difethialone is presumed to pose comparable risks. Some uncertainty exists due to the lack of hazard data and also because difethialone baits are formulated with less active ingredient (25 ppm) than are brodifacoum baits (50 ppm).

The other anticoagulants also exhibit a potential for secondary risk to birds but not to the same extent as brodifacoum and possibly difethialone. Secondary hazard studies suggest that bromadiolone and diphacinone pose greater potential risks than do chlorophacinone and warfarin, which are less hazardous and less likely to bioaccumulate in body tissues.

Some information is available for zinc phosphide, but additional data are needed to characterize potential secondary risks of bromethalin and cholecalciferol. Studies indicate that zinc phosphide has a low secondary hazard, probably because it is rapidly converted to phosphine gas in the stomach and not retained in toxicologically significant quantities in body tissues of primary consumers. However, undigested bait in primary consumers may pose a hazard to raptors or scavengers that might consume the GIT.

Based on the data from secondary hazard laboratory studies and the data available on retention times in blood and liver of target species, the comparative analysis model indicates that brodifacoum and difethialone pose the greatest potential secondary risks to birds (Table 41). Brodifacoum has higher summary values than difethialone for all three measures of effect. Mean (%) mortality of secondary lab studies appears to be the most significant measure of effect leading to the conclusion that brodifacoum poses substantially greater potential secondary risk to birds than the other rodenticides (Figure 4).

Table 41. Comparative Analysis Model Results for Secondary Risk to Birds

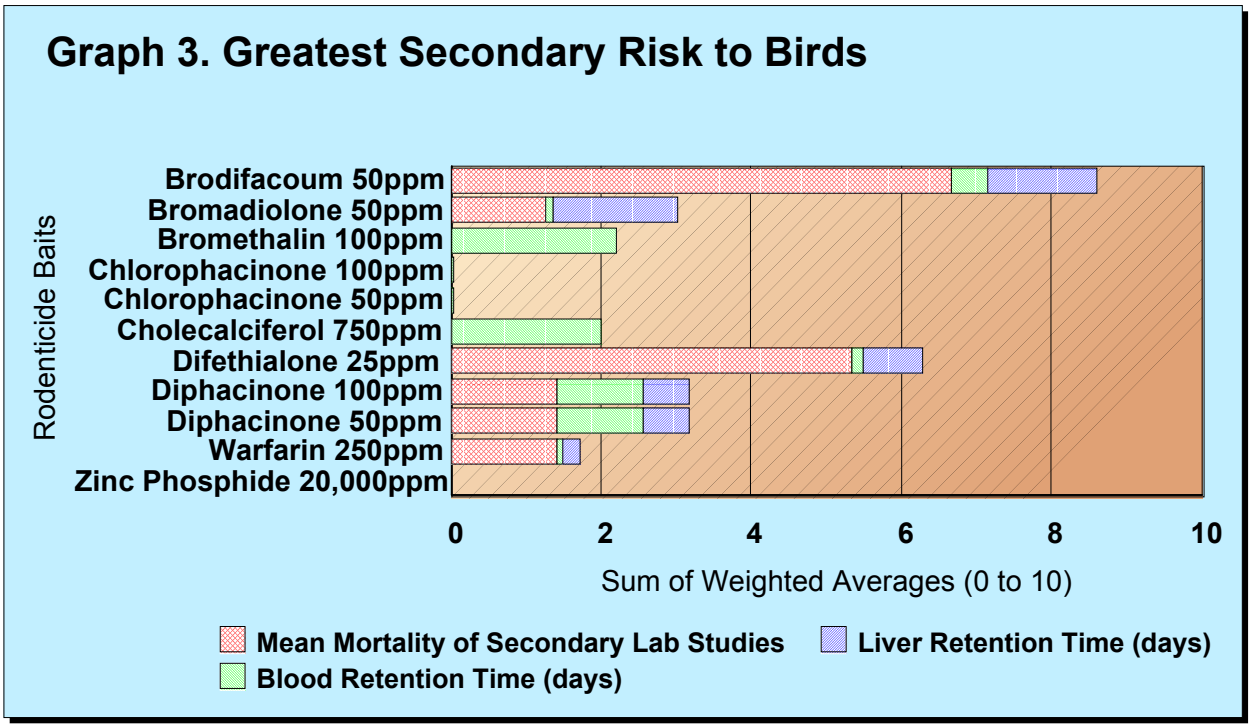
Rodenticide	mg ai/kg bait	Measure-of-effect values			Summary value
		mean mortality (%)[a]	blood retention time (days)[b]	liver retention time (days)[b]	
Brodifacoum	50	42.00	7.30	217.00	8.60
Bromadiolone	50	8.00	1.40	248.00	3.03
Bromethalin	100	No Data	5.60	No Data	2.20
Chlorophacinone	100	0.00	0.40	No Data	0.03
Chlorophacinone	50	0.00	0.40	No Data	0.03
Cholecalciferol	750	0.00	25.50	No Data	2.00
Difethialone	25	33.60[c]	2.50	117.70	6.29
Diphacinone	100	9.00	17.50	90.00	3.18
Diphacinone	50	9.00	17.50	90.00	3.18
Warfarin	250	9.00	0.82	35.00	1.72
Zinc phosphide	20,000	0.00	No Data	No Data	0.00

[a] from Tables 11-12, 14-16, and 18-19

[b] from Tables 13 and 17

[c] as noted in Appendix C, difethialone is considered a special case due to its similarity to brodifacoum; while missing data, it is given a % equal to 80% of that for brodifacoum.

Figure 4. Comparative Analysis Model Summary Values For Secondary Risk to Birds



Information from field studies and control programs: Some information from field studies and control programs is available for some rodenticides, especially brodifacoum. Hegdal and Colvin (1988) examined risk to Eastern screech-owls (*Otus asio*) during experimental baiting for vole control in orchards during the fall and winter of 1981-82. The study indicates considerable risk to screech-owls and possibly other raptors that feed on voles baited with a 10 ppm brodifacoum bait (baits registered for rat and mouse control are 50 ppm). Thirty-two screech-owls were radio-tracked after the baiting. Some owls disappeared or were taken by predators, but the minimum documented mortality of screech-owls was 58% for those individuals for which more than 20% of their home range included treated orchard. Mortality was also considerable (17%) for those owls having less than 10% of their home range including treated areas. Liver-residue analysis was conducted on 16 screech-owls collected or found dead during the study. Although the limit of detection 0.3 ppm was deemed inadequate by the authors, brodifacoum residue was detected at levels ranging from 0.3 to 0.8 ppm in 9 owls., and residue was found in owls collected up to 57 days posttreatment. Death of a long-eared owl (*Asio otus*) also was presumed due to brodifacoum, based on extensive hemorrhage and detection of residue in owl pellets containing vole remains.

Hegdal and Blaskiewicz (1984) found no secondary risk to barn owls residing on New Jersey farms when brodifacoum was applied to control rats and mice from late July to September in 1980. Radio-telemetry data for 34 owls indicated they spent most feeding time hunting for meadow voles in fields and marshes and spent little time foraging for rats and mice around farms. Rats and mice comprised only 3.9% and 2% of the diet, respectively, and owl traps baited with mice and placed around farmsteads were ignored by owls. In contrast, Duckett 1984 (cited in Newton et al. 1999 and Eason and Spurr 1995) reported a major decline in a barn owl population on an oil palm plantation in Malaysia after second-generation anticoagulants were applied for rat control. The owls were feeding on rats and the owl population declined from 40 to 2 individuals.

Howald et al. (1999) examined effects of brodifacoum baiting on avian scavengers during rat control on a Canadian island. They conclude that there is a very real risk of secondary poisoning of some predators and scavengers, and the impact on ravens may have been severe. Thirteen dead ravens were found out of an island population estimated at 20 to 72 individuals. All 13 dead ravens had brodifacoum residue in the liver, with concentrations ranging from 0.98 to 2.52 ppm. Ravens were likely exposed from eating the bait as well as secondarily via prey who had previously fed on the bait. Secondary poisoning is evident from observations of ravens scavenging on rat carcasses and the presence of rat hair in the gizzard of several ravens. Assuming an LD50 of 0.56 mg ai/kg (a value offering 95% species protection for birds) and a rat total-body burden of 1.4 mg ai (based on measured residue concentrations in 10 rats), the authors calculate that a single brodifacoum-poisoned rat could provide 2 to 3 LD50 doses for a raven or crow. No mortality of bald eagles was evident during the baiting program, but exposure occurred. Twenty bald eagles were trapped and 1 other rescued during the baiting program. Brodifacoum was detected at levels of 0.037, 0.041, and 1.74 ppm in the blood plasma of 3 (15%) of 21 eagles sampled. The authors calculated that a bald eagle, because of its large size, would need to eat about 3.2 rats to obtain an LD50 dose.

Based on numerous bird kills during operational control programs with brodifacoum in New Zealand, Eason and Spurr (1995) conclude that the potential for secondary adverse effects is much greater for second-generation anticoagulants than for first-generation anticoagulants. Secondary adverse effects on Australasian harriers (*Circus approximans*), New Zealand falcons (*Falco novaeseelandiae*), rails, brown skuas (*Catharacta skua*), gulls, and owls (morepork, *Ninox novaeseelandiae*) has been reported after brodifacoum baiting (Eason and Spurr 1995, Towns et al. 1993, Ogilvie et al. 1997, Walker and Elliott 1997). Stephenson et al. (1999) studied the fate of moreporks, which feed on mice, after a single aerial application of brodifacoum to eradicate mice on Mokoia Island. Twenty-eight owls were monitored after the baiting, including 14 that were radio-tagged and tracked. Three (21%) radio-collared owls died. Seven (50%) owls not radio-collared disappeared, which the authors believe is most likely a result of secondary poisoning. Two dead owls were analyzed for residue, and brodifacoum was detected in the liver of both at concentrations of 1 and 1.1 ppm.

A survey in Great Britain indicates that exposure of barn owls to second-generation anticoagulants may be frequent and widespread. As part of a pesticide-monitoring scheme, the livers from 717 dead barn owls were analyzed for anticoagulant residue from 1983 to 1996

(Newton et al. 1990, 1999; Wyllie 1995). Although second-generation anticoagulants were detected in 26% of the owls (34 to 37% in the latter years when better analytical methods were available), most deaths resulted directly from collisions with cars and trucks or starvation. However, the authors believe that the proportion of deaths due to rodenticides may have been underestimated. Almost all carcasses had been collected from open areas, such as roadsides. As the authors note, death from anticoagulant exposure is delayed and preceded by lethargy, and most victims are likely to die in their roosts, in roof-cavities or hollow trees, where they are not likely to be found. Also, carcasses found in such locations are most often too decayed to permit tissue analysis. Newton et al. (1990) also note that ". . . there remains the possibility that sub-lethal levels of rodenticide may predispose death from other causes, or reduce the chance of recovery from accidents.", and they emphasize that ". . . more monitoring of residues and population trends is clearly desirable."

No field studies are available for difethialone or bromadiolone. Some information on nontarget exposure to bromadiolone has been reported in France and Switzerland, where bromadiolone is used for control of water voles (*Arvicola terrestris*) and coypu (nutria). From 1991 to 1994, a number of dead birds suspected to have been exposed to anticoagulant rodenticides were submitted for analysis. Bromadiolone was detected in the liver of 15 of 16 dead Eurasian buzzards, 5 of 5 kites (*Milvus migrans*), and the one harrier examined (Berny et al. 1997). Saucy et al. (2001) reported deaths of numerous birds, mostly Eurasian buzzards but also kites and carrion crows, after bromadiolone bait (150 ppm) was mechanically applied in underground burrows for water vole control in Switzerland.

The Agency is not aware of any field tests designed to assess secondary risk to raptors from first-generation anticoagulants or the non-anticoagulants. Several field tests designed to assess the efficacy of chlorophacinone and zinc phosphide included searches for nontarget carcasses as a secondary objective. None found any indications that raptors or avian scavengers were killed from feeding on target species previously exposed to the rodenticides. However, most search effort was devoted to locating nontarget carcasses on and immediately around baited plots. Because raptors may be wide-ranging and anticoagulants are slow-acting, radio-tracking individual birds is essential to evaluate their interactions with the target species and to determine their fate (Fagerstone and Hegdal 1998, Colvin et al. 1991, Colvin et al. 1988, Edwards et al. 1988).

Nontarget mammals

Based on a qualitative assessment of potential secondary risk to mammals from feeding studies, all 6 anticoagulants appear to pose a potential secondary risk to mammalian predators and scavengers, although warfarin apparently less so than the others. Secondary risks from zinc phosphide appear to be low for most species, especially those that don't consume the GIT where undigested bait may be present. Too few data are available to adequately assess potential risks of either bromethalin or cholecalciferol.

The comparative analysis model results indicate that diphacinone, chlorophacinone, and brodifacoum pose the greatest potential secondary risk to mammals (Table 42). Retention time in blood was the most significant measure of effect leading to the conclusion that diphacinone poses greater potential secondary risk than does chlorophacinone, while mean (%) mortality of secondary lab studies was the most significant measure of effect leading to the conclusion that both diphacinone and chlorophacinone poses greater potential secondary risk than does brodifacoum (Figure 5).

Table 42. Comparative Analysis Model Results for Secondary Risk to Mammals

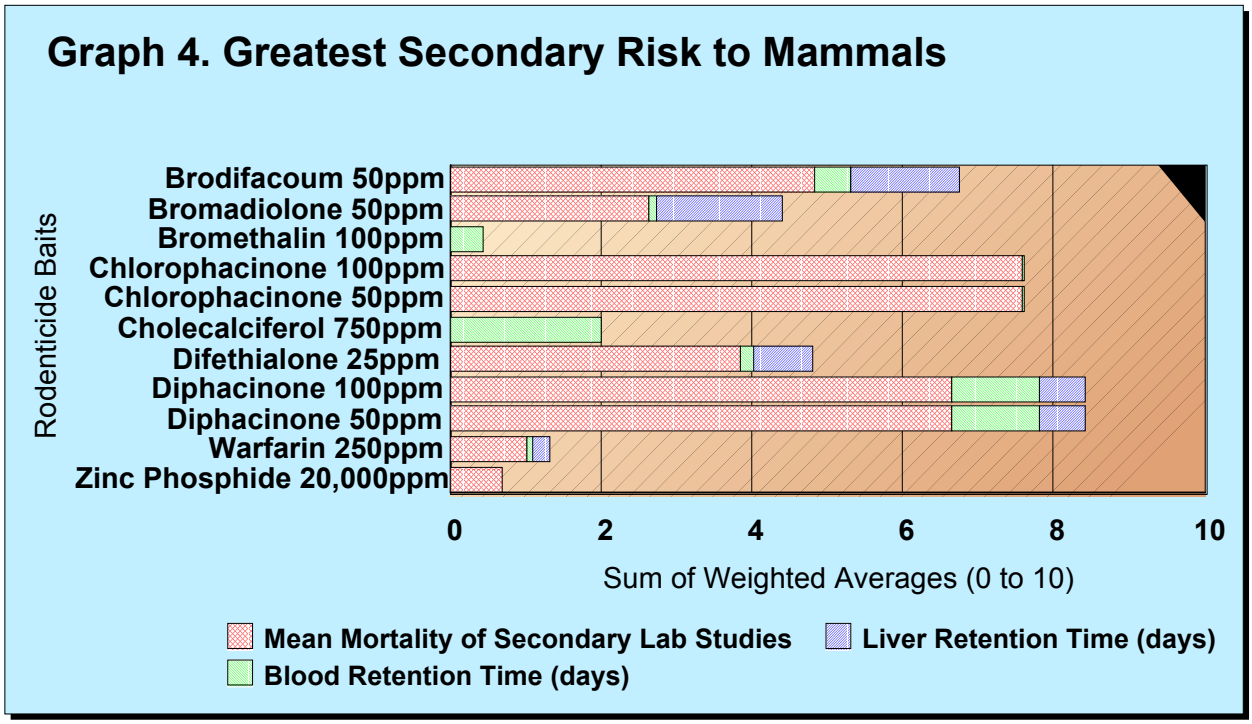
Rodenticide	mg ai/kg bait	Measure-of-effect values			Summary value
		mean mortality (%)[a]	blood retention time (days)[b]	liver retention time (days)[b]	
Brodifacoum	50	42.00	7.30	217.00	6.76
Bromadiolone	50	23.00	1.40	248.00	4.40
Bromethalin	100	0.00	5.60	No Data	0.44
Chlorophacinone	100	55.00	0.40	No Data	7.62
Chlorophacinone	50	55.00	0.40	No Data	7.62
Cholecalciferol	750	0.00	25.50	No Data	2.00
Difethialone	25	33.60[c]	2.50	117.70	4.82
Diphacinone	100	58.00	17.50	90.00	8.42
Diphacinone	50	58.00	0.82	90.00	8.42
Warfarin	250	9.00	5.60	35.00	1.32
Zinc phosphide	20,000	4.00	No Data	No Data	0.69

[a] from Tables 20-27

[b] from Tables 13 and 17

[c] as noted in Appendix C, difethialone is considered a special case due to it's similarity to brodifacoum; while missing data, it is given a % equal to 80% of that for brodifacoum.

Figure 5. Comparative Analysis Model Summary Values For Secondary Risk to Nontarget Mammals



Information from field studies and control programs: The Agency is not aware of any field studies designed to assess secondary risks to mammals, but exposure and mortality has been documented in some situations. Extensive mortality of introduced mammalian predators was reported during brodifacoum-baiting operations for rats in New Zealand forests. Mortality of stoats (ermine), ferrets, weasels, and cats was reported to be 100% after brodifacoum application (Alterio 1996, Alterio et al. 1997; cited in Stephenson et al. 1999). In one study, all 11 radio-collared stoats and the 1 radio-collared weasel died within 9 days of bait application. In another study, Murphy et al. (1998) detected brodifacoum residues in the liver of 56% of 16 feral ferrets, 78% of 40 stoats, and 71% of 14 weasels examined after baiting.

Some information on nontarget exposure of mammals to bromadiolone was obtained during vole and coypu control in France (Berny et al. 1997). Bromadiolone was detected in the liver of 22 of 31 red foxes (*Vulpes vulpes*), 4 of 28 rabbits (*Oryctolagus cuniculus*) and hares (*Lepus capensis*), 3 of 6 wild boar (*Sus scrofa*), 2 roe deer (*Capreolus capreolus*), 2 stone martens (*Martes foina*), a lynx (*Lynx lynx*), and a badger (*Meles meles*). Based on the species involved, secondary poisoning seems to have been the predominant route of exposure. Saucy et al. (2001) reported deaths of 38 wild mammals, mostly red foxes and mustelids, and 18 cats and dogs after

bromadiolone bait (150 ppm) was mechanically applied in underground burrows for water vole control in Switzerland.

Second-generation anticoagulants were detected in the liver of 31% of 29 polecats (*Mustela putorius*) analyzed from 1992 to 1994 in Britain (Shore et al. 1996, Newton et al. 1999). Most of the carcasses collected were found along roadsides. The authors believe the survey results indicate exposure of polecats to second-generation rodenticides may be common, and they suggest that studies to determine potential effects of such exposure are warranted.

Savarie et al. (1979) orally dosed 10 wild coyotes with diphacinone, with doses ranging from 0.31 to 5 mg ai/kg. Radio collars were attached to these animals, and they were released back into the wild and monitored for survival. Seven (70%) of the 10 coyotes died within 7 to 16 days, with an average time to death of 9.6 days.

Incident Data: Birds and Nontarget Mammals

Ecological Incidents Information System (EIIS)

Incident reports submitted to the Agency indicate that birds and nontarget mammals are being exposed to rodenticides, especially brodifacoum. EFED's EIIS contains information on more than 300 incidents in which one or more of the rodenticides was detected in birds or nontarget mammals (Table 43 and Attachment D). Brodifacoum was detected in more than 244 of those, including 25 of 26 involving exposure to more than one rodenticide. Bromadiolone was detected in 39 incidents, including 17 that also involved exposure to brodifacoum. Twenty-five incidents are reported for zinc phosphide, 20 for diphacinone, 13 for chlorophacinone, 4 for warfarin, 1 for difethialone, and none for bromethalin or cholecalciferol. Eleven of the incidents for the first-generation anticoagulants also included exposure to a second-generation anticoagulant, usually brodifacoum. Approximately 80 additional incidents involving raptors exposed to anticoagulant rodenticides, mostly brodifacoum (84%), have been reported by Stone et al. (2003). The New York State Department of Environmental Conservation has committed to providing those incident reports to EFED, and they will be added to the EIIS database when received.

Other anticoagulant-rodenticide incidents in the EIIS include rodents (mostly tree squirrels), opossums, and deer. Seven deer in New York state tested positive for anticoagulants, including 5 with brodifacoum and 2 with diphacinone. The deer apparently were exposed due to misuse and careless bait application.

Zinc phosphide was implicated in the deaths of some wild turkeys, waterfowl (especially geese) and a few squirrels and a rabbit. In most incidents, treated bait was present in crop or gizzard contents. Two red foxes also apparently died after eating mice who fed on zinc phosphide treated grain.

Table 43. Comparative Number of Reported Rodenticide Nontarget Incidents[a]

Rodenticide	Total[b]	Owls	Diurnal raptors	Corvids	Other birds	Wild canids	Wild felids	Other carnivores	Deer	Rodents/ Rabbits	Opossum
Second-generation anticoagulants											
Brodifacoum	244[c]	54	68	17	4	48	5	10	5	31	2
Difethialone	1	0	0	0	0	0	1	0	0	0	0
Bromadiolone	39	13	5	1	2	5	1	3	0	8	1
First-generation anticoagulants											
Chlorophacinone	13	0	1	0	2	5	1	0	0	4	0
Diphacinone	20	3	2	0	1	4	1	2	2	5	0
Warfarin	4	1	2	0	0	0	0	0	0	1	0
Others (non-anticoagulants)											
Bromethalin	0	0	0	0	0	0	0	0	0	0	0
Zinc Phosphide	25	0	0	0	22	1	0	0	0	2	0
Cholecalciferol	0	0	0	0	0	0	0	0	0	0	0

[a] based on confirmed exposure (e.g., detection of anticoagulant in the liver, zinc phosphide in crop contents); see Attachment B for additional details
[b] 26 incidents involved exposure to more than 1 registered anticoagulant
[c] Syngenta reported two incidents in 6(a)(2) aggregate reports; the species and number of individuals involved were not reported for these incidents

Most of the incidents in the EIIS occurred in New York and California, where state agencies have taken the time, effort, and expense of screening the liver of dead animals suspected to have been killed by rodenticides. Few other states appear to do so, although Wisconsin has reported several raptor incidents. A proper evaluation of rodenticide exposure requires necropsy of a dead animal by a wildlife pathologist. Liver tissue be extracted, frozen, and shipped to an analytical laboratory for analysis by high performance liquid chromatography (HPLC). Because so few anticoagulant screens are conducted, exposure of birds to anticoagulants is likely much more widespread than the number of incidents suggests. Most rodenticide incidents likely go undetected except in those rare instances when a predator carcass happens to be exposed in an open area (e.g., roadside) where it is observed by someone willing to take the time and effort to report it to the proper authorities (McDonald et al. 1998, Newton et al. 1999). In many situations, carcasses might not be detected, death may be attributed to natural mortality, or an incident may not be reported for a variety of reasons, including ignorance, apathy, or failure of authorities to investigate and confirm the cause of death (Rymph 1994, Vyas 1999).

The incidents reported in the EIIS are based on confirmed exposure to a rodenticide. Anticoagulants are detected from residue analysis of liver tissue, supplemented by gross pathological findings. According to Stone et al. (1999), the most frequent pathological signs observed in birds (>50% of individuals examined) exposed to anticoagulants are subcutaneous hemorrhage and overall pallor. Occasional signs (10 to 50% of individuals) include inter/intra-muscular hemorrhage, free hemorrhage in the body cavity, excessive bleeding from minor wounds, and low blood volume in the heart and major blood vessels. Toxicosis resulting from exposure to non-anticoagulants may be more difficult to confirm than for an anticoagulant. Zinc phosphide is generally detected by the presence of dyed bait in the crop, stomach, or alimentary canal. The presence of an acetylene odor also is diagnostic of zinc phosphide toxicity but can be detected only if intact carcasses are sent to an examining laboratory soon after death (Michigan Wildlife Diseases Manual, undated). Little information is available on methodology for detecting bromethalin or cholecalciferol in body tissues.

Anticoagulant rodenticides, especially brodifacoum, have been detected in numerous predators and scavengers. Avian species most commonly exposed are great horned owls and red-tailed hawks. Multiple incidents also have been reported for golden and bald eagles, corvids, barn owl, eastern screech-owl, northern spotted owl, Cooper's hawk (*Accipiter cooperii*), red-shouldered hawk, sharp-shinned hawk (*Accipiter striatus*), peregrine falcon (*Falco peregrinus*), American kestrel, and vultures. Other incidents have included a long-eared owl, a barred owl (*Strix varia*), a snowy owl (*Nyctea scandiaca*), and a spotted owl (*Strix occidentalis*). Carnivores exposed include coyotes, various foxes (including the endangered kit fox), raccoons, bobcats, skunks, mountain lions, and a weasel. Brodifacoum was detected most often, followed by bromadiolone, chlorophacinone, and diphacinone. Difethialone was detected in 1 dead bobcat.

The American Society for Prevention of Cruelty to Animals (ASPCA) Poison Control Center also has some incident information for pets, mostly dogs. The Center reports 2334 cases involving potential exposure of 2685 animals from November 01, 2001 to June 16, 2003 (S. Hansen, Senior Vice President, pers comm.). By rodenticide, the number of cases were 1161 for brodifacoum,

511 for bromadiolone, 218 for zinc phosphide, 206 for diphacinone, 66 for bromethalin, 48 each for difethialone and warfarin, 42 for chlorophacinone, and 34 for cholecalciferol. EFED does not assess risks to pets, and these data are not a component of the EIIS. However, they do augment the wildlife incident data in demonstrating that nontarget animals are being exposed to some rodenticides, despite product-label use directions to apply bait in locations out of reach of children, pets, domestic animals and nontarget wildlife, or in tamper-resistant bait stations.

The Rodenticide Registrants Task Force (Kaukeinen et al.2000) believe that rodenticide incidents are few when compared to other sources of wildlife mortality. They note that diseases accounted for most of the mortality reported by the National Wildlife Health Center (NWHC) from July 1998 through March 1999 and that there is only a single rodenticide incident. This is not surprising, because the NWHC focuses on diseases and does not analyze wildlife carcasses for rodenticide residues (A. Schrader, NWHC, pers comm.). The Rodenticide Registrants Task Force also contend that bird deaths from collisions with television and radio towers, starvation, and parasitism far exceed deaths attributable to rodenticides. However, small birds such as sparrows, starlings, and other songbirds far outnumber predatory birds such as owls, hawks, and eagles in such incidents. The latter are more likely to comprise incidents attributed to rodenticide toxicity and are more likely to be found and reported. Based on an analysis of the EIIS by Mastrota (1999), brodifacoum was surpassed only by diazinon in the number of wildlife incidents reported for pesticides from 1994 through 1998, the latest period analyzed.

New York State Raptor Incidents

Stone et al. (1999, 2003) provide some perspective on the extent of exposure on some raptor species. They reported 26 cases of anticoagulant poisoning of raptors in New York State from 1994 to 1997, of which 23 (88%) involved brodifacoum. The incidents comprised 17% of all diagnoses for great horned owls (n = 59) and 6% of all diagnoses (n = 114) for red-tailed hawks during that period. For the period 1998 through 2001, they detected anticoagulant rodenticide in 49% of the 265 raptors analyzed in New York State (Table 44). Brodifacoum was detected in 84% of the positive cases and bromadiolone in 22%. One or more anticoagulants were detected in 12 of 19 species examined, with most detections made in great horned owls (81%), red-tailed hawks (58%), Cooper's hawks (36%), and screech owls (45%). Mean residue levels in those 4 raptor species are presented in Table 45. The data are not sufficient to determine if these exposures are impacting local or state-wide populations of these species via mortality or reduced reproductive success, but they do indicate a need for a sound monitoring program to determine potential adverse effects of such exposure.

Table 44. Detection of Anticoagulant Rodenticides in Liver Tissue of Raptors and Vultures In New York State From 1998 Through 2001 (from Stone et al. 2003)

Species	no. analyzed	no. with anticoagulant rodenticide	% positive detects
Red-tailed hawk	78	45	58
Great horned owl	53	43	81
Cooper's hawk	50	18	36
Screech owl	22	10	45
Barred owl	13	3	23
Long-eared owl	7	2	29
Turkey vulture	2	2	100
Golden eagle	1	1	100
Bald eagle	5	1	20
Sharp-shinned hawk	11	1	9
Saw-whet owl	3	1	33
Peregrine falcon	2	1	50
Broad-winged hawk	11	0	0
Snowy owl	2	0	0
Northern goshawk	1	0	0
Rough-legged hawk	1	0	0
Merlin	1	0	0
Short-eared owl	1	0	0
Black vulture	1	0	0

Table 45. Anticoagulant Rodenticide Residues In Four Raptor Species Analyzed by Stone et al. (2003)

Anticoagulant/ Raptor species	no. detects	0 liver residue (ppm)	liver residue range (ppm)
Brodifacoum:			
Red-tailed hawk	42	0.21	0.006-1.28
Great horned owl	42	0.21	0.007-0.97
Screech owl	8	0.16	0.007-0.47
Cooper's hawk	12	0.10	0.008-0.22
Bromadiolone:			
Red-tailed hawk	6	0.23	0.08-0.50
Cooper's hawk	5	0.35	0.04-0.60
Diphacinone:			
Red-tailed hawk	1	0.34	
Cooper's hawk	1	0.10	
Warfarin:			
Great horned owl	1	0.73	
Cooper's hawk	1	0.10	
Chlorophacinone:			
Red-tailed hawk	1	0.18	

Endangered San Joaquin kit fox

Of particular concern are findings over the past several years that the endangered San Joaquin kit fox is being exposed to rodenticides, especially brodifacoum. From 1999 to 2003, liver tissue from 32 dead kit foxes has been screened for rodenticide residues by the Pesticide Investigations Unit of the California Department of Fish and Game and by the U. S. Fish and Wildlife Service (R. Hosea, pers. comm.). Anticoagulant rodenticide was detected in the liver of 27 (84%) foxes. Brodifacoum was detected in all 27 individuals. Bromadiolone also was detected along with brodifacoum in 2 of those foxes, and chlorophacinone and pival were found with brodifacoum in 1 fox each. Pival is no longer registered but may have been used under existing-stocks provisions.

Liver residue levels

Uncertainty exists as to what liver concentration might corroborate death or other adverse effects from anticoagulant exposure or even if such a cause-effect relationship is appropriate. The Rodenticide Registrants Task Force proposes a "threshold of toxicity" of 0.7 ppm for brodifacoum in liver tissue (Kaukeinen et al. 2000, Anonymous 2001). However, the proposed threshold level is based on only 2 laboratory studies with a total of 8 barn owls and some selected field surveys. Variation in susceptibility of different bird species, mammals, and other rodenticides is not addressed. Brodifacoum concentrations less than 0.7 ppm have been associated with toxicosis. Eason et al. (1996), for example, dosed 6 brushtail possums with a dose of 0.1 mg ai/kg and reported that 1 animal that died had a liver concentration of only 0.1 ppm brodifacoum. In another study, possums were offered brodifacoum baits for 3 nights (C. Eason, pers comm.). Mean bait consumption of 165.1 g, equivalent to 0.86 $\pm$ 0.04 mg ai/kg brodifacoum (range 0.33 to 1.09 mg ai/kg), provided a lethal dose. Extensive hemorrhaging was observed. The mean concentration in the liver was 0.56 mg ai/kg (range 0.17 to 1.04 mg ai/kg), and most animals that died had a liver concentration below the Rodenticide Registrants Task Force's proposed threshold level of 0.7 mg ai/kg. Hegdal and Colvin (1988) collected dead screech-owls during a brodifacoum-baiting study in Virginia; 8 of 9 dead owls with detectable residue had a level <0.7 ppm, and most had hepatic concentrations ranging from 0.3 (the limit of detection) to 0.5 ppm. Those authors also note that other wildlife has been killed in which brodifacoum liver residues were as low as 0.05 ppm (e.g., Rammell et al. 1984). Brown et al. (1996), in their review entitled "*Identification of pesticide poisoning in wildlife*", state that anticoagulant residues remaining after death are usually above or around 0.1 ppm.

A recent incident in Georgia correlates low levels of liver residue with deaths of a red-tailed hawk and a barn owl. These birds and several other raptors were housed in mews at the Amicalola Falls State Park. In November of 2003, the hawk and owl began showing abnormal physical and behavioral symptoms, and both birds died within a few days. Two other great horned owls later showed similar symptoms and were treated with vitamin K. A dead rat was also discovered in a hole in the back of one of the raptor cages. Second-generation anticoagulant rodenticides were in used at the park at the time of the incident to control rats around a lodge and intern housing. Necropsy of the bird carcasses by the Southeastern Cooperative Wildlife Disease Study, The University of Georgia, found moderate to severe clavarial hemorrhage in both birds and moderate focal myocardial hemorrhage in the barn owl. Microscopic examination also showed moderate to severe multifocal hemorrhage in the owl. Microbiological tests were negative. A fresh liver and kidney samples from each bird were screened for heavy metals and organic chemicals, including anticoagulant rodenticides. The only chemical detected in either bird was brodifacoum, with concentrations measured in the at 0.077 ppm in the hawk and 0.007 ppm in the owl. Despite the very low levels detected, the evidence of this case strongly indicates that the birds died from secondary poisoning by feeding on rats exposed to brodifacoum.

Hosea et al. (2001) demonstrate the importance of a proper necropsy in a case where a low liver-residue concentration (0.04 ppm) in the liver determined that brodifacoum caused the death of a golden eagle in California:

> "The carcass of an adult Golden Eagle was recovered from its breeding territory in Contra Costra County on March 11, 1999 (DFG case accession # P-2060A). The bird had been part of a long term radio telemetry study of eagles in the area. Based on telemetry data the breeding territory consisted mainly of open rangeland and random outbuildings with some areas of urban development.
>
> "The bird was not recovered in the vicinity of power lines and the feathers did not have the "singed" odor characteristic of accidental electrocution. The necropsy indicated no other evidence of physical trauma. The animal was skinned to determine the presence of puncture wounds from conflicts with other eagles or from a gunshot. The pericardial sac contained serum and blood. Approximately 65% of the surface of the heart muscle was haemorrhagic. The major vessels associated with the heart contained unclotted blood. The lung tissue was haemorrhagic, bleeding from a cut surface. the cerebro-spinal fluid was blood stained, indicating cranial haemorrhage. These clinical signs were consistent with previously published symptoms of anticoagulant toxicosis in raptors (Hegdal et al. 1988, Mendenhall and Pank 1980, Newton et al. 1990, Radvanyi et al. 1988). Liver tissue was analyzed for residues of anticoagulant rodenticides. Kidney tissue was also analyzed for lead concentrations. Kidney tissue had a lead concentration of 1.1 ppm, well below the level that would indicate acute toxicosis (Aiello 1998). Liver tissue had a brodifacoum concentration of 0.04 ppm. The presence of the rodenticide in liver tissue alone does not support a diagnosis of anticoagulant toxicosis. However, if considered in conjunction with the observed clinical signs consistent with anticoagulant toxicosis, a diagnosis of anticoagulant toxicosis is supported."

C. Eason (pers comm.) provided data depicting the range of brodifacoum concentration in various birds collected dead in areas where brodifacoum was applied in New Zealand. A total of 66 (63%) out of 105 birds found dead and 33 (40%) out of 82 collected alive contained brodifacoum residue (Table 44). As might be expected, brodifacoum residues were found in higher concentrations in birds found dead than in birds collected alive. Many dead birds had a liver concentration <0.7 ppm.

Taken together, findings from the field and the incident data indicate that the liver is an appropriate organ for determining exposure of birds and mammals to anticoagulant rodenticides. However, establishing a toxicity threshold of 0.7 ppm seems to be inappropriate and is not supported by the available data on mortality. Moreover, a toxicity threshold would need to account for adverse sublethal effects (e.g., reproductive, chronic).

Table 44. Brodifacoum Residues Detected In the Liver of Birds In New Zealand (compiled by C. Eason; data obtained from the New Zealand National Vertebrate Pesticide Database and Towns et al. 1994, Morgan et al. 1996, Ogilvie et al. 1997, Dowding et al. 1999, Empson and Miskelly 1999, Robertson et al. 1999, and Stephenson et al. 1999)

Species	Collected alive				Collected dead			
	No. tested	No. positive	mg ai/kg in positives		No. tested	No. positive	mg ai/kg in positives	
			mean	range			mean	range
Astralaian harrier	1	0			2	2	0.64	0.61-0.66
Australasian magpie	10	2	0.25	0.08-0.41	10	2	0.47	0.08-0.99
Bellbird	1	0						
Blackbird	6	6	0.10	0.01-0.20	7	7	0.55	0.01-1.10
Chaffinch					3	3	1.43	0.12-2.31
Paradise shelduck					4	4	0.56	0.24-0.80
Grey duck					1	1	0.91	
Mallard					2	2	1.07	0.90-1.23
Fantail	1	0						
Kaka (parrot)					3	3	2.87	1.20-4.10
Kakariki (parakeet)					2	1	0.03	
Kereru (pigeon)					5	0		
Brown kiwi					29	14	0.09	0.01-0.69
Kokako (wattlebird)					4	0		
Morepork (owl)	1	1	0.61		3	3	1.84	0.97-3.44
Myna					3	3	0.80	0.54-1.27
Pukeko (gallinule)					8	8	0.86	0.52-1.35
Robin, Chatham Island					1	1	0.35	
Robin, North Island					1	1	0.58	
Saddleback					4	2	0.33	0.05-0.60

Species	Collected alive				Collected dead			
	No. tested	No. positive	mg ai/kg in positives		No. tested	No. positive	mg ai/kg in positives	
			mean	range			mean	range
Silvereye					1	0		
Southern black-backed gull					1	1	0.58	
Spotless crake					1	1	0.04	
Tomtit	5	0			1	0		
Tui (honeyeater)					1	0		
Weka (rail)	48	24	0.25	0.01-0.95	7	7	1.08	0.11-2.30
Whitehead	5	0			1	0		

The liver is only one of many organs and tissues in which anticoagulant residue accumulates in the body. Concentrations in the liver are often, but not always, higher than in other tissues (e.g., Tables 39, 40, 46, 47). However, because the liver comprises only about 4 to 7% of the weight of a rat or mouse (Newton et al. 1990, Howald et al. 1999), most residue actually may be stored in other parts of the body. For example, Newton et al. (1990) reported a much higher mean residue concentration in liver (2.13 ppm) than in the remainder of the carcass (0.36 ppm) of 10 mice fed brodifacoum bait. However, the mean total amount of residue in the carcass (excluding the liver) was 11.85 µg ai versus only 3.51 µg ai in the liver (Table 47).

Table 46. Tissue Residues in Nine Captive Coyotes Killed With a Single Oral Dose of Diphacinone (adapted from Savarie et al. 1979)

Dose (mg ai/kg)	Tissue residue (ppm)					
	liver	small intestine	kidney	heart	muscle	fat
10	1.2	1.8	0.6	0.5	0.2	<0.1
10	0.7	0.3	0.5	0.2	<0.1	0.3
5	1.8	4.7	1.7	1.5	0.7	<0.1
5	0.5	0.4	<0.1	<0.1	<0.1	<0.1
2.5	0.6	1.3	0.9	0.5	<0.1	<0.1
2.5	0.6	1.0	0.6	0.2	<0.1	<0.1
1.25	1.1	0.5	0.7	0.2	<0.1	<0.1
0.63	1.0	0.3	0.5	0.1	<0.1	<0.1
0.63	0.6	0.2	0.2	<0.1	<0.1	<0.1

Table 47. Brodifacoum Residue in the Liver and Carcass of Mice Fed 20 ppm Bait For 1 Day (adapted from Newton et al. 1990)

Mouse	Liver		Carcass minus liver	
	µg ai	ppm (µg ai/g)	µg ai	ppm (µg ai/g)
1	0.14	0.07	15.39	0.45
2	1.73	1.66	16.07	0.53
3	4.06	3.03	13.13	0.42
4	4.44	2.39	7.44	0.22
5	5.52	2.70	5.10	0.16
6	1.69	1.10	14.48	0.47
7	5.67	3.64	9.77	0.28
8	6.72	2.85	19.83	0.58
9	2.70	1.86	5.37	0.18
10	2.44	1.97	11.88	0.35
mean	3.51 $\pm$ 0.66	2.13 $\pm$ 0.33	11.85 $\pm$ 1.54	0.36 $\pm$ 0.05

The "threshold of toxicity" concept (Kaukeinen et al. 2000, Anonymous 2001) also assumes that mortality is the only endpoint of concern. A sublethal dose of anticoagulant can produce significant clotting abnormalities and some hemorrhaging (Eason and Murphy 2001), and such effects might be especially detrimental if combined with other stressors that have additive or synergistic adverse effects. Jaques (1959) reported that stress is a hemorrhagic factor in rabbits and rats, and it could be induced by a variety of factors (e.g., frostbite, insulin, NACL). Only 6% of his rats died after 5 days of exposure to an anticoagulant compound (dicoumarol), but 50% died when exposed to the anticoagulant and additional stressors. Others have speculated that birds exposed to anticoagulants may become more susceptible to environmental stressors, such as adverse weather conditions, food shortages, and predation (Hegdal 1985, Hegdal and Colvin 1988, LaVoie 1990). Newton et al. (1999) have speculated that sublethal levels of rodenticide might predispose death from other causes (e.g., collisions with automobiles, starvation) or may reduce the chance of recovery from accidents.

Three golden eagles (*Aquila chrysactos*) recently died in captivity during relocation from the California Channel Islands (J. Linthicum, The Santa Cruz Predatory Bird Research Group [TSCPBRG], pers. comm.). Necropsies were performed and tissues analyzed for a variety of contaminants. Hemorrhaging in lung and brain tissue was reported in 2 birds, and brodifacoum was detected in the liver (0.004 to 0.026 ppm) of all 3 birds. TSCPBRG has trapped hundreds of golden and bald eagles as part of various studies and never previously had an injury or fatality. SCPBRG noted that "Birds of prey, in particular golden eagles, are hardy, tough animals." and

"Nothing in our experience or other's we have spoken to suggest that these birds should have died under these circumstances." Brodifacoum can't be directly implicated in the deaths of the 3 golden eagles, but concern exists. These birds might have succumbed to brodifacoum when augmented by additional stresses from handling and captivity.

Papworth (1959), in discussing the mechanism of anticoagulant toxicity, speculated that a slight scratch, bruise, or even a minor internal injury might lead to death from hemorrhage if clotting is inhibited over an injured surface. Some incidents reported to the Agency suggest that raptors exposed to anticoagulants can be in danger of excessive bleeding from minor wounds caused by their prey. Such wounds, not normally life-threatening, may cause prolonged bleeding and mortality when blood-clotting mechanisms are disrupted. One great horned owl exposed to brodifacoum (0.64 ppm liver residue) was collected near death on a farm where brodifacoum bait had been applied in barns and sheds. This owl was almost completely exsanguinated from a small laceration on a toe. Other owls and hawks found dead had bled excessively from minor wounds, usually on their feet, likely inflicted by prey (see Attachment D). A partially eaten muskrat was found by one dead owl that appeared to have bled excessively from a puncture wound extending from between the eyes into the sinuses. Brodifacoum was detected in the liver of these raptors at concentrations ranging from 0.08 to 0.80 ppm. Bromadiolone also was detected in 1 owl.

Some of the concerns and uncertainties regarding possible adverse sublethal effects can be addressed through avian reproduction studies, which the Agency will require for all pesticides with outdoor uses. The no-observable-adverse-effects concentration (NOAEC) established from these studies will be a more appropriate indicator of a toxicity threshold than is the liver residue in dead animals.

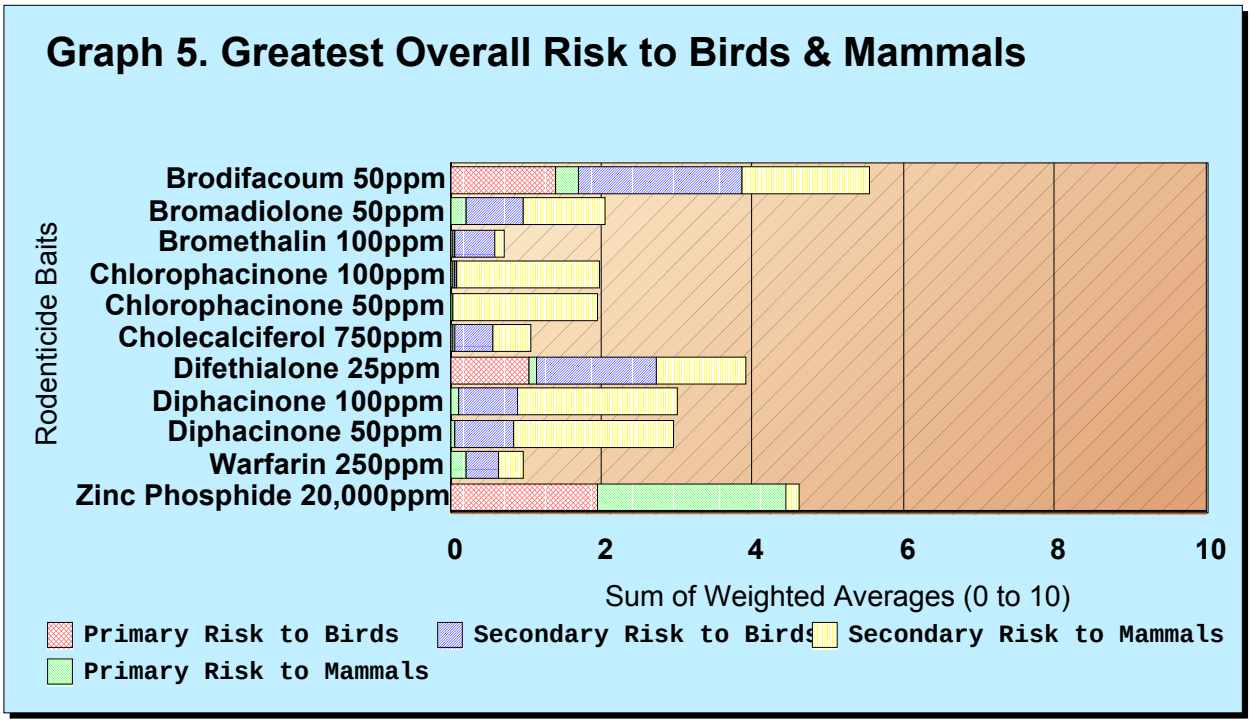
Conclusions

The available information indicates that differences exist among these rodenticides in their potential risks (primary and secondary) to birds and nontarget mammals. Based on the comparative analysis model, comparing measures of effect for primary and secondary risks to birds and mammals, brodifacoum, zinc phosphide, and difethialone are ranked as the rodenticides posing the greatest potential overall risk (Table 48, Figure 6).

Table 48. Comparative Analysis Model Results for Overall Risk to Birds and Mammals. Tabulated values are weighted measures of effect.

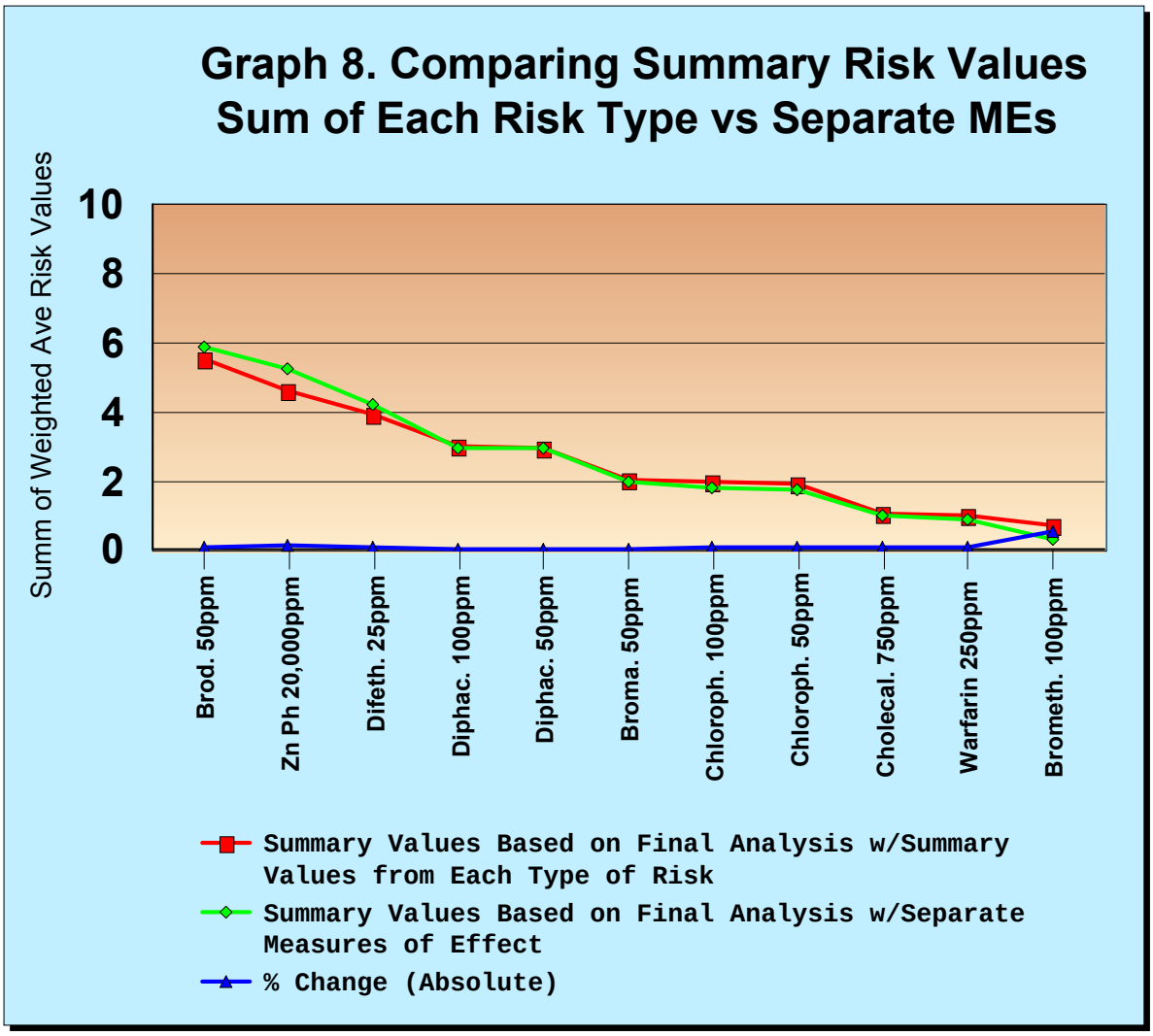
Rodenticide	mg ai/kg bait	Primary risks		Secondary risks		Summary values
		birds	mammals	birds	mammals	
Brodifacoum	50	5.58	1.25	8.60	6.76	5.55
Bromadiolone	50	0.10	0.71	3.03	4.40	2.06
Bromethalin	100	0.10	0.10	2.20	0.44	0.71
Chlorophacinone	100	0.14	0.16	0.03	7.62	1.99
Chlorophacinone	50	0.07	0.08	0.03	7.62	1.95
Cholecalciferol	750	0.12	0.18	2.00	2.00	1.07
Difethialone	25	4.15	0.45	6.29	4.82	3.93
Diphacinone	100	0.01	0.43	3.18	8.42	3.01
Diphacinone	50	0.01	0.22	3.18	8.42	2.96
Warfarin	250	0.04	0.83	1.72	1.32	0.98
Zinc Phosphide	20,000	7.81	10.00	0.00	0.69	4.63

Figure 6. Comparative Analysis Model Summary Values For Overall Risks to Birds and Nontarget Mammals



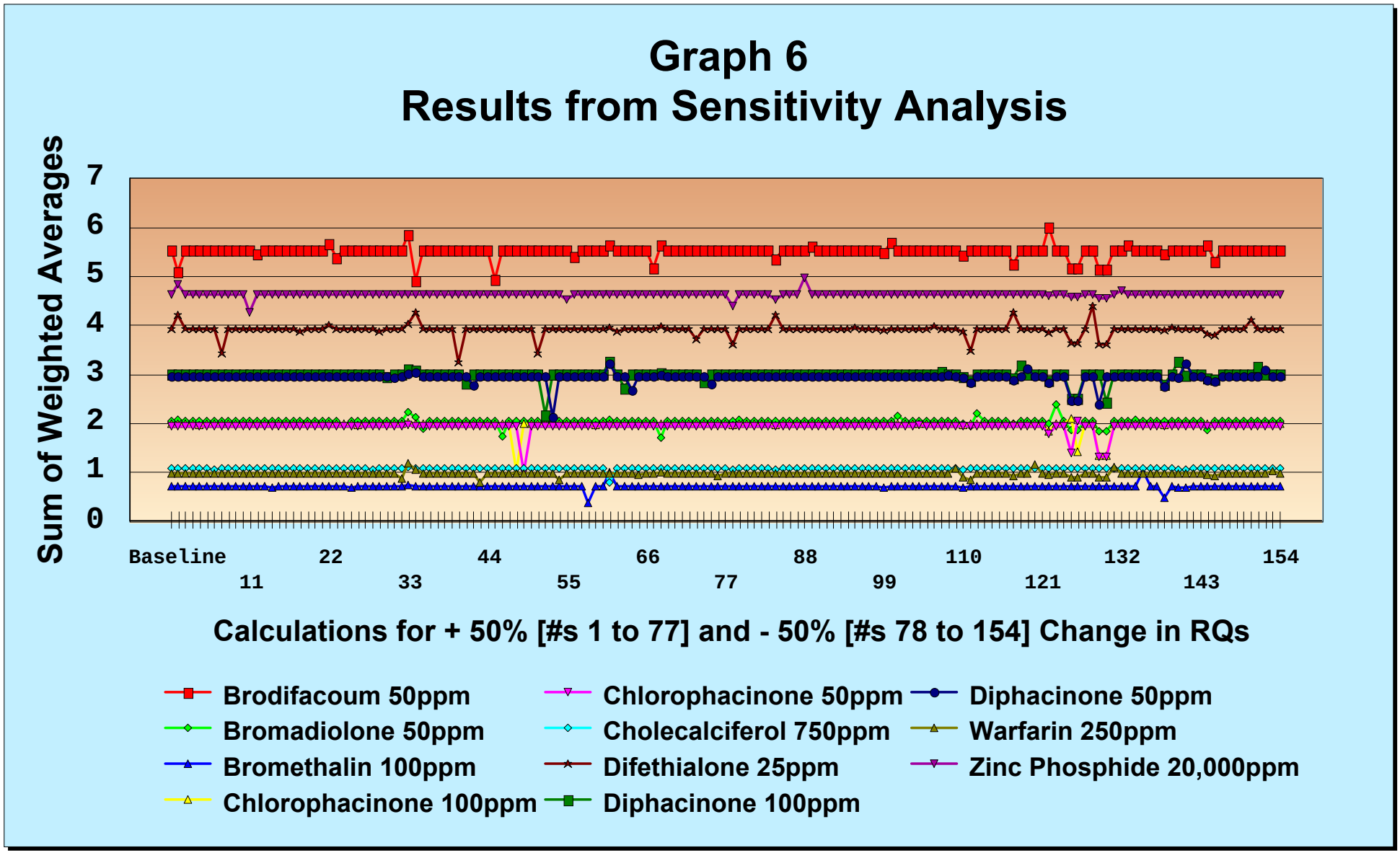
The approach taken for the overall analysis is to analyze each risk type separately, then analyze the summary values for each of the four risk types together. Each type of risk included variable and unequal numbers of measures of effect. Analyzing them separately and using summary values to derive an overall risk value eliminates unequal weighting of one risk over another due to differences in the number of measures of effect. An alternate approach is to consider all measures of effect in a single step and ignore unequal weighting. This alternate approach did not result in a change in the rankings (see Fig. 6).

Figure 7. Comparative Analysis Model Results Summary Values For Overall Risks When All Measures of Effect Are Considered in One Step



The sensitivity analysis (Fig. 7) indicates that the comparative analysis model rankings are robust, especially for brodifacoum, zinc phosphide and difethialone. Their ranking as the three rodenticides posing the greatest overall potential risk do not change when values for the measures of effect are varied by $\pm$50%. See Appendix C for additional details of the sensitivity analysis.

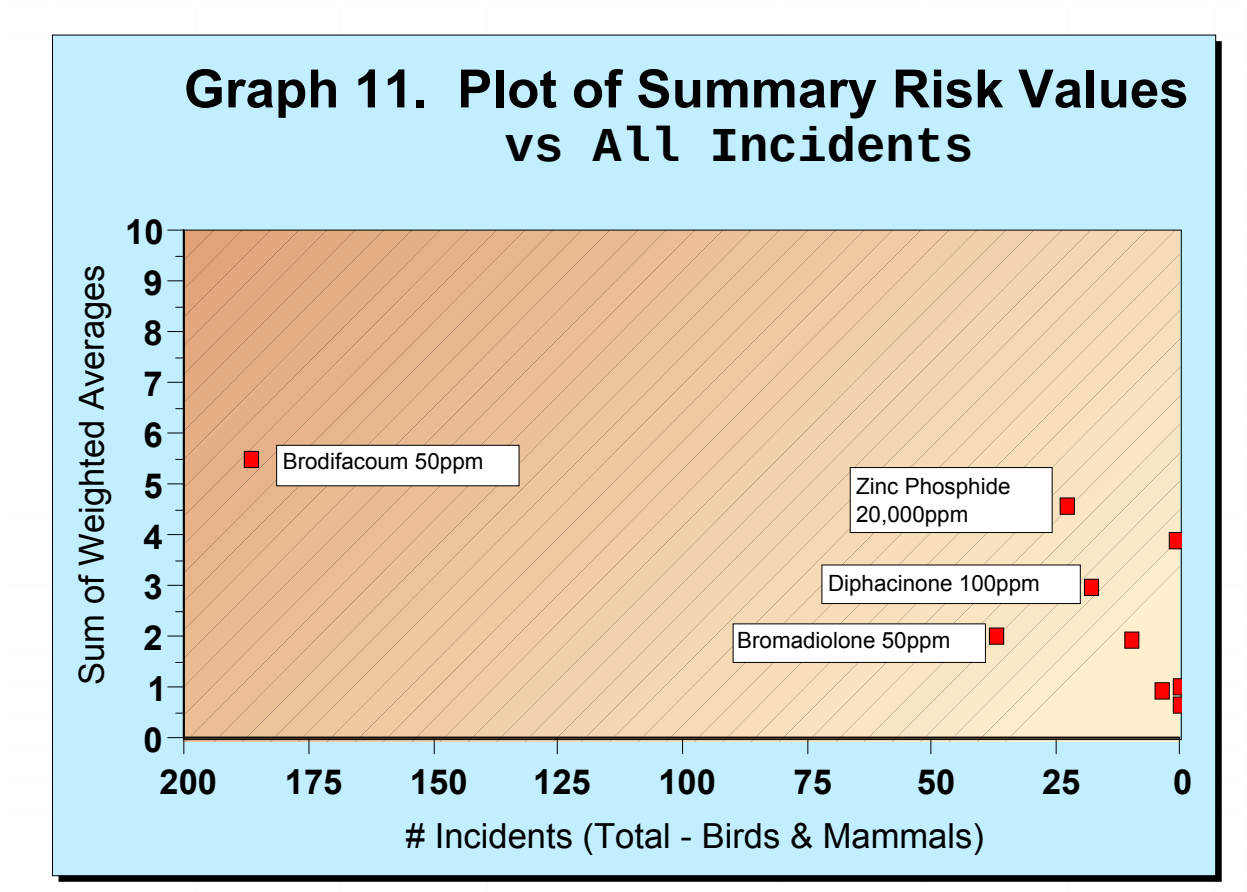
Figure 8. Sensitivity Analysis of Measure-of-effect Values Used in the Comparative Analysis Model. Each measure-of-effect value is separately decreased by 50% and then increased by 50%.



Lack of data for some rodenticides accounts for the most uncertainty in the comparative analysis model results. Data gaps include no secondary-hazards data for difethialone and few for bromethalin and cholecalciferol. For difethialone, which is highly similar to brodifacoum but used at a lower ai in baits (50 ppm vs 25 ppm), an assumption is made that secondary mortality would be about 80% of that reported for brodifacoum. Data are sufficient to distinguish differences in potential primary risks between 50 ppm and 100 ppm chlorophacinone and diphacinone baits but are insufficient to assess differences in secondary risks. Also, few if any data are available regarding retention time in blood and/or liver for some rodenticides, especially first-generation anticoagulants and the non-anticoagulants.

The incident data are not included in the comparative analysis model results but are meaningful for characterizing risk. A comparison of incidents versus the summary risk values for each rodenticide bait is depicted in Figure 9 (see graphs 9 and 10 in Attachment C for separate plots for birds and mammals). The baits with the most incidents and highest risk values are in the upper left, whereas those with the fewest incidents and lowest risk values are in the lower right portion of the graph. Brodifacoum is distinguished by its high summary value and high number of incidents in relation to the other rodenticides. Distinctions cannot be made between the 50 ppm and 100 ppm chlorophacinone and diphacinone baits in the incident data, but the 100 ppm baits are likely to present greater risk than the 50 ppm baits.

Figure 9. Plot of Summary Risk Values Versus Number of Incidents For Each Rodenticide



A "lines-of-evidence" assessment was performed based on the available data and supporting information. Each rodenticide is assigned a rating of high, moderate, or low for primary risk to birds, primary risk to nontarget mammals, secondary risk to birds, and secondary risk to mammals (Table 49). Differences among the rodenticides in their potential primary and secondary risks to birds are pronounced. Brodifacoum, and possibly difethialone, baits present the highest potential overall primary and secondary risks to birds and nontarget mammals. Brodifacoum is hazardous to birds and mammals, is persistent, and is widely used for commensal rodent control (see Table 2 for over-the-counter sales in 1996 and 1997). Difethialone is also hazardous to birds and mammals and it is very similar to brodifacoum (e.g., chemical structure, acute-toxicity profile). However, some uncertainty exists when comparing difethialone risks to brodifacoum risks, because market-share and use information and secondary-hazards data are lacking.

Based on the lines-of-evidence assessment, potential primary risks to birds are highest for zinc phosphide, brodifacoum, and difethialone. A small bird finding and eating a pellet or two of any of these baits is likely to ingest a lethal dose, and just a few pellets could provide a lethal dose to larger birds. In contrast, it seems highly unlikely that any small bird could eat 100 to 1000 pellets in a single feeding, which would be needed to provide an LD50 dose from a first-generation anticoagulant, bromadiolone, or cholecalciferol bait. Avian dietary RQs for zinc phosphide, brodifacoum, and difethialone greatly exceed the Agency's LOC for acute risk to birds, whereas they are not or only slightly exceeded for other rodenticides. The dietary RQ provides some useful information for comparing potential risks among rodenticide baits but is based on birds feeding continuously on rodenticide bait for several days. Although some birds might do so, others might only find one or a few pellets in a foraging bout. Therefore, the number of pellets needed to be eaten to provide an LD50 dose may be a more appropriate approximation of potential risk than is the dietary RQ. Nevertheless, the characterization of risk does not change based on the method used to estimate potential risk.

Brodifacoum and difethialone clearly present a greater potential risk to raptors and avian scavengers than do the other rodenticides. Risks posed by brodifacoum are apparent from experimental and other control applications in outdoor settings and from many incidents involving owls, hawks, eagles, corvids and other birds. Concern about risks of second-generation anticoagulants to avian predators and scavengers is widely expressed in the rodenticide literature (Colvin et al. 1988; Hegdal and Colvin 1988; Joermann 1998; Howald et al. 1999; Stephenson et al. 1999; Stone et al. 1999), and the need to monitor residues and population trends is evident (Newton et al. 1990, 1999). This need is especially critical for brodifacoum, because it is so widely used for commensal-rodent control and because it may pose a greater potential risk compared to the other rodenticides.

Rodenticide baits are not selective to the target species. Some baits pose a greater hazard than others, but all rodenticides pose a risk to small nontarget mammals that eat bait, and many pose a potential risk to mammals that prey or scavenge dead or dying rodents that have eaten bait. Baits are formulated to be lethal to small mammals, and many small nontarget mammals are likely to

find and eat bait available around the outside of buildings, inside barns and farm or utility shed, or in other outdoor settings.

Table 49. Primary and Secondary Risk Presumptions For Birds and Nontarget Mammals

Rodenticide	Primary risks		Secondary risks	
	birds	mammals	birds	mammals
Second-generation anticoagulants				
Brodifacoum	high	high	high	high
Difethialone	high	high	high	high
Bromadiolone	low to moderate	high	moderate	high
First-generation anticoagulants				
Diphacinone	low	high	moderate	high
Chlorophacinone	low to moderate	high	low	high
Warfarin	low	high	low	moderate
Others (non-anticoagulants)				
Bromethalin	moderate to high	high	insufficient data available	
Zinc phosphide	high	high	low	low
Cholecalciferol	low to moderate	high	insufficient data available	

The anticoagulants present a potential secondary risk to mammals, although warfarin probably to a lesser extent than the others. The incident data in Attachment D helps characterize and corroborate these risks. Zinc phosphide potentially poses minimal risks to either predatory birds or mammals, but insufficient data are available for bromethalin and cholecalciferol.

Eason et al. (2001) assessed risks of brodifacoum to nontarget birds and mammals in New Zealand, where brodifacoum is widely used to control rodents and possums. They conclude that ". . . the recorded mortality of birds after some control operations, coupled with the detection of brodifacoum residues in a range of wildlife including native birds and feral game animals raises

serious concerns about the long-term effects of the targeted field use of brodifacoum or its use around farms where wildlife might encounter poisoned carcasses." Eason et al. (in prep.) also note: "On an international level we note that the reports of non-target wildlife mortality and contamination in raptors and mustelids from anticoagulants are on the increase (Shore *et al.*, 1999; Howald *et al.* 1999; Stone *et al.* 1999; B. Hosea, pers. comm.) and we strongly recommend that residue-monitoring programmes are established in those countries where anticoagulants are used in the field or extensively around farm buildings. An improved understanding of the risk associated with this class of compound will be achieved when there is a better understanding of whether or not food-chain contamination is occurring. The development of 'biomarkers' of exposure for different bird species will assist those agencies involved in wildlife protection."

More information also is needed on the potential adverse sublethal effects of rodenticides. Newton et al. (1990) note that ". . . there remains the possibility that sub-lethal levels of rodenticide may predispose death from other causes, or reduce the chance of recovery from accidents." Eason and Murphy (2001) emphasize that the risk of brodifacoum is magnified by its persistence, which could lead to accumulation on repeated exposure. A compound that is rapidly metabolized or excreted from a primary consumer may result in a lesser risk than one that bioaccumulates with repeated sublethal exposure, even if repeated exposure occurs weeks or even months after the initial exposure. Those compounds more rapidly cleared from the body are less likely to pose such long-term risk. Unfortunately, most laboratory tests and risk assessments do not consider the potential for bioaccumulation of the highly persistent anticoagulant compounds. Sublethal effects on reproduction will be considered when the data become available.

Uncertainty and Data Needs

A number of factors contribute uncertainty to the assessment. Those that appear to contribute the greatest uncertainty are: (1) missing data, including acute, chronic, and secondary toxicity as well as retention of some active ingredients in the liver, blood, and other body tissues; (2) the variable quality and quantity of existing data on metabolism and retention times in rodents and nontarget species; (3) specific use information by formulation, including typical amounts applied by use site, seasonally, and annually; distances applied from buildings; amounts used in rural versus urban areas; use by Certified Applicators versus homeowners and other non-certified applicators; and other such relevant information; (4) information on the number and species of birds and nontarget mammals frequenting baited areas and their likelihood of their finding and consuming bait or poisoned primary consumers in the various use areas; (5) methods to determine liver concentration(s) and total body burdens of rodenticide that would corroborate death or even if such a cause-effect relationship is appropriate (e.g., the "threshold of toxicity" concentration); (6) not accounting for the impacts of sublethal effects on reproduction and nontarget mortality (e.g., clotting abnormalities, hemorrhaging, stress factors including environmental stressors, such as adverse weather conditions, food shortages, and predation); (7) not accounting for bioaccumulation of repeated sublethal exposures to bait or poisoned rodents utilized as food by predators and scavengers; and (8) lack of incident reporting.

The greatest reduction in uncertainty for these analyses is likely to come from addressing data gaps where data is missing or needs to be standardized because quality is variable, as well as obtaining specific use and exposure information. Some of the concerns about adverse sublethal effects can be addressed through reproduction studies, which the Agency will require for all pesticides with outdoor uses. The no-observable-adverse-effects concentration (NOAEC) established from these studies will be a more appropriate indicator of a toxicity threshold than is the liver residue in dead animals.

Endangered Species Considerations

In response to a formal consultation requested by EPA (1991b) under Section 7 of the Endangered Species Act, the United States Fish and Wildlife Service issued a Biological Opinion on *Effects of 16 Vertebrate Control Agents On Threatened and Endangered Species* in March, 1993 (USFWS 1993). The Biological Opinion included jeopardy determinations for mammals, birds, and reptiles potentially exposed via primary or secondary exposure to brodifacoum, bromadiolone, chlorophacinone, diphacinone, warfarin, bromethalin, zinc phosphide, and cholecalciferol. For each species addressed in the Biological Opinion, the Service determined either that use of the rodenticide "is likely to jeopardize" or "is not likely to jeopardize" the continued existence of the species. For the likely-to-jeopardize determinations the Service provided "reasonable and prudent alternatives" that preclude jeopardy but still allow use of the rodenticide. These alternatives represent the Service's best professional judgement of the measures necessary to provide the appropriate level of protection to the species. The Service also provided "incidental take" statements and "reasonable and prudent measures" to minimize take. Table 50 indicates the number of species, by rodenticide, for which the Service made a likely-to-jeopardize determination. The species addressed, jeopardy and no-jeopardy determinations, and the Service's reasonable and prudent alternatives and/or measures are tabulated for each of the 8 rodenticides in Attachment E. Difethialone, first registered in 1995, is not addressed in this or any subsequent Biological Opinion, but EPA believes the jeopardy determinations for brodifacoum also would be applicable for difethialone.

Table 50. USFWS (1993) Jeopardy Determinations For Endangered and Threatened Species at Risk From Use of Each Rodenticide (Except Difethialone).

Rodenticide	no. species likely at jeopardy		
	mammals	birds	reptiles
Brodifacoum	10	2	0
Bromadiolone	7	0	0
Chlorophacinone	20	1	0
Diphacinone	28	1	0
Warfarin	10	0	0
Bromethalin	10	0	0
Zinc phosphide	16	9	0
Cholecalciferol	10	0	0
Total no. species	29	11	0

Acknowledgments

We would like to thank those people who took the time and effort to provide information, critical peer review, or comments on various drafts of this assessment. We are especially grateful to C. Eason (Centre for Environmental Toxicology, New Zealand), E. Hill (USGS Patuxent Wildlife Research Center, retired), and R. O'Connor (University of Maine) for critical peer review of a previous draft of this assessment. Their peer reviews and credentials as peer reviewers are available in the public docket for the rodenticides. Dr. Eason also generously provided data from his research with rodenticides, especially brodifacoum and cholecalciferol, in New Zealand. Thanks also to G. Joermann (Federal Biological Research Centre for Agriculture and Forestry, Germany) and B. Rattner (USGS Patuxent Wildlife Research Center) for providing constructive comments and information. Other scientists who commented on previous drafts or various relevant topics include:

T. Bargar, EPA Office of Pesticides Program
S. Bradbury, EPA Office of Pesticides Program
J. Brooks, Tetrahedron, Inc.
S. Cragg, Tetrahedron, Inc.
C. Cubbison, EPA Office of Research and Development
J. Goodyear, EPA Office of Pesticides Program
G. Howald, Island Conservation and Ecology Group
W. Jacobs, EPA Office of Pesticides Program
N. Mastrota, EPA Office of Pesticides Program
P. Mineau, Canadian Wildlife Service
C. Moulton, Tetrahedron, Inc.
D. Rieder, EPA Office of Pesticides Program
T. Sinnott, NY State Department of Environmental Conservation

R. Hosea (California Department of Fish and Game) and W. Stone (NY State Department of Environmental Conservation) have provided most of the incident data cited in the assessment. The Wisconsin Department of Natural Resources also submitted several incident reports. The National Wildlife Health Center in Madison, WI generously provided data from their database, even though their primary focus is wildlife diseases. The Predatory Bird Research Group (University of California, Santa Cruz) furnished background and clinical histories of the three golden eagles from Santa Cruz Island, and N. Hamlett (Harvey Mudd College) contributed information on nontarget mortality and brodifacoum poisoning of owls and a hawk in Claremont, CA. The cooperation of these individuals and organizations is greatly appreciated.

T. Nguyen (EPA Office of Pesticides Program) drew most of the chemical structures in Attachment A.
K. McCormack (EPA Office of Pesticides Program) provided editorial comments.

W. Erickson would also like to acknowledge the input of Doug Urban in conducting this assessment. Doug passed away in December of 2003. He will be missed.

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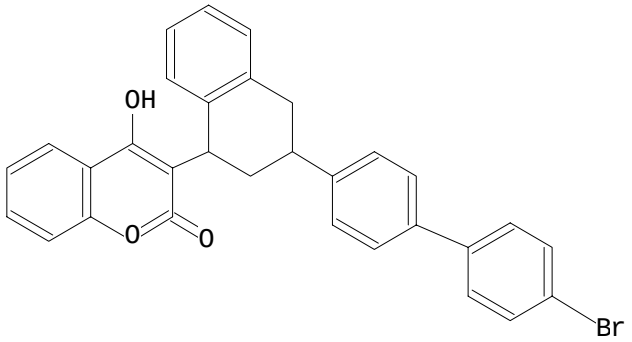
Attachment A: Chemical Structures and Selected Physical/Chemical Properties of the Rodenticides

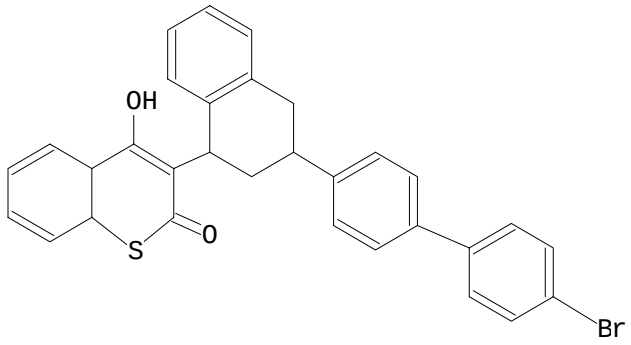
Brodifacoum:

Chemical name:	3-[3-(4'-bromo[1,1'-biphenyl]-4-yl)-1,2,3,4-tetrahydro-1-naphthalenyl]-4-hydroxy-2H-1-benzopyran-2-one
Chemical structure:	
Class:	coumarin anticoagulant
Molecular formula:	$C_{31}H_{23}BrO_3$
Molecular weight:	523.4
Physical state:	solid
Melting point:	228-232° C
Solubility:	<10 ppm in water at 20° C, pH 7

Difethialone:

Chemical name: 3-[3-(4'-bromo[1,1'-biphenyl]-4-yl)-1,2,3,4-tetrahydro-1-naphthalenyl]-4-hydroxy-

Chemical structure:



Class: coumarin anticoagulant

Molecular formula: $C_{31}H_{24}BrO_2S$

Molecular weight: 539.5

Physical state: solid

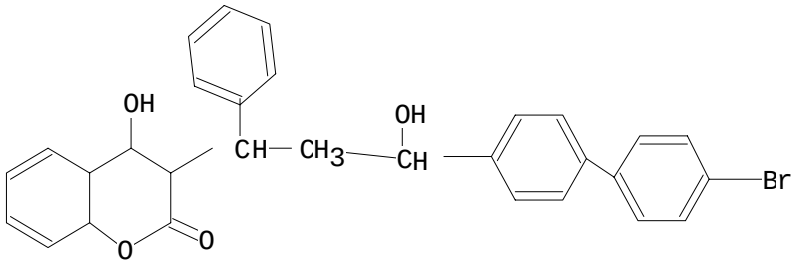
Melting point: 230° C

Solubility: 0.39 ppm in water at 25° C

Bromadiolone:

Chemical name: 3-[3-(4'-bromo[1,1'-biphenyl]-3-hydroxy-1-phenylpropyl]-4-hydroxy-2H-1-benzopyrane-2-one

Chemical structure:



Class: coumarin anticoagulant

Molecular formula: $C_{30}H_{23}BrO_4$

Molecular weight: 527.4

Physical state: solid

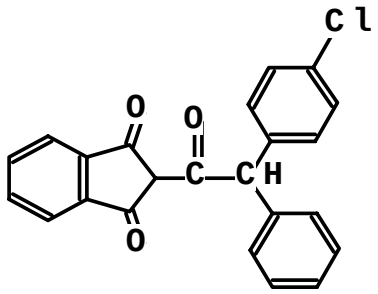
Melting point: 200-210° C

Solubility: 12 ppm in water at 20° C

Chlorophacinone:

Chemical name: 2-[(4-chlorophenyl)phenylacetyl]-1H-indene-1,3(2H)-dione

Chemical structure:



Class: indandione anticoagulant

Molecular formula: $C_{23}H_{14}O_3Cl$

Molecular weight: 373.8

Physical state: solid

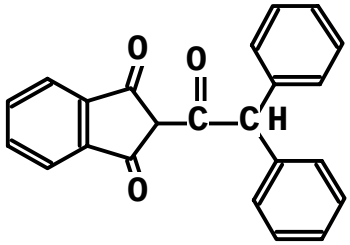
Melting point: 140° C

Solubility: 20-34 ppm

Diphacinone:

Chemical name: 2-(diphenylacetyl]-1H-indene-1,3(2H)-dione

Chemical structure:



Class: indandione anticoagulant

Molecular formula: $C_{23}H_{16}O_3$

Molecular weight: 340.4

Physical state: solid

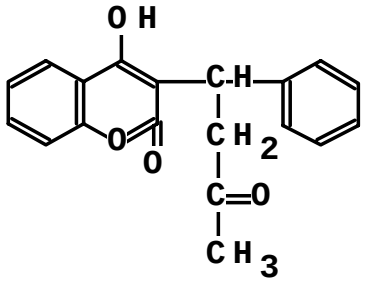
Melting point: 141-145^{o} C

Solubility: 17-30 ppm in water (not verified)

Warfarin:

Chemical name: 4-hydroxy-3-(3-oxo-1-phenylbutyl)-2H-1-benzopyran-2-one

Chemical structure:



Class: coumarin anticoagulant

Molecular formula: $C_{19}H_{16}O_4$
$C_{19}H_{15}NaO_4$ (sodium salt)

Molecular weight: 308.4
330.1 (sodium salt)

Physical state: solid

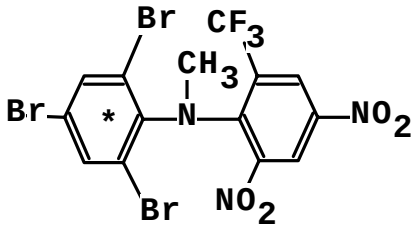
Melting point: 159-165° C

Solubility: 0.196 ppm in water at 25° C

Bromethalin:

Chemical name: N-methyl-2,4-dinitro-N-(2,4,6-tribromophenyl)-6-(trifluoromethyl)-benzenamine

Chemical structure:



Class: diphenylamine

Molecular formula: $C_{13}H_7Br_3F_3N_3O_4$

Molecular weight: 578.0

Physical state: solid

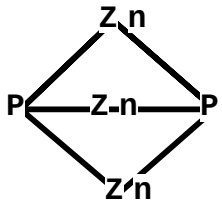
Melting point: 148-152°C

Solubility: 3.8 ppb at 25°C

Zinc phosphide:

Chemical name: zinc phosphide

Chemical structure:



Class: inorganic compound

Molecular formula: Zn_3P_2

Molecular weight: 258.09

Physical state: solid

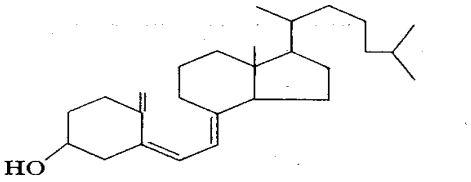
Melting point: 420^{o} C

Solubility: reported to be insoluble in water

Cholecalciferol:

Chemical name: 9,10-Secocholesta-5,7,10(19)-trien-3 beta-ol

Chemical structure:



Class:	sterol
Molecular formula:	$C_{27}H_{44}O$
Molecular weight:	384.6
Physical state:	solid
Melting point:	84-85^{o} C
Solubility:	no data available, but reported to be insoluble in water

Attachment B: Common and Scientific Names of the Birds and Mammals Cited in the Assessment

Order/ Common name	Scientific name	Family
Waterfowl (Anseriformes)		
Mallard	*Anas platyrhynchos*	Anatidae
Canada goose	*Branta canadensis*	Anatidae
White-fronted goose	*Anser albifrons*	Anatidae
Snow goose	*Chen caerulescens*	Anatidae
Paradise shelduck	*Tadorna variegata*	Anatidae
Grey duck	*Anas superciliosa*	Anatidae
Gallinaceous birds (Galliformes)		
Northern bobwhite	*Colinus virginianus*	Phasianidae
Ring-necked pheasant	*Phasianus colchicus*	Phasianidae
California quail	*Callipepla californica*	Phasianidae
Japanese quail	*Coturnix coturnix*	Phasianidae
Chukar	*Alectoris chukar*	Phasianidae
Gray partridge	*Perdix perdix*	Phasianidae
Turkey (wild)	*Meleagris gallopavo*	Phasianidae
Owls (Strigiformes)		
Barn owl	*Tyto alba*	Tytonidae
Great-horned owl	*Bubo virginianus*	Strigidae
Spotted eagle owl	*Bubo africanus*	Strigidae
Northern saw-whet owl	*Aegolius acadicus*	Strigidae
Eastern screech-owl	*Otus asio*	Strigidae
Long-eared owl	*Asio otus*	Strigidae
Short-eared owl	*Asio flammeus*	Strigidae
Spotted owl	*Strix occidentalis*	Strigidae
Tawny owl	*Strix aluco*	Strigidae
Barred owl	*Strix varia*	Strigidae
Snowy owl	*Nyctea scandiaca*	Strigidae
Morepork	*Ninox novaeseelandiae*	Strigidae

Order/ Common name	Scientific name	Family
Diurnal birds of prey (Falconiformes)		
Red-tailed hawk	*Buteo jamaicensis*	Accipitridae
Red-shouldered hawk	*Buteo lineatus*	Accipitridae
Eurasian buzzard	*Buteo buteo*	Accipitridae
Broad-winged hawk	*Buteo platypterus*	Accipitridae
Rough-legged hawk	*Buteo lagopus*	Accipitridae
Cooper's hawk	*Accipiter cooperii*	Accipitridae
Sharp-shinned hawk	*Accipiter striatus*	Accipitridae
Northern goshawk	*Accipiter gentilis*	Accipitridae
Golden eagle	*Aquila chrysactos*	Accipitridae
Bald eagle	*Haliaeetus leucocephalus*	Accipitridae
Eurasian harrier	*Circus pygargus*	Accipitridae
Australasian harrier	*Circus approximans*	Accipitridae
Kite	*Milvus migrans*	Accipitridae
American kestrel	*Falco sparverius*	Falconidae
Merlin	*Falso columbarius*	Falconidae
Peregrine falcon	*Falco peregrinus*	Falconidae
New Zealand falcon	*Falco novaeseelandiae*	Falconidae
Turkey vulture	*Cathartes aura*	Cathartidae
Black vulture	*Coragyps atratus*	Cathartidae
Herons (Ciconiformes)		
Great blue heron	*Ardea herodias*	Ardeidae
White stork	*Ciconia ciconia*	Ciconiidae
Gulls and shorebirds (Charadriiformes)		
Southern black-backed gull	*Larus dominicans*	Laridae
Laughing gull	*Larus atricilla*	Laridae
Black-billed gull	*Larus bulleri*	Laridae
Franklin's gull	*Larus pipixcan*	Laridae
Brown skua	*Catharacta skua*	Stercorariidae
New Zealand dotterel	*Charadrius obscurus*	Charadriidae
Variable oystercatcher	*Haematopus unicolor*	Haematopodidae

Order/ Common name	Scientific name	Family
Rails (Gruiformes)		
Weka	*Gallirallus australus*	Rallidae
Pukeko (purple gallinule)	*Porphyrio porphyrio*	Rallidae
Spotless crake	*Porzana tabuensis*	Rallidae
Parrots (Psittaciformes)		
Kaka	*Nestor meridionalis*	Psittacidae
Kakariki	*Cyanoramphus* sp.	Psittacidae
Pigeons/doves (Columbiformes)		
Mourning dove	*Zenaida macroura*	Columbidae
Kereru	*Hemiphaga novaeseelandiae*	Columbidae
Kiwi (Apterygiformes)		
Brown kiwi	*Apteryx mantelli*	Apterygidae
Perching Birds (Passeriformes)		
American crow	*Corvus brachyrhynchos*	Corvidae
Carrion crow	*Corvus corone*	Corvidae
Common raven	*Corvus corax*	Corvidae
Northwestern crow	*Corvus caurinus*	Corvidae
Fish crow	*Corvus ossifragus*	Corvidae
Black-billed magpie	*Pica pica*	Corvidae
Blue jay	*Cyanocitta cristata*	Corvidae
Australian magpie	*Gymnorhina tibicen*	Cracticidae
Myna	*Acridotheres tristis*	Sturnidae
House sparrow	*Passer domesticus*	Passeridae
Horned lark	*Eremophila alpestris*	Alaudidae
Lincoln's sparrow	*Melospiza lincolnii*	Emberizidae
Song sparrow	*Melospiza melodia*	Emberizidae
Red-winged blackbird	*Agelaius phoeniceus*	Emberizidae
Canary	*Serinus canarius*	
Chaffinch	*Fringilla coelebs*	Fringillidae
Robin (New Zealand)	*Petroica australis*	Eopsalttriidae

Order/ Common name	Scientific name	Family
Tomtit	*Petroica macrocephala*	Eopsalttriidae
Fantail	*Rhipidura fuliginosa*	Monarchidae
Bellbird	*Anthornis melanura*	Meliphagide
Tui	*Prosthemadera novaeseelandiae*	Meliphagide
Saddleback	*Philesturnus carunculatus*	Callaeidae
Kokako	*Callaeas cinerea*	Callaeidae
Whitehead	*Mohoua ochrocephala*	Pachycephalidae
Silvereye	*Zosterops lateralis*	Zosteropidae
Blackbird (Eurasian)	*Turdus merula*	Muscicapidae
Rodents (Rodentia)		
Norway rat	*Rattus norvegicus*	Muridae
Roof rat (black rat, ship rat)	*Rattus rattus*	Muridae
Polynesian rat	*Rattus exulans*	Muridae
House mouse	*Mus musculus*	Muridae
Deer mouse	*Peromyscus maniculatus*	Muridae
Meadow vole	*Microtus pennsylvanicus*	Muridae
Pine vole	*Microtus pinetorum*	Muridae
Water vole	*Arvicola terrestris*	Muridae
Muskrat	*Ondatra zibethicus*	Muridae
Heermann's kangaroo rat	*Dipodomys heermanni*	Heteromyidae
Banner-tailed kangaroo rat	*Dipodomys spectabilis*	Heteromyidae
San Joaquin pocket mouse	*Perognathus inornatus*	Heteromyidae
Botta's pocket gopher	*Thomomys bottae*	Geomyidae
California ground squirrel	*Spermophilus beecheyi*	Sciuridae
Richardson's ground squirrel	*Spermophilus richardsonii*	Sciuridae
Rock squirrel	*Spermophilus variegatus*	Sciuridae
Black-tailed prairie dog	*Cynomys ludovicianus*	Sciuridae
Gray squirrel	*Sciurus carolinensis*	Sciuridae
Fox squirrel	*Sciurus niger*	Sciuridae
Eastern chipmunk	*Tamias striatus*	Sciuridae

Order/ Common name	Scientific name	Family
Nutria (coypu)	*Myocastor coypus*	Myocastoridae
Insectivores (Insectivora)		
Dusky shrew (montane shrew)	*Sorex monticolus*	Soricidae
Rabbits/hares (Lagomorpha)		
Cottontail rabbit	*Sylvilagus floridanus*	Leporidae
Desert cottontail	*Sylvilagus auduboni*	Leporidae
Black-tailed jack rabbit	*Lepus californicus*	Leporidae
European rabbit	*Oryctolagus cuniculus*	Leporidae
European hare	*Lepus capensis*	Leporidae
Carnivores (Carnivora)		
Coyote	*Canis latrans*	Canidae
Red fox	*Vulpes vulpes*	Canidae
San Joaquin kit fox	*Vulpes macrotis mutica*	Canidae
Gray fox	*Urocyon cinereoargenteus*	Canidae
Mountain lion	*Felis concolor*	Felidae
Bobcat	*Lynx rufus*	Felidae
Lynx	*Lynx lynx*	Felidae
Badger	*Meles meles*	Mustelidae
Ermine (stoat)	*Mustela erminea*	Mustelidae
European ferret	*Mustela putorius furo*	Mustelidae
Siberian ferret	*Mustela eversmanni*	Mustelidae
Mink	*Mustela vison*	Mustelidae
Least weasel	*Mustela nivalis*	Mustelidae
Long-tailed weasel	*Mustela frenata*	Mustelidae
Polecat	*Mustela putorius*	Mustelidae
Striped skunk	*Mephitis mephitis*	Mustelidae
Stone marten	*Martes foina*	Mustelidae
Raccoon	*Procyon lotor*	Procyonidae
Mongoose	*Herpestes auropunctatus*	Herpestidae

Order/ Common name	Scientific name	Family
Marsupials (Marsupialia)		
Opossum	*Didelphis virginiana*	Didelphidae
Brushtail possum	*Trichosurus vulpecula*	Phalangeridae
Ungulates (Artiodactyla)		
White-tailed deer	*Odocoileus virginianus*	Cervidae
Roe deer	*Capreolus capreolus*	Cervidae
Boar (pig)	*Sus scrofa*	Suidae

Attachment C: Comparing Potential Risks of Rodenticide Baits to Birds and Mammals Using A Comparative Analysis Model

Prepared by: Douglas J. Urban, Senior Scientist, EFED

Executive Summary

The standard comparative analysis modeling technique often used in decision-analysis called the simple multi-attribute rating technique or SMART is adapted for comparing the risks of rodenticide baits based on a number of measures of effect values for primary and secondary risk to birds and mammals. Of the 11 rodenticide baits considered in the main document, three are considered to pose the greatest overall potential risk to birds and mammals: brodifacoum, zinc phosphide, and difethialone. Based on this analysis, brodifacoum poses the greatest potential risk to birds and mammals, and by a substantial margin over the other rodenticide baits. Brodifacoum has higher summary risk values than zinc phosphide for both secondary risk to birds and secondary risk to mammals. Zinc phosphide has higher summary risk values than difethialone for both primary risk to birds and primary risk to mammals.

A sensitivity analysis is performed to identify the most sensitive measure of effect(s) and to determine if changes of 50% or more in these sensitive measures of effect would change the results of the analysis. The results of this analysis show that the ranking for the rodenticide baits which pose the greatest potential risk to birds and mammals is robust when the measures of effect are changed by +/- 50%. The ranking is generally robust when the measures of effect are changed by +/- 99%, with the following exceptions: a reduction of greater than 67% in the Mean Dietary Risk Quotient for brodifacoum, 64% in the Mean (%) Mortality of Secondary Lab Studies on Birds for brodifacoum, and 76% in the Mean (%) Mortality of Secondary Lab Studies on Mammals for brodifacoum, would result in zinc phosphide moving ahead of brodifacoum as posing the greatest overall risk to birds and mammals; and, an increase of 99% in the Mean (%) Mortality of Secondary Lab Studies on Mammals for difethialone would result in difethialone moving ahead of zinc phosphide as posing the second greatest overall risk to birds and mammals. Thus, with few exceptions, the sensitivity analysis shows that brodifacoum poses the greatest overall potential risk to birds and mammals, followed by zinc phosphide and difethialone.

Acute toxicity reference values for rodenticides to birds and an alternative approach are also considered. The toxicity reference values from a recent publication are substituted for the avian LD50 values for bobwhite quail and mallard ducks used in one of the avian measures of effect for Primary Risk to Birds. The results show that the overall ranking remains the same and the use of these toxicity values does not affect the analysis. When unequal weighting of measures of effect for each type of risk is ignored and all measures of effect are considered together, again the results show that the overall ranking does not change. Unequal weighting of one type of risk over another, at least in this case, does not appear to have a significant effect on the overall ranking.

Two factors are identified as contributing the greatest uncertainty to the analysis: (1) missing data, especially secondary mortality data for difethialone, bromethalin, and cholecalciferol, and blood and liver retention values for a number of rodenticides; and (2) the assumption that field mortality to birds and mammals due to difethialone would likely equal 80% of that reported for brodifacoum. This assumption is based on the many chemical similarities between these two rodenticides, because difethialone bait is formulated at a lower % a.i. than brodifacoum, and the fact that compared to brodifacoum less difethialone is used.

The available incidents for birds and mammals are analyzed and compared to the summary of the weighted average risk values. The results confirm that brodifacoum is the rodenticide bait that poses the greatest potential overall risk to birds and mammals, but they also identify bromadiolone and zinc phosphide as potential concerns for birds, and bromadiolone, diphacinone (100 ppm), and chlorophacinone (100 ppm) as potential concerns for mammals.

Introduction

Comparative risk assessment can be a daunting process when risk assessors are faced with risks for a number of alternative pesticides covering multiple endpoints. When attempting to decide which pesticides present the greatest overall risk and having to consider many different endpoints that lead to a matrix of comparisons, many risk assessors rely on individual or group intuition. The inability to simultaneously track risk values assigned to multiple endpoints among many alternative pesticides as well as the varying importance of each to the assessment can easily result in paralysis (indecision).

The Agency attempted to address such situations in a December 1998 presentation to the Federal Insecticide, Fungicide and Rodenticide (FIFRA) Science Advisory Panel (SAP) titled, "*A Comparative Analysis of Ecological Risks from Pesticides and Their Use: Background, Methodology, Case Study*"[1]. The Panel noted the many scientific uncertainties in the method, yet agreed that it was a useful screening tool that provides a rough estimate of relative risk. The Panel also made a number of helpful suggestions to improve the utility of the methodology presented for use in comparative analyses of ecological risk from pesticides. There are, however, two recommendations that the panel thought critical for valid results: risk quotients - risk indices which are used to express risk from pesticides to nontarget organisms, should never be combined (added); and, a sensitivity analysis should always be included. Following this advice, no risk quotients or indices have been added together for this analysis, and a sensitivity analysis has been included. An early draft of this analysis was submitted for additional peer review by experts outside the Agency. Their comments and suggestions are very helpful and have also been incorporated, to the extent possible, into the updated analysis and this final report.

[1]See http://www.epa.gov/scipoly/sap/1998/index.htm#december8

Endpoint and Data Selection

This comparative analysis of the potential risks from eleven rodenticide baits is based on the available primary and secondary toxicity data and persistence information for the nine rodenticides which are presented the main document *"Potential Risks of Nine Rodenticides to Birds and Nontarget Mammals: A Comparative Approach"*. Henceforth, this will be referred to as the "main document". These eleven baits are compared based on four types of risk: primary risk to birds, primary risk to mammals, secondary risk to birds, and secondary risk to mammals. Each type of risk is quantitatively evaluated by one to three measures of effect:

Type or Risk	Measures of Effect (ME)
Primary Risk to Birds	1) Mean Dietary Risk Quotient (RQ = the ppm ai in the rodenticide bait/LC50). See Table 29 in the main document. When more than one dietary RQ is available, the mean is calculated and used. 2) Inverse of the No. of Bait Pellets Needed for 100-g Bird to Ingest LD50 Dose at a Single Feeding See Table 28 in the main document and the 'no. bait pellets' column under 100-g non-passerine. All > values are assumed to be = values.
Primary Risk to Mammals	1) Inverse of the No. of Bait Pellets Needed for 100-g Mammal to Ingest LD50 Dose at a Single Feeding See Table 31 in the main document and the 'no. bait pellets' column under 100-g rodent. All > values are assumed to be = values.
Secondary Risk to Birds	1) Mean % Mortality of Secondary Lab Studies (Birds). See Tables 11-12, 14-16, 18-19 in the main document and the '% dead' column. Missing data are not considered in the analysis. Difethialone is considered a special case due to it's similarity to brodifacoum. While missing data, it is given a % equal to 80% of that for brodifacoum. Bait specific data is not available; thus, where there are two baits (chlorophacinone, diphacinone), the % dead is applied to both baits. 2) Blood Retention Time (days). See Tables 13 and 17 in the main document and the 'Blood $t_{1/2}$' column. Missing data are not considered in the analysis. Where multiple half-lives existed, the mean is calculated and used. Bait specific data are not available; thus, where there are two

	baits (chlorophacinone, diphacinone), the half-life is applied to both baits. 3) Liver retention Time (days). See Tables 13 and 17 in the main document and the 'Liver $t_{1/2}$' column. Missing data are not considered in the analysis. Where multiple half-lives existed, the mean is calculated and used. Bait specific data is not available; thus, where there are two baits (chlorophacinone, diphacinone), the half-life is applied to both baits.
Secondary Risk to Mammals	1) Mean % Mortality of Secondary Lab Studies (Mammals). See Tables 20-27 in the main document and the '% dead' column. Missing data are not considered in the analysis. Difethialone is considered a special case due to it's similarity to brodifacoum. It is given a % equal to 80% of that for brodifacoum. Bait specific data is not available; thus, where there are two baits (chlorophacinone, diphacinone), the % dead is applied to both baits. 2) Blood Retention Time (days). See Tables 13 and 17 in the main document and the 'Blood $t_{1/2}$' column. Missing data are not considered in the analysis. Where multiple half-lives existed, the mean is calculated and used. Bait specific data is not available; thus, where there are two baits (chlorophacinone, diphacinone), the half-life is applied to both baits. 3) Liver retention Time (days). See Tables 13 and 17 in the main document and the 'Liver $t_{1/2}$' column. Missing data are not considered in the analysis. Where multiple half-lives existed, the mean is calculated and used. Bait specific data is not available; thus, where there are two baits (chlorophacinone, diphacinone), the half-life is applied to both baits.

Table 1 contains the data for each of the measures of effect used in the analysis.

Method & Approach[2]

[2]Much of the software description is based on a software review by Len Tashman and Sara Munro, 1997.

During the 1998 SAP presentation, commercially available software called *DecideRight® (Version 1.2)*[3] was presented as an useful tool designed to aid comparative analysis and support decision-making. This user friendly software is designed primarily for use in business, but it can be applied to many situations where risk assessors and decision-makers must choose among alternatives when many factors must be considered. The underlying methodology used in the software is called the simple multi-attribute rating technique or SMART (Goodwin and Wright, 1998). This technique was developed approximately 30-years ago and has become a standard in decision modeling. When faced with a number of alternatives pesticide baits and a number of types of risk with measures of effect, SMART prescribes that (1) each alternative pesticide be rated on each measure of effect, (2) each measure of effect be assigned a measure of importance to the decision-maker, and (3) a summary score for each alternative pesticide be calculated as a weighted average of the ratings, where the weights represent the relative importance of the measure of effect for each type of potential risk. In the end, the higher the summary score, the higher the potential risk for that alternative pesticide. The result of this process has proved to be superior to the alternative of reliance on intuition.

SMART is not rooted in probability and ignores any interaction or correlation between criteria. The assigned ratings are assumed to be based on full knowledge of the type of risk. However, some uncertainty can be dealt with in the ratings by a sensitivity analysis. In this case, two scenarios are developed where the individual risk ratings are varied to see the effect on the overall ranking. This results of this analysis is included.

To begin, the problem must be formulated as a question. In this analysis, the question being asked is: "*Which of the 11 Rodenticide Baits Pose the Greatest Overall Risk to Birds and Mammals Based on their Primary and Secondary Risk Characteristics?*" The following basic equation is used to calculate the summary values for the risk comparison:

Equation 1.

$$\textbf{Summary Value}_{\text{(scale from 0 to 10)}} = \sum \left[(\textbf{ME}_i)(\textbf{ME}_{max})^{-1}\right] \left[(\textbf{Weight})\left(\sum \textbf{Weights}\right)^{-1}\right] (10)$$

where $\textbf{ME}_i$ is the measure of effect value for one of the eleven rodenticide baits and $\textbf{ME}_{max}$ is the maximum ME for all rodenticide baits; **Weight** is the importance value placed on each measure of effect, with high = 10 to 6.67, medium = 6.68 to 3.33, and low = 3.34 to 0; and, $\sum$**Weights** is the sum of all the weights for all the measures of effect.

For this analysis, potential risk increased as all measures of effect values increased. For two measures: No. Bait Pellets Needed for 100-g Bird to Ingest LD50 Dose at a Single Feeding; and,

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[3]*DecideRight®* was developed by Avantos Performance Systems of Emertville, California. The company has since closed; however, the software is still available from Performance Management Solutions, LLC, 1198 Pacific Coast Hwy., D515 Seal Beach, CA. 90740 [Ph. 562/430-7096 Ext. 0 - Fax. 800/645-6618]. Also, see http://www.performancesolutionstech.com/default.htm . Mention of this commercial product does not constitute a recommendation or endorsement by EPA.

No. Bait Pellets Needed for 100-g Mammal to Ingest LD50 Dose at a Single Feeding, the inverse of the number of bait pellets was used in order to correctly calculate the weighted averages and avoid skewed results. Further, the weights given to all measures of effect are high (=10) since we did not have any scientific reason to differentiate between the importance of the measures, except for the two measures of retention or persistence in prey. The half-life in blood and liver are each given a weight of medium (2.5) for the secondary risk to birds and the secondary risk to mammals since we believe that the overall importance of the persistence should equal that of the mortality observed in the toxicity studies (2.5 x 4 = 10). Finally, summary values for each of the four risk types (i.e., primary risk to birds, primary risk to mammals, secondary risk to birds, secondary risk to mammals) are calculated separately and then these summary values are analyzed together in a final overall analysis. An alternate approach is considered where all measure of effects are considered in one step. The results of different approaches are compared and discussed later in this appendix. Basically, the approach using separate risk calculations is chosen because it eliminated unequal weighting of one risk over another due to differences in the number of measures of effect.

The *DecideRight*® software is not used for the analysis; rather, *Lotus SmartSuite 1-2-3*® is used for all calculations .

Table 1. Input Data for Comparative Analysis of Risk from 11 Rodenticide Baits									
	Type of Risk								
	Primary Risk to Birds		*Primary Risk to Mammals*	*Secondary Risk to Birds*			*Secondary Risk to Mammals*		
	Measures of Effect		**Measure of Effect**	**Measures of Effect**			**Measures of Effect**		
Alternative Pesticides	**Mean Dietary Risk Quotient (ppm bait/LC50)**	**Inverse of the No. Bait Pellets Needed for 100gm Bird to Ingest LD50 Dose**	**Inverse of the No. Bait Pellets Needed for 100gm Mammal to Ingest LD50 Dose**	**Mean Mortality (%)of Secondary Lab Studies (Birds)**	**Blood Retention Time (days)**	**Liver Retention Time (days)**	**Mean Mortality (%) of Secondary Lab Studies (Mammals)**	**Blood Retention Time (days)**	**Liver Retention Time (days)**
Brodifacoum 50 ppm	**44.00**	**0.3846**	**0.25**	**42.00**	**7.30**	**217.00**	**42.00**	**7.30**	**217.00**
Bromadiolone 50 ppm	**0.85**	**0.0007**	**0.14**	**8.00**	**1.40**	**248.00**	**23.00**	**1.40**	**248.00**
Bromethalin 100 ppm	**0.35**	**0.0435**	**0.02**	**No Data**	**5.60**	**No Data**	**0.00**	**5.60**	**No Data**
Chlorophacinone 100 ppm	**1.20**	**0.0008**	**0.03**	**0.00**	**0.40**	**No Data**	**55.00**	**0.40**	**No Data**
Chlorophacinone 50 ppm	**0.60**	**0.0004**	**0.02**	**0.00**	**0.40**	**No Data**	**55.00**	**0.40**	**No Data**
Cholecalciferol 750 ppm	**1.00**	**0.0025**	**0.04**	**0.00**	**25.50**	**No Data**	**0.00**	**25.50**	**No Data**
Difethialone 25 ppm	**34.00**	**0.1923**	**0.09**	**33.60**	**2.50**	**117.70**	**33.60**	**2.50**	**117.70**
Diphacinone 100 ppm	**0.10**	**0.0005**	**0.09**	**9.00**	**17.50**	**90.00**	**58.00**	**17.50**	**90.00**
Diphacinone 50 ppm	**0.10**	**0.0003**	**0.04**	**9.00**	**17.50**	**90.00**	**58.0**	**17.50**	**90.00**
Warfarin 250 ppm	**0.35**	**0.0008**	**0.17**	**9.00**	**0.82**	**35.00**	**9.00**	**0.82**	**0.35.00**
Zinc Phosphide 20,000 ppm	**24.75**	**3.3333**	**2.00**	**0.00**	**No Data**	**No Data**	**4.00**	**No Data**	**No Data**

Results of the Comparative Analysis Model

As noted above, the summary values for each of the four risk types are calculated separately and then these summary values are analyzed together in a final overall analysis. Decision tables and graphs of the sums of the weighted averages for each of the four risk types are presented separately below. At the end, the decision table and graph for the overall potential risk analysis is presented.

By way of example, a detailed explanation of how the comparative analysis model results presented in Table 2. - Greatest Primary Risk to Birds - are calculated, is provided here in a series of steps. The measure of effect values come from Table 1.

Step 1. Give a Weight (Importance Value) to each Measure of Effect

Both Measures of Effect for Primary Risk to Birds are given a weight of high =10.

Step 2. Normalize the Assigned Weights for each Measure of Effect

Divide each weight by the sum of the all weights, i.e. 10/20 = 0.5, and multiply the result by 10. Thus, the weight for each Measure of Effect = 5.

Step 3. Calculate the Weighted Average Values for Each Measure of Effect and each Bait

Substep A. The first measure of effect is the Mean Dietary Risk Quotient (ppm bait/LC50). The calculation for each rodenticide bait is: The RQ value for that rodenticide is divided by the Maximum RQ value for all the rodenticides; and, the result is multiplied by the normalized wight for the measure of effect. Specifically, for each rodenticide bait, the calculations are as follows:

Brodifacoum 50 ppm:	(44.0/44.0)*5 = 5.00
Bromadiolone 50 ppm:	(0.85/44.0)*5 = 0.10
Bromethalin 100 ppm:	(0.35/44.0)*5 = 0.04
Chlorophacinone 100 ppm:	(1.20/44.0)*5 = 0.14
Chlorophacinone 50 ppm:	(0.60/44.0)*5 = 0.07
Cholecalciferol 750 ppm:	(1.00/44.0)*5 = 0.11
Difethialone 25 ppm:	(34.0/44.0)*5 = 3.86
Diphacinone 100 ppm:	(0.10/44.0)*5 = 0.01
Diphacinone 50 ppm:	(0.10/44.0)*5 = 0.01
Warfarin 250 ppm:	(0.35/44.0)*5 = 0.04
Zinc Phosphide 20,000 ppm:	(24.75/44.0)*5 = 2.81

Substep B. The second measure of effect is the No. Bait Pellets Needed for a 100 g Bird to Ingest LD50 Dose at a Single Feeding. The inverse of this measure of effect was used in order to correctly calculate the weighted averages and avoid skewed results. The Inverse of the No. Bait Pellets value for each rodenticide is divided by the Maximum

Inverse of the No. Bait Pellets value; then, this result is multiplied by the normalized weight for the measure of effect. Specifically, for each rodenticide bait, the calculations are as follows:

Brodifacoum 50 ppm:	(0.3846/3.3333)*5 = 0.58
Bromadiolone 50 ppm:	(0.0007/3.3333)*5 = 0.00
Bromethalin 100 ppm:	(0.0435/3.3333)*5 = 0.07
Chlorophacinone 100 ppm:	(0.0008/3.3333)*5 = 0.00
Chlorophacinone 50 ppm:	(0.0004/3.3333)*5 = 0.00
Cholecalciferol 750 ppm:	(0.0025/3.3333)*5 = 0.00
Difethialone 25 ppm:	(0.1923/3.3333)*5 = 0.29
Diphacinone 100 ppm:	(0.0005/3.3333)*5 = 0.00
Diphacinone 50 ppm:	(0.0003/3.3333)*5 = 0.00
Warfarin 250 ppm:	(0.0008/3.3333)*5 = 0.00
Zinc Phosphide 20,000 ppm:	(3.3333/3.3333)*5 = 5.00

Step 4. Sum the Weighted Average Values for Both Measures of Effect for each Rodenticide Bait

The weighted average values calculated above are summed for each rodenticide bait to arrive at the sum of the weighted average values for primary risk to birds.

Brodifacoum 50 ppm:	5.00+0.58 = 5.58
Bromadiolone 50 ppm:	0.10+0.00 = 0.10
Bromethalin 100 ppm:	0.04+0.07 = 0.10
Chlorophacinone 100 ppm:	0.14+0.00 = 0.14
Chlorophacinone 50 ppm:	0.07+0.00 = 0.07
Cholecalciferol 750 ppm:	0.11+0.00 = 0.12
Difethialone 25 ppm:	3.86+0.29 = 4.15
Diphacinone 100 ppm:	0.01+0.00 = 0.10
Diphacinone 50 ppm:	0.01+0.00 = 0.01
Warfarin 250 ppm:	0.04+0.00 = 0.04
Zinc Phosphide 20,000 ppm:	2.81+5.00 = 7.81

The summary values above, in ranked order from highest to lowest, are found in Table 2, and Figure 1 presents a graph of the calculations. Rounding affects some of the calculations.

Results of Comparative Analysis for Primary Risk to Birds

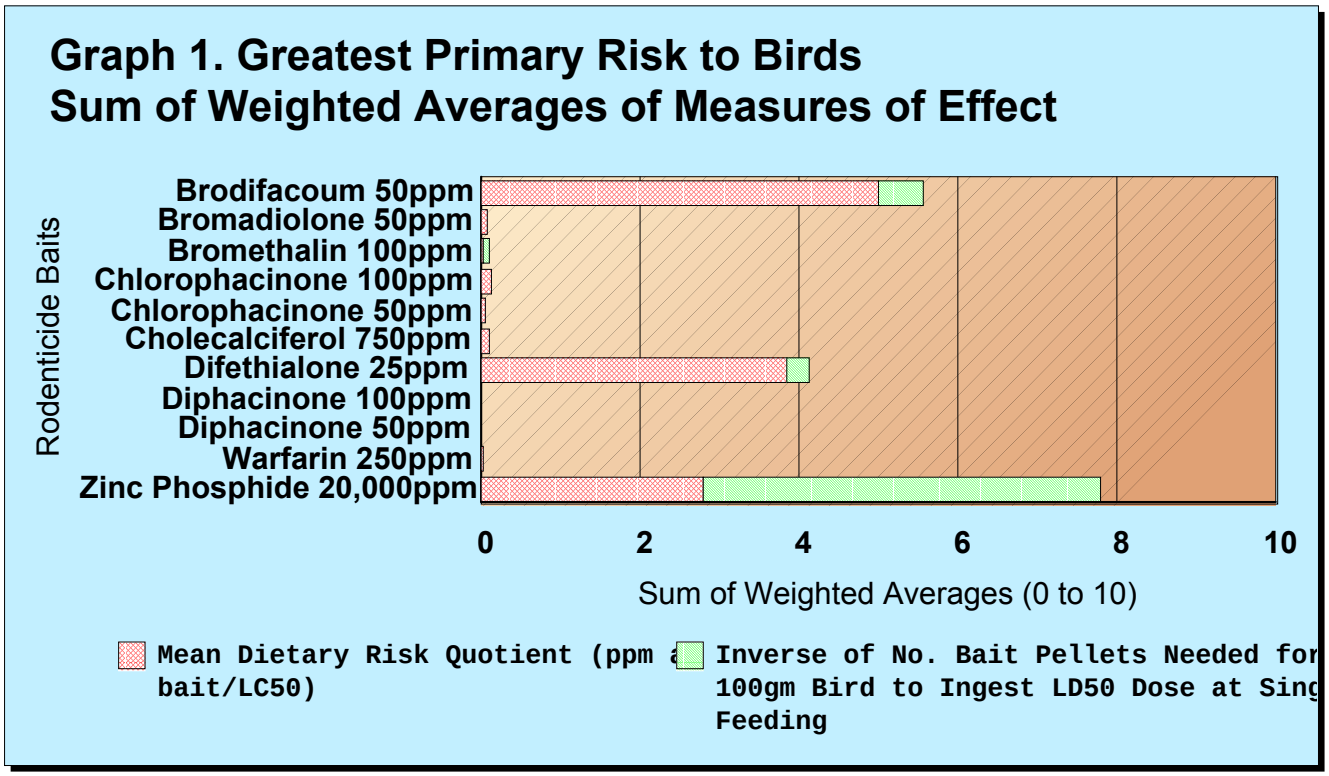
The question *"Which of the 11 Rodenticide Baits Pose the Greatest Primary Risk to Birds?"* is analyzed by the comparative model and the results are presented in a table (Table 2). The sum of the weighted average values for primary risk to birds is found in the 'Summary Values" column in Table 2, and graphically shown in Figure 1. The results are based on two measures of effect: Mean Dietary Risk Quotient (ppm bait/LC50) and the Inverse of the No. Bait Pellets Needed for 100-g Bird to Ingest LD50 at Single Feeding. Of all the rodenticide baits considered, three are considered to pose the greatest potential primary risk to birds:

Zinc Phosphide 20,000 ppm
Brodifacoum 50 ppm
Difethialone 25 ppm

Based on this analysis, zinc phosphide poses the greatest potential primary risk to birds. The Inverse of the No. Bait Pellets Needed for 100-g Bird to Ingest LD50 at Single Feeding appears to be the most significant measure of effect leading to the conclusion that zinc phosphide poses greater risk to birds than brodifacoum. It also appears to be the most significant measure of effects leading to the conclusion that zinc phosphide poses greater potential primary risk to birds than difethialone. Brodifacoum has a higher summary risk value for one of the two measures of effect, mean dietary risk quotient (ppm ai bait/LC50), than both zinc phosphide and difethialone. Difethialone also has a higher summary risk value for one of the two measures of effect, mean dietary risk quotient (ppm ai bait/LC50), than zinc phosphide.

Table 2. Decision Table: Greatest Primary Risk to Birds.

Alternative Pesticides	*Mean Dietary Risk Quotient (ppm bait/ LC50)*	*Inverse of No. Bait Pellets Needed for 100gm Bird to Ingest LD50 Dose at Single Feeding*	*Summary Values*
	Measure of Effect Values		
Brodifacoum 50ppm	44.00	0.38	5.58
Bromadiolone 50ppm	0.85	0.00	0.10
Bromethalin 100ppm	0.35	0.04	0.10
Chlorophacinone 100ppm	1.20	0.00	0.14
Chlorophacinone 50ppm	0.60	0.00	0.07
Cholecalciferol 750ppm	1.00	0.00	0.12
Difethialone 25ppm	34.00	0.19	4.15
Diphacinone 100ppm	0.10	0.00	0.01
Diphacinone 50ppm	0.10	0.00	0.01
Warfarin 250ppm	0.35	0.00	0.04
Zinc Phosphide 20,000ppm	24.75	3.33	7.81



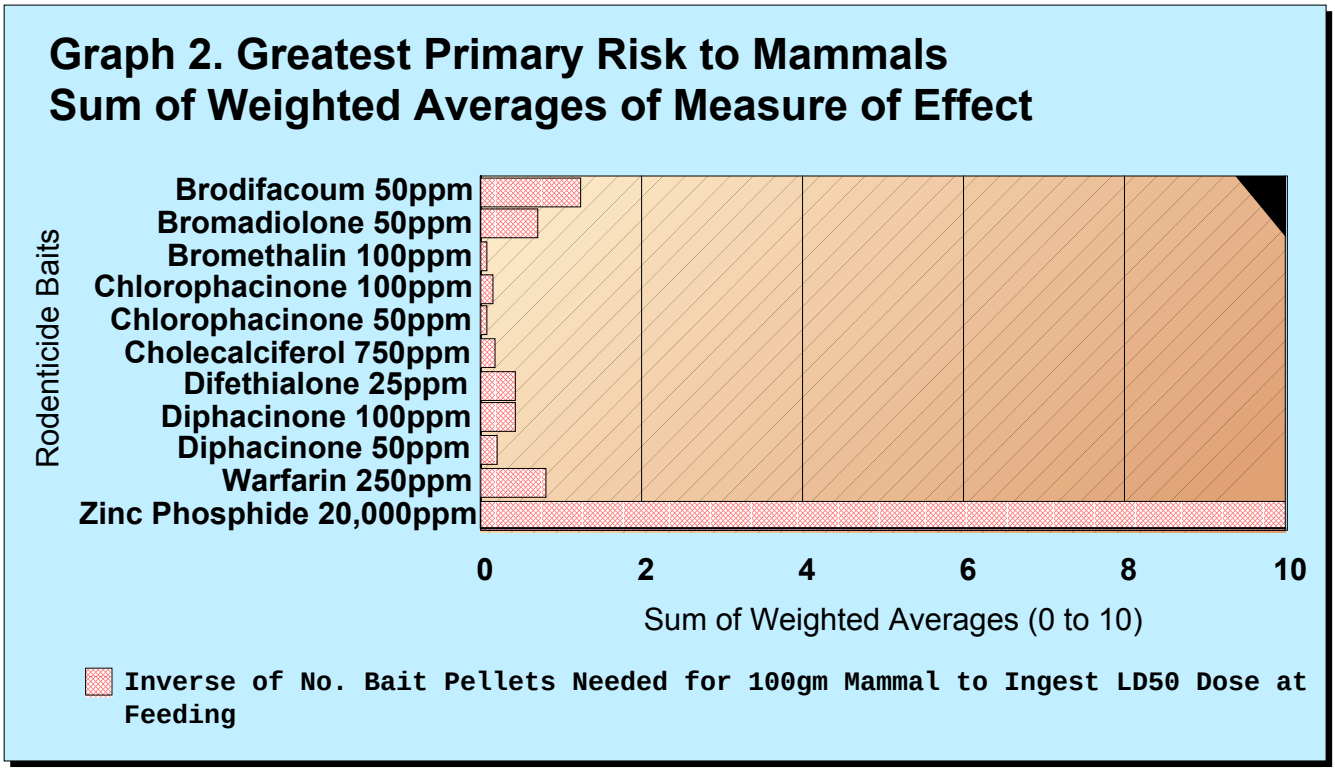
Results of Comparative Analysis for Primary Risk to Mammals

The question *"Which of the 11 Rodenticide Baits Pose the Greatest Primary Risk to Mammals?*" is analyzed by the comparative model and the results are presented in a table (Table 3). The sum of the weighted average values for primary risk is found in the 'Summary Values" column in Table 3, and graphically shown in Figure 2. The results are based on a single measure of effect: Inverse of the No. Bait Pellets Needed for 100-g Mammal to Ingest an LD50 Dose at a Single Feeding. Of all the rodenticide baits considered, one is considered to pose the greatest potential primary risk be mammals:

Zinc Phosphide 20,000 ppm

Based on this analysis, zinc phosphide poses the greatest potential primary risk to mammals by a substantial margin over the other rodenticide baits. Warfarin and brodifacoum are in distant second and third place.

Table 3. Greatest Primary Risk to Mammals.		
	Inverse of No. Ba Pellets Needed for 100gm Mammal to Ingest LD50 Dose at Single Feeding	*Summary Values*
Alternative Pesticides	Measure of Effect Value	
Brodifacoum 50ppm	0.25	1.25
Bromadiolone 50ppm	0.14	0.71
Bromethalin 100ppm	0.02	0.10
Chlorophacinone 100ppm	0.03	0.16
Chlorophacinone 50ppm	0.02	0.08
Cholecalciferol 750ppm	0.04	0.18
Difethialone 25ppm	0.09	0.45
Diphacinone 100ppm	0.09	0.43
Diphacinone 50ppm	0.04	0.22
Warfarin 250ppm	0.17	0.83
Zinc Phosphide 20,000ppm	2.00	10.00



Results of Comparative Analysis for Secondary Risk to Birds

The question *"Which of the 11 Rodenticide Baits Pose the Greatest Secondary Risk to Birds ?"* is analyzed by the comparative model and the results are presented in a table (Table 4). The sum of the weighted average values for secondary risk to birds is found in the 'Summary Values" column in Table 4, and graphically shown in Figure 3. The results are based on three measures of effect: Mean % Mortality of Secondary Lab Studies, Blood Retention Time (Days), Liver Retention Time (Days). Of all the rodenticide baits considered, two are considered to pose the greatest potential secondary risk to birds:

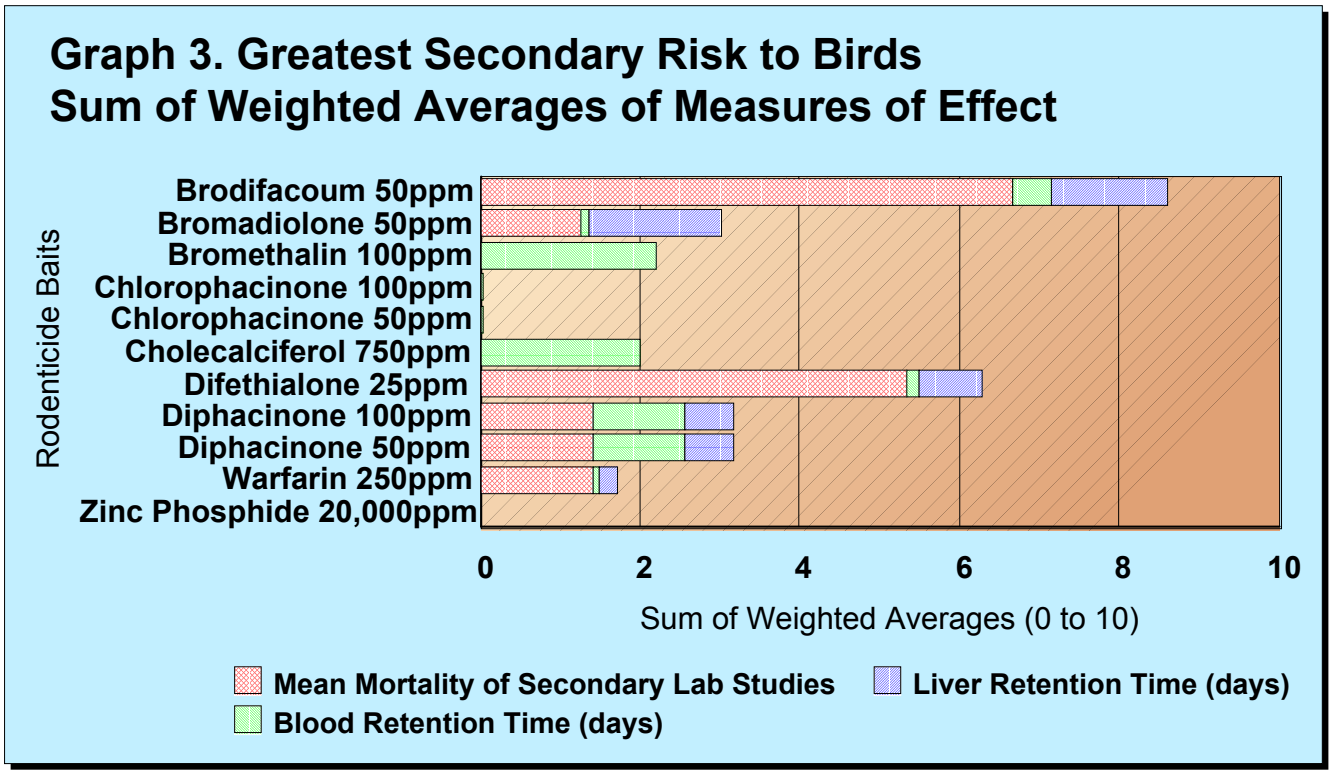
Brodifacoum 50 ppm
Difethialone 25 ppm

Based on this analysis, brodifacoum poses the greatest potential secondary risk to birds, and by a substantial margin over difethialone. Brodifacoum had higher summary values for all three measures of effect. Mean (%) Mortality of Secondary Lab Studies appears to be the most significant measure of effect leading to the conclusion that brodifacoum poses greater risk than difethialone.

Table 4. Greatest Secondary Risk to Birds.

Alternative Pesticides	Mean Mortality of Secondary Lab Studies	Blood Retention Time (days)	Liver Retention Time (days)	*Summary Values*
	Measures of Effect Value			
Brodifacoum 50ppm	42.00	7.30	217.00	8.60
Bromadiolone 50ppm	8.00	1.40	248.00	3.03
Bromethalin 100ppm	No Data	5.60	No Data	2.20
Chlorophacinone 100ppm	0.00	0.40	No Data	0.03
Chlorophacinone 50ppm	0.00	0.40	No Data	0.03
Cholecalciferol 750ppm	0.00	25.50	No Data	2.00
Difethialone 25ppm	33.60	2.50	117.70	6.29
Diphacinone 100ppm	9.00	17.50	90.00	3.18
Diphacinone 50ppm	9.00	17.50	90.00	3.18
Warfarin 250ppm	9.00	0.82	35.00	1.72
Zinc Phosphide 20,000ppm	0.00	No Data	No Data	0.00

Results of Comparative Analysis for Secondary Risk to Mammals



The question *"Which of the 11 Rodenticide Baits Pose the Greatest Secondary Risk to Mammals?"* is analyzed in the comparative analysis model and the results are presented in a table (Table 5). The sum of the weighted average values for secondary risk to mammals is found in the 'Summary Values" column in Table 5, and graphically shown in Figure 4. The results are based on three measures of effect: Mean % Mortality of Secondary Lab Studies, Blood Retention Time (Days), Liver Retention Time (Days). Of all the rodenticide baits considered, five are considered to pose the greatest potential secondary risk to mammals:

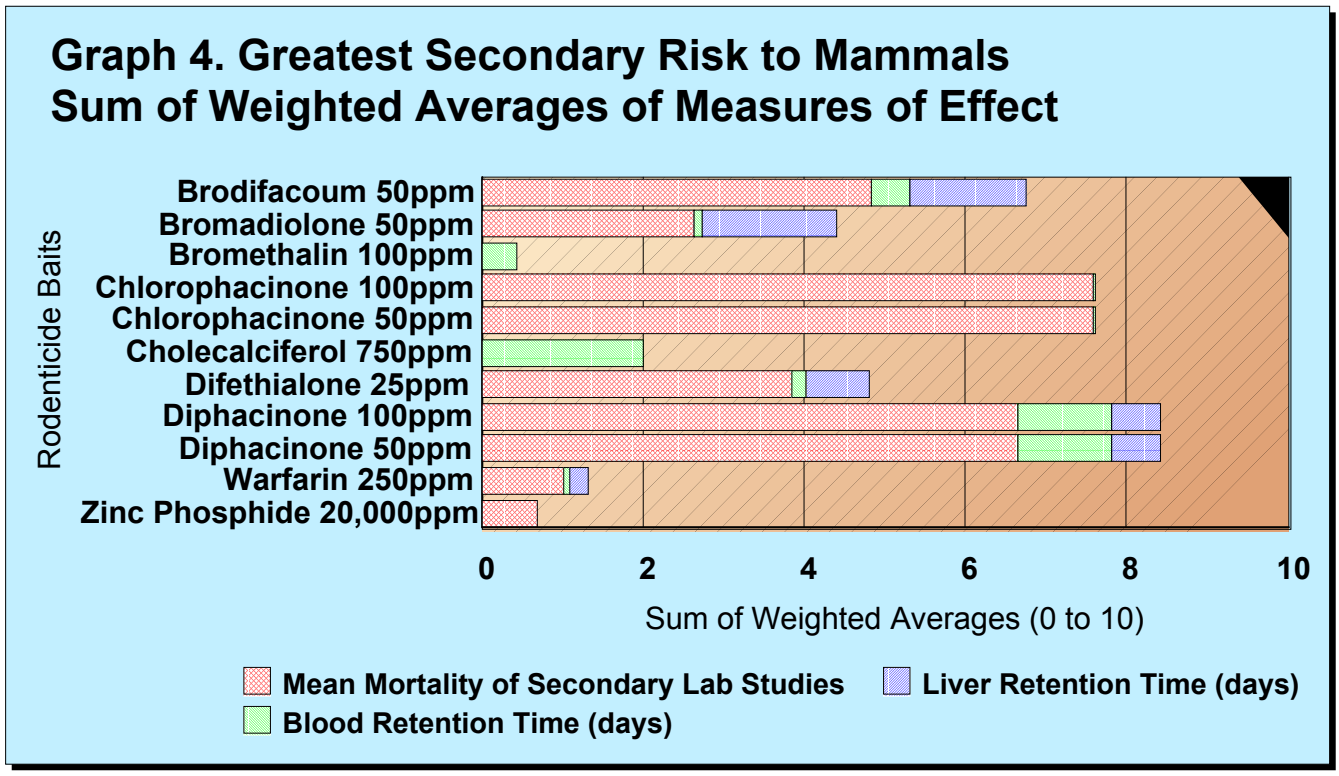
Diphacinone 100 ppm
Diphacinone 50 ppm
Chlorophacinone 100 ppm
Chlorophacinone 50 ppm
Brodifacoum 50 ppm

Based on this analysis, diphacinone (100 ppm and 50 ppm baits) pose the greatest potential secondary risk to mammals. Both rodenticide baits had identical summary risk values. Blood Retention Time (days) appears to be the most significant measure of effect leading to the conclusion that both of these diphacinone baits pose greater secondary risk to mammals than the

chlorophacinone baits (100 ppm and 50 ppm baits). Both of the chlorophacinone baits had identical summary risk values as well. Mean (%) Mortality of Secondary Lab Studies appears to be the most significant measure of effect leading to the conclusion that both baits of diphacinone and chlorophacinone pose greater secondary risk to mammals than brodifacoum.

Table 5. Greatest Secondary Risk to Mammals.

Alternative Pesticides	Mean Mortality of Secondary Lab Studies	Blood Retention Time (days)	Liver Retention Time (days)	*Summary Values*
	Measures of Effect Value			
Brodifacoum 50ppm	42.00	7.30	217.00	6.76
Bromadiolone 50ppm	23.00	1.40	248.00	4.40
Bromethalin 100ppm	0.00	5.60	No Data	0.44
Chlorophacinone 100ppm	55.00	0.40	No Data	7.62
Chlorophacinone 50ppm	55.00	0.40	No Data	7.62
Cholecalciferol 750ppm	0.00	25.50	No Data	2.00
Difethialone 25ppm	33.60	2.50	117.70	4.82
Diphacinone 100ppm	58.00	17.50	90.00	8.42
Diphacinone 50ppm	58.00	17.50	90.00	8.42
Warfarin 250ppm	9.00	0.82	35.00	1.32
Zinc Phosphide 20,000ppm	4.00	No Data	No Data	0.69



Results of Comparative Analysis for Overall Risk to Birds and Mammals

The question *"Which of the 11 Rodenticide Baits Pose the Greatest Overall Risk to Birds and Mammals?"* is analyzed by the comparative analysis model and the results are presented in a table (Table 6). The sum of the weighted average values for overall risk to birds and mammals is found in the 'Summary Values" column in Table 6, and graphically shown in Figure 5. The results are based on four types of risk, which in this case are the four measures of effect: Primary Risk to Birds, Primary Risk to Mammals, Secondary Risk to Birds, and Secondary Risk to Mammals. Of all the rodenticide baits considered, three are considered to pose the greatest potential overall risk to birds and mammals:

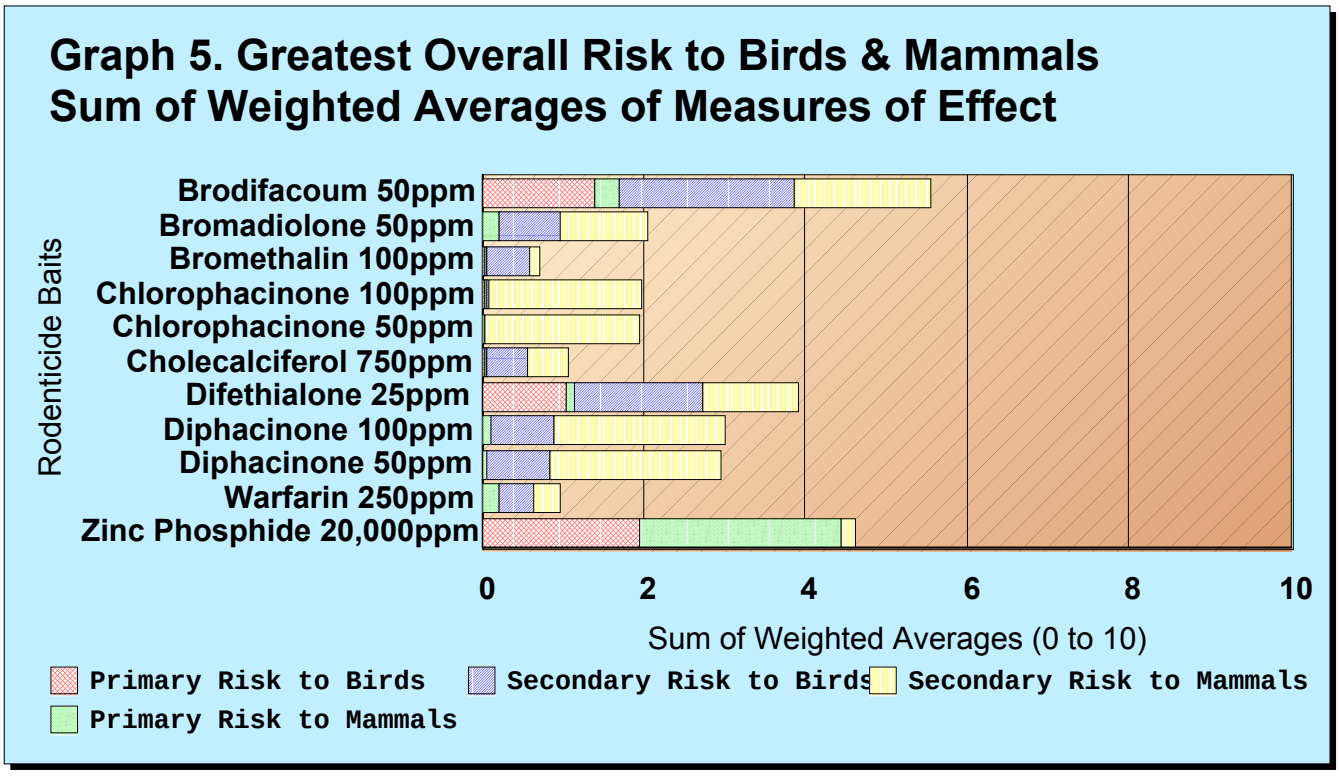
Brodifacoum 50 ppm
Zinc Phosphide 20,000 ppm
Difethialone 25 ppm

Based on this analysis, brodifacoum poses the greatest overall potential risk to birds and mammals and by a substantial margin over the other rodenticide baits. Brodifacoum has higher summary risk values than zinc phosphide for two of the four measures of effect. Secondary Risk

to Birds and Secondary Risk to Mammals appear to be the most significant measures of effect leading to the conclusion that brodifacoum poses greater overall potential risk to birds and mammals than zinc phosphide. Zinc phosphide has higher summary risk values than difethialone for two of the four measures of effect, and Primary Risk to Mammals and Primary Risk to Birds appear to be the most significant measures of effect leading to the conclusion that zinc phosphide poses greater overall risk to birds and mammals than difethialone. Difethialone has higher summary risk values than both diphacinone baits (100 ppm and 50 ppm) for three of the four measures of effect, and Primary Risk to Birds appears to be the most significant measure of effect leading to the conclusion that difethialone poses greater overall potential risk to birds and mammals than both diphacinone baits.

Table 6. Greatest Overall Risk to Birds and Mammals.

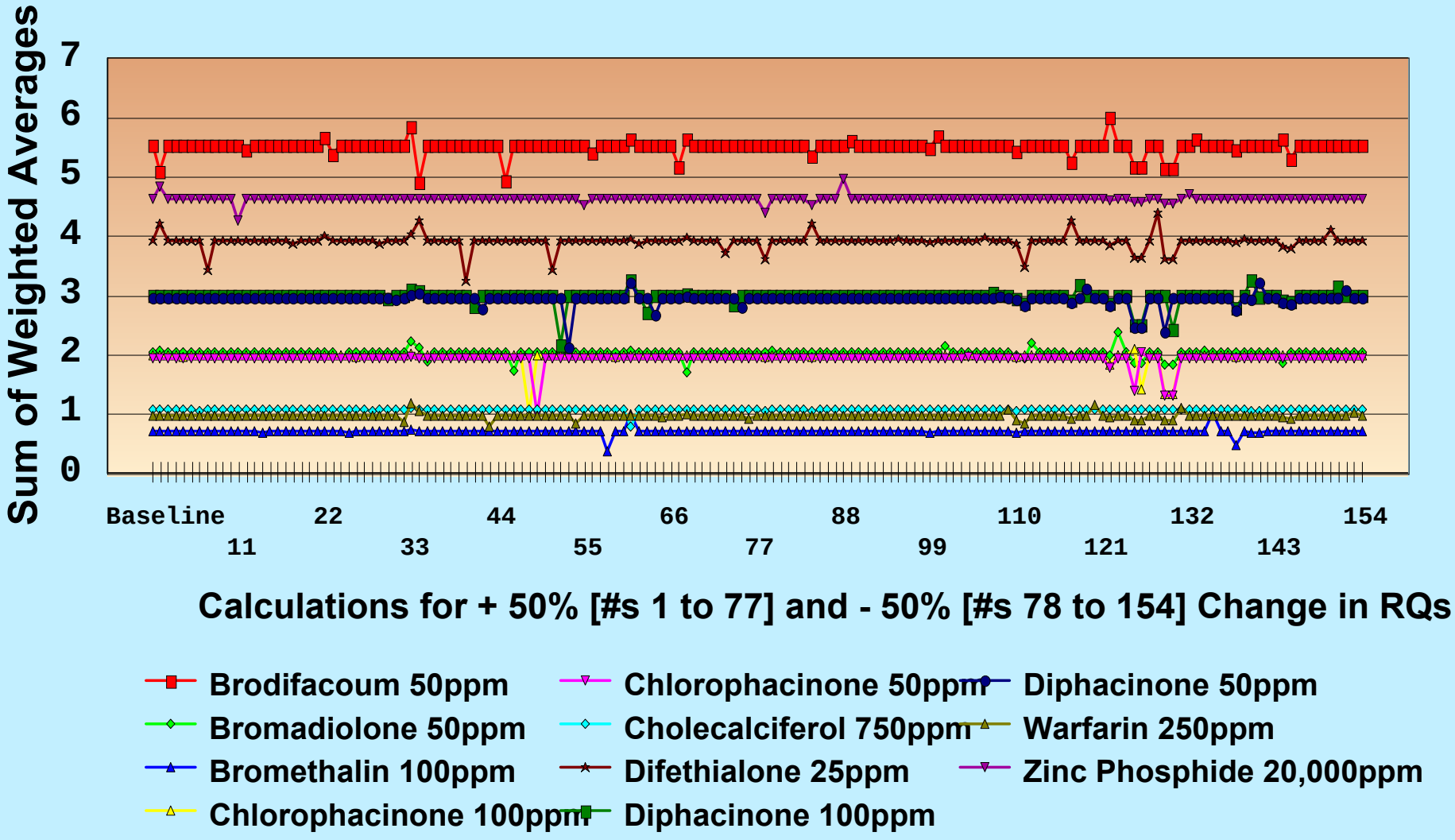
	Primary Risk to Birds	Primary Risk to Mammals	Secondary Risk to Birds	Secondary Risk to Mammals	*Summary Values*
Alternative Pesticides	Measures of Effect Value				
Brodifacoum 50ppm	5.58	1.25	8.60	6.76	5.55
Bromadiolone 50ppm	0.10	0.71	3.03	4.40	2.06
Bromethalin 100ppm	0.10	0.10	2.20	0.44	0.71
Chlorophacinone 100ppm	0.14	0.16	0.03	7.62	1.99
Chlorophacinone 50ppm	0.07	0.08	0.03	7.62	1.95
Cholecalciferol 750ppm	0.12	0.18	2.00	2.00	1.07
Difethialone 25ppm	4.15	0.45	6.29	4.82	3.93
Diphacinone 100ppm	0.01	0.43	3.18	8.42	3.01
Diphacinone 50ppm	0.01	0.22	3.18	8.42	2.96
Warfarin 250ppm	0.04	0.83	1.72	1.32	0.98
Zinc Phosphide 20,000ppm	7.81	10.00	0.00	0.69	4.63



Results of Sensitivity Analysis

As previously noted, the FIFRA SAP recommended performing a sensitivity analysis. Specifically, they suggested that *"it would be useful to test the rankings by changing the values of the input variables...to lend insight to the robustness of the rankings, increase the confidence in the predictions, and move toward a better understanding of the effect that varying levels of uncertainty can have on the predictions."* This is also a recommendation from a number of the peer reviewers. Therefore, to study how changes in each measure of effect value could affect the overall summary risk results presented above (Table 6 and Graph 5), a simple sensitivity analysis is performed using two scenarios: (1) vary each individual risk rating +50%, and -50%; and , (2) select certain risk rating that appeared to show a sensitivity to change, extend the change up to 90% (+ or -) or more. Thus, for the first scenario, each measure of effect value is separately decreased by 50%, and then increased by 50%. The percentage 50% is chosen arbitrarily, with the intention of choosing greater percentages for change in the second scenario after viewing these results. The changes in the overall summary risk values found in Table 6 as a result of the change in each measure of effect value, are recorded. The overall summary risk values in Table 6 are the baseline values. The results of the 154 changes in the summary risk values are presented in Graph 6.

Graph 6
Results from Sensitivity Analysis



With a 50 % (+ or -) change in the measure of effect values, the ranked positions for brodifacoum, zinc phosphide, and difethialone do not change, indicating that the ranking is robust at this level of change. However, the ranked positions of the other rodenticide baits change numerous times, as indicated by the numerous times the lines cross each other. A few of the changes do result in lower values for brodifacoum, such as #s 1, 34, 45 and 67, or higher values for zinc phosphide, such as #s 1 and 88, or higher values for difethialone, such as # 128. To further test the rankings, the measures of effect values for these numbers are increased to 90% (+ or -) or greater and the resultant overall summary risk values are presented below:

#1, Reduction in the Mean Dietary Risk Quotient (ppm bait/LC50), one measure of effect for primary risk to birds for brodifacoum, of 50%, 67%, 70% and 90% resulted in the following ranking of overall summary risk values:

Alternative Pesticides	Brodifacoum 50ppm Summary Values	Brodifacoum 50ppm Summary Values	Brodifacoum 50ppm Summary Values	Brodifacoum 50ppm Summary Values
Brodifacoum 50ppm	5.11	4.83	**4.78**	**4.46**
Bromadiolone 50ppm	2.07	2.07	2.07	2.07
Bromethalin 100ppm	0.71	0.71	0.71	0.71
Chlorophacinone 100ppm	2.00	2.00	2.00	2.00
Chlorophacinone 50ppm	1.95	1.95	1.95	1.95
Cholecalciferol 750ppm	1.08	1.08	1.08	1.08
Difethialone 25ppm	4.21	4.21	4.21	4.21
Diphacinone 100ppm	3.01	3.01	3.01	3.01
Diphacinone 50ppm	2.96	2.96	2.96	2.96
Warfarin 250ppm	0.98	0.98	0.98	0.98
Zinc Phosphide 20,000ppm	4.83	4.83	**4.83**	**4.83**
	50%	**67%**	**70%**	**90%**

Results: A reduction in the Mean Dietary Risk Quotient, one of two measures of effect for primary risk to birds for brodifacoum, of greater than 67% would result in zinc phosphide moving ahead of brodifacoum as the rodenticide bait posing the greatest overall potential risk to birds and mammals.

#34, Reduction in the Mean (%) Mortality of secondary Lab Studies on Birds, one measure of effect for secondary risk to birds for brodifacoum, of 50%, 64%, 70 and 90%, resulted in the following ranking of overall summary risk values:

Alternative Pesticides	Brodifacoum 50ppm Summary Values	Brodifacoum 50ppm Summary Values	Brodifacoum 50ppm Summary Values	Brodifacoum 50ppm Summary Values
Brodifacoum 50ppm	4.92	4.63	**4.51**	**4.09**
Bromadiolone 50ppm	2.14	2.14	2.14	2.14
Bromethalin 100ppm	0.71	0.71	0.71	0.71
Chlorophacinone 100ppm	1.99	1.99	1.99	1.99
Chlorophacinone 50ppm	1.95	1.95	1.95	1.95
Cholecalciferol 750ppm	1.07	1.07	1.07	1.07
Difethialone 25ppm	4.26	4.26	4.26	4.26
Diphacinone 100ppm	3.10	3.10	3.10	3.10
Diphacinone 50ppm	3.04	3.04	3.04	3.04
Warfarin 250ppm	1.07	1.07	1.07	1.07
Zinc Phosphide 20,000ppm	4.63	4.63	**4.63**	**4.63**
	50%	**64%**	**70%**	**90%**

Results: A reduction in the Mean (%) Mortality of Secondary Lab Studies on Birds, one of two measures of effect for secondary risk to birds for brodifacoum, of greater than 64% would result in zinc phosphide moving ahead of brodifacoum as the rodenticide bait posing the greatest overall potential risk to birds and mammals.

#45, Reduction in the Mean (%) Mortality of secondary Lab Studies on Mammals, one measure of effect for secondary risk to mammals for brodifacoum, of 50%, 76% and 90%, resulted in the following ranking of overall summary risk values:

Alternative Pesticides	Summary Values	Summary Values	Summary Values
Brodifacoum 50ppm	4.94	4.63	**4.46**
Bromadiolone 50ppm	2.06	2.06	2.06
Bromethalin 100ppm	0.71	0.71	0.71
Chlorophacinone 100ppm	1.99	1.99	1.99
Chlorophacinone 50ppm	1.95	1.95	1.95
Cholecalciferol 750ppm	1.07	1.07	1.07
Difethialone 25ppm	3.93	3.93	3.93
Diphacinone 100ppm	3.01	3.01	3.01
Diphacinone 50ppm	2.96	2.96	2.96
Warfarin 250ppm	0.98	0.98	0.98
Zinc Phosphide 20,000ppm	4.63	4.63	**4.63**
	50%	**76%**	**90%**

Results: A reduction in the Mean (%) Mortality of Secondary Lab Studies on Mammals, one of two measures of effect for secondary risk to mammals for brodifacoum, of greater

than 76% would result in zinc phosphide moving ahead of brodifacoum as the rodenticide bait posing the greatest overall potential risk to birds and mammals.

#128, Increase in the Mean (%) Mortality of secondary Lab Studies on Mammals, one measure of effect for secondary risk to mammals for difethialone, of 50% and 99%, resulted in the following ranking of overall summary risk values:

Alternative Pesticides	Difethialone 25ppm Summary Values	Difethialone 25ppm Summary Values
Brodifacoum 50ppm	5.55	5.39
Bromadiolone 50ppm	2.06	1.97
Bromethalin 100ppm	0.71	0.71
Chlorophacinone 100ppm	1.99	1.74
Chlorophacinone 50ppm	1.95	1.70
Cholecalciferol 750ppm	1.07	1.07
Difethialone 25ppm	4.41	**4.63**
Diphacinone 100ppm	3.01	2.79
Diphacinone 50ppm	2.96	2.73
Warfarin 250ppm	0.98	0.94
Zinc Phosphide 20,000ppm	4.63	**4.60**
	50%	**99%**

Results: An increase in the Mean (%) Mortality of Secondary Lab Studies on Rodents, one of two measures of effect for secondary risk to mammals for difethialone, of 99% would result in difethialone moving ahead of zinc phosphide as the rodenticide bait posing the second greatest overall potential risk to birds and mammals.

None of the following changes resulted in changes in rankings of brodifacoum, zinc phosphide or difethialone: a 99% reduction in Liver Retention Time (days) for brodifacoum (#67); a 99% increase in the Mean Avian Dietary Risk Quotient for zinc phosphide (#88); a 99% increase in the Mean (%) Mortality of secondary Lab Studies on Mammals for difethialone.

The sensitivity analysis shows that the ranking for the rodenticide baits which pose the greatest potential risk to birds and mammals is robust when the measures of effect are changed by +/- 50%. The ranking is generally robust when the measures of effect are changed by +/- 99%. However, a reduction of greater than 67% in the Mean Dietary Risk Quotient for brodifacoum, 64% in the Mean (%) Mortality of Secondary Lab Studies on Birds for brodifacoum, and 76% in the Mean (%) Mortality of Secondary Lab Studies on Mammals f or brodifacoum, would result in zinc phosphide moving ahead of brodifacoum as posing the greatest overall risk to birds and mammals. In addition, an increase of 99% in the Mean (%) Mortality of Secondary Lab Studies

on Mammals for difethialone would result in difethialone moving ahead of zinc phosphide as posing the second greatest overall risk to birds and mammals. Thus, the sensitivity analysis shows that the ranking for the rodenticide baits is generally robust. With few exceptions we can confidently say that brodifacoum poses the greatest overall potential risk to birds and mammals, followed by zinc phosphide and difethialone.

Results Using Toxicity Reference Values for Birds

Mineau *et al* (2001) state that *"when carrying out comparative assessments for pesticides, it is essential to use the most unbiased data possible."* They suggest a distribution approach for avian LD50 data, modified (1) to incorporate body-weight scaling, and (2) to use extrapolation factors for pesticides for which there are insufficient data from which to derive a distribution. *"A distribution-based approach uses the pesticide-specific data available to define the shape of the distribution through the estimation of a mean and variance for the distribution."* As the authors note, *"Working with a distribution allows one to set a desired percentile, or threshold LD50 value sufficiently protective for an arbitrarily chosen portion of the entire population of bird species."* They follow other authors and arbitrarily set the protection level at the 5th percentile of the species distribution, which they term the Hazardous Dose 5% or HD_5. Further, they fixed the level of certainty at 50%. Thus, the HD_5(50%) reference value is the 5% tail of the avian LD50 toxicity distribution calculated with 50% probability of overestimation. They believe that this *"approach of using reference values based on species specific extrapolation factors represents the most unbiased attempt to date to compare the toxicity of pesticides for which many data points are available with those about which we know very little."*

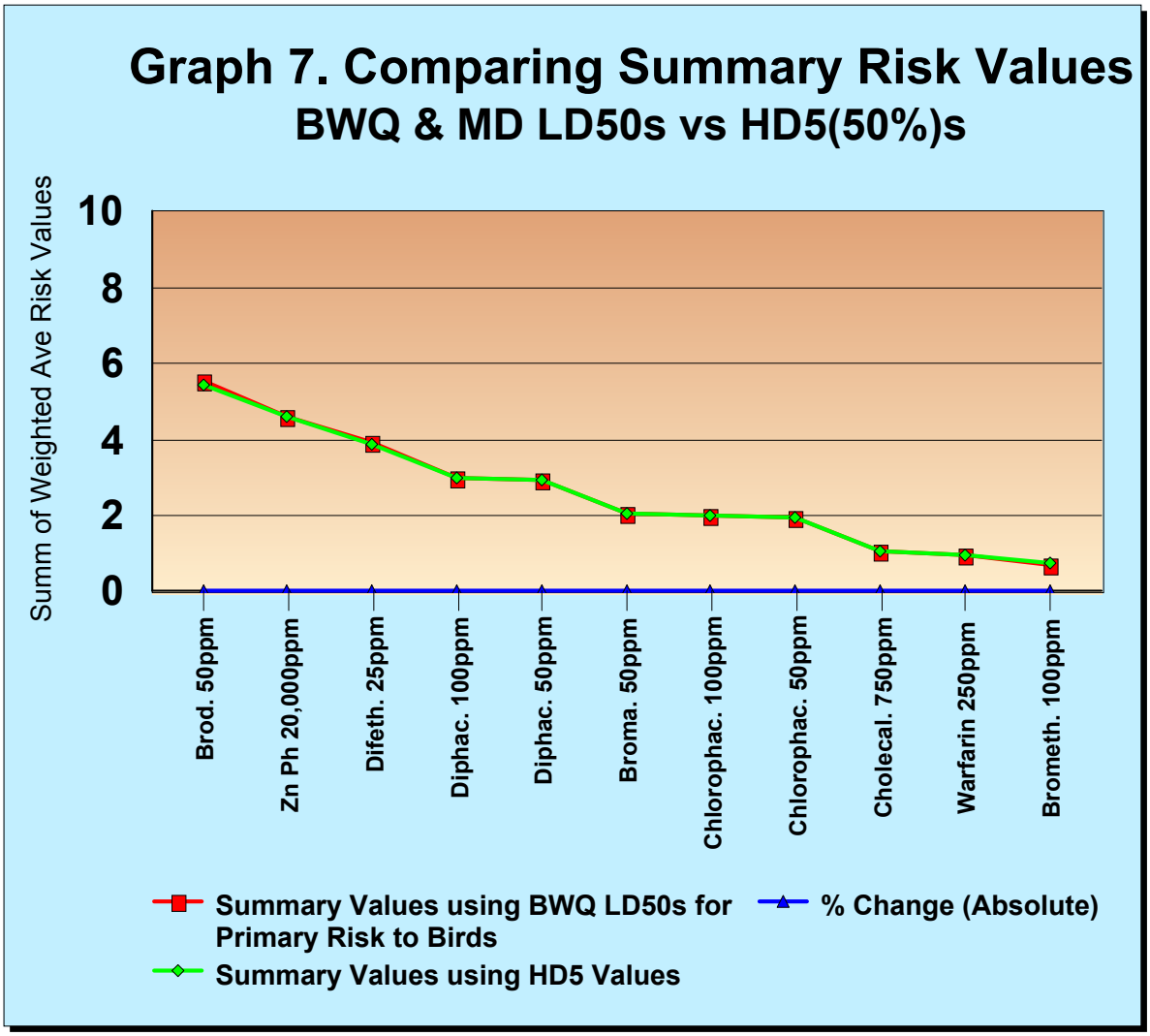
Since HD_5(50%) reference values are available for all rodenticides but diphacinone (Table 3 in Mineau *et al*), these values are substituted for the LD50 values for bobwhite quail or mallard duck used in the measure of effect - Inverse the No. Bait Pellets Needed for a 100-g Bird LD50 Dose at a Single Feeding in the comparative analysis for Primary Risk to Birds.

Rodenticide	HD_5(50%)
Brodifacoum 50 ppm	0.81
Bromadiolone 50 ppm	53.26
Bromethalin 100 ppm	0.83
Chlorophacinone 100 ppm	3.32
Chlorophacinone 50 ppm	4.98
Cholecalciferol 750 ppm	192.68
Difethialone 25 ppm	0.31
Diphacinone 100 ppm	No Data
Diphacinone 50 ppm	No Data
Warfarin 250 ppm	120.21
Zinc Phosphide 20,000 ppm	5.45

Since bait-specific HD_5(50%)s are not available, the HD_5(50%) value from Mineau *et al* is applied to the highest active ingredient concentration of two baits, and it is reduced by the

proportion difference in active ingredient concentrations between baits and applied to the bait with the lower active ingredient concentration. Lacking slope data, this assumes a linear relationship between the active ingredient in the bait and the acute toxicity to birds. Finally, the overall summary values for risk to birds and mammals are calculated and compared to the baseline in Table 6 and Graph 5. The results of the analysis are presented in Graph 7.

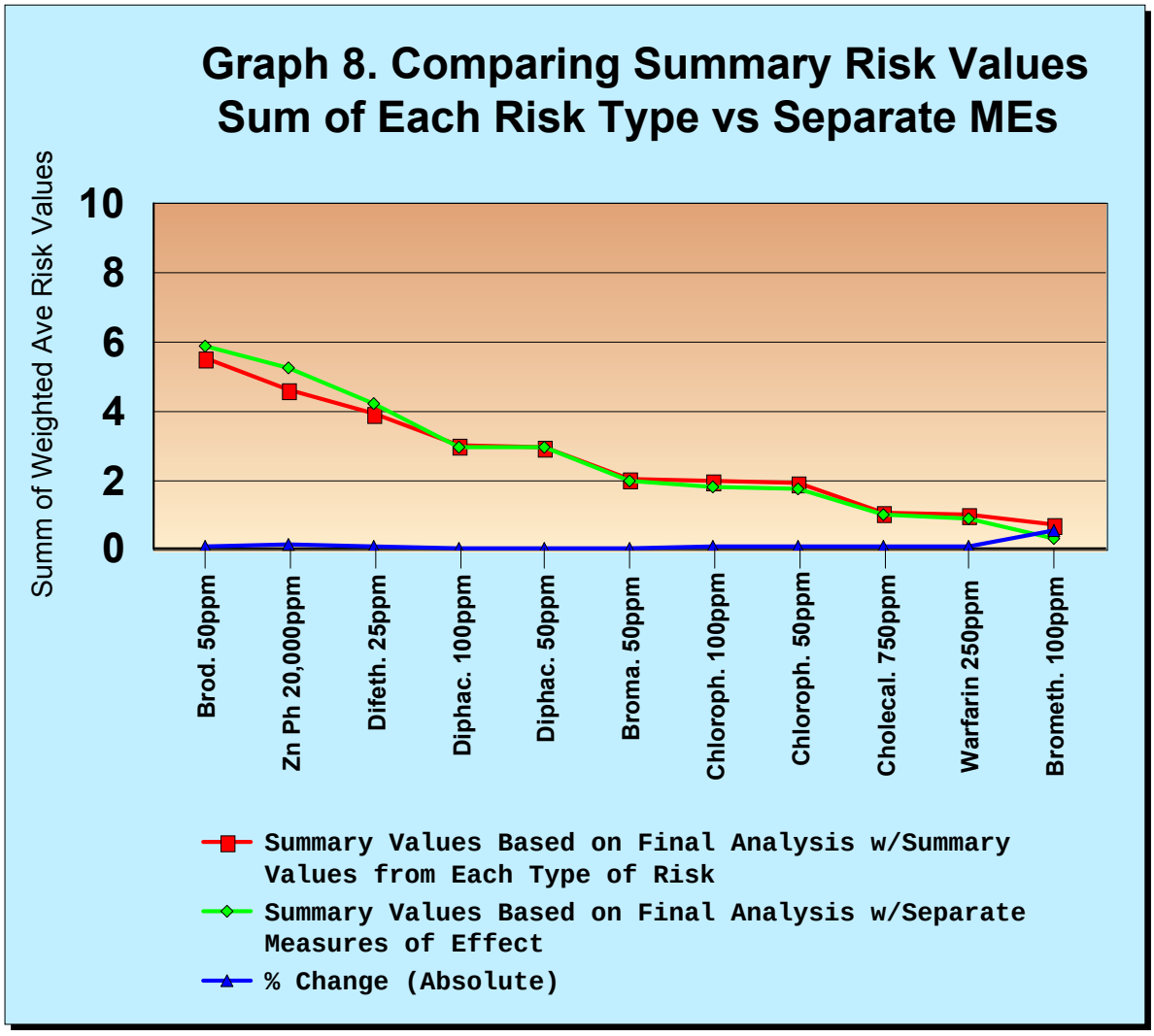
This analysis shows that the ranking remains the same and the use of the HD_5(50%) values from Mineau *et al* in place of the LD50 values for bobwhite quail or mallard duck does not have any affect on ranking of the rodenticide baits posing the greatest overall potential risk to birds and mammals. Missing HD_5(50%)data for diphacinone adds uncertainty to this conclusion.



Results Using An Alternative Approach

As noted previously, the approach taken for this analysis is to separately analyze the risk for each risk type, then analyze the summary values for each of the four risk types together in a final overall analysis. Each type of risk included variable and unequal numbers of measures of effect. Analyzing them separately and then using their summary values to arrive at an overall risk value eliminated unequal weighting of one type of risk over another due to differences in the number of measures of effect.

An alternate approach is considered where the unequal weighting is ignored and all measure of effects are considered in one step. The weights are all rated high (10.0), except for blood retention and liver retention, which are weighted medium (5.0) so that the total contribution of persistence is rated equal to the other measures of effect (10.0). The overall summary risk values are calculated and compared to the baseline results in Table 5 and Graph 6. The results of this analysis is presented in Graph 8. The rankings for overall risk to birds and mammals do not change. Thus in this case, the unequal weighting of one type of risk over another due to differences in the number of measures of effect does not appear to have a significant effect on the overall ranking.


Graph 8. Comparing Summary Risk Values
Sum of Each Risk Type vs Separate MEs
Summ of Weighted Ave Risk Values
10
8
6
4
2
0
Brod. 50ppm
Zn Ph 20,000ppm
Difeth. 25ppm
Diphac. 100ppm
Diphac. 50ppm
Broma. 50ppm
Chloroph. 100ppm
Chloroph. 50ppm
Cholecal. 750ppm
Warfarin 250ppm
Brometh. 100ppm
Summary Values Based on Final Analysis w/Summary Values from Each Type of Risk
Summary Values Based on Final Analysis w/Separate Measures of Effect
% Change (Absolute)

Incidents

Bird and mammal incidents provide additional information to further characterize the risk of rodenticide baits. The collection and reporting of incidents is not systematic, and the presence or absence of incidents is also affected by the extent of use of the rodenticide bait as well as other factors. Thus, the existence of incidents for a rodenticide bait can be viewed as confirming the risk, where as the absence of them says little about the risk. Further, without more information than is typically available for most incident reports, it can sometimes be difficult to separate the incidents based on primary or secondary effects.

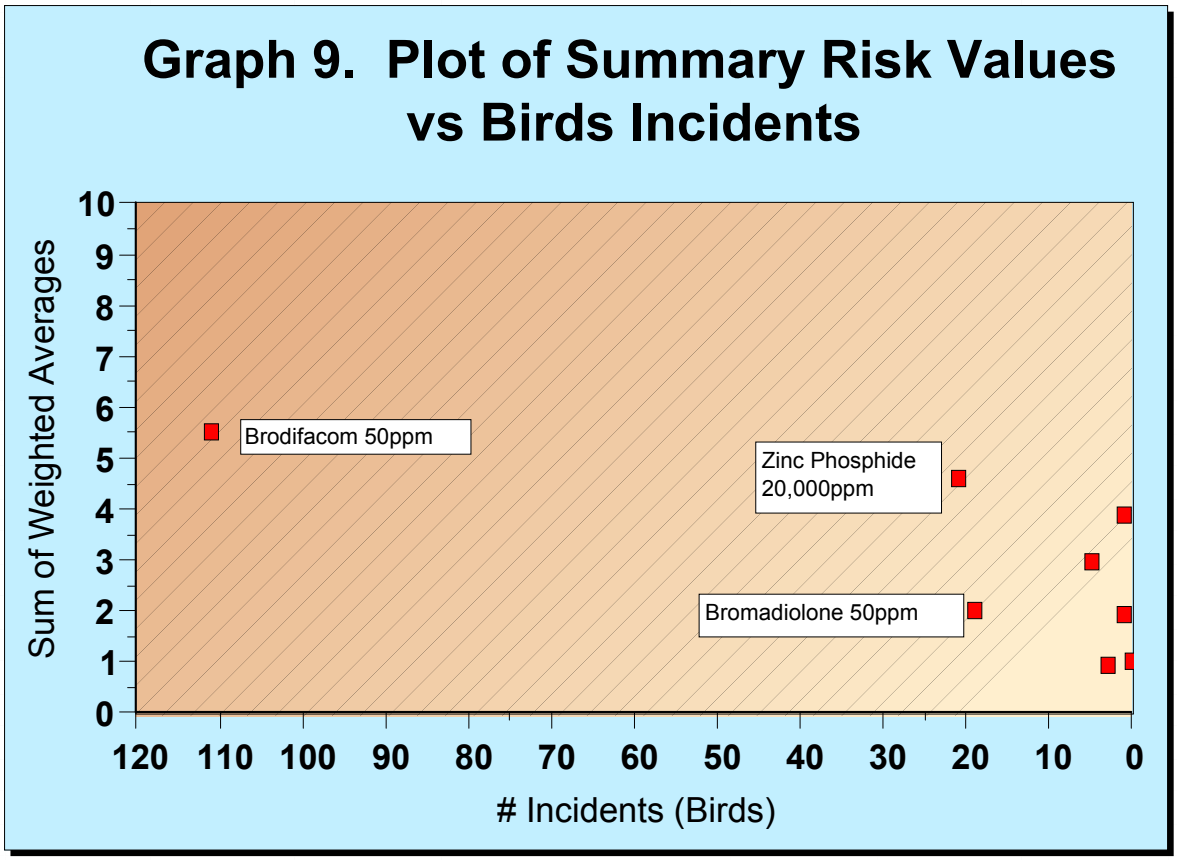
Based on Table 42 in the main document, there are a large number of bird and mammal incidents reported for rodenticide baits (161 birds; 119 mammal; 280 total). Reported mortality is attributed to both primary and secondary effects. The incidents reported for each rodenticide bait (where two baits are included in the analysis, the one with the highest concentration in the bait formulation is used) are plotted on the x-axis against the summary values of the weighted averages for the overall risk to birds and mammals (See summary values, Table 6) on the y-axis. The incidents are 'turned around' so that the rodenticide baits with the greatest number of reported incidents and the largest summary risk values should appear in the upper left of the graph. Tables 7, 8 and 9 show the input values for the following graphs. Graph 9 presents the bird incidents; Graph 10, the mammal incidents; and Graph 11, both combined.

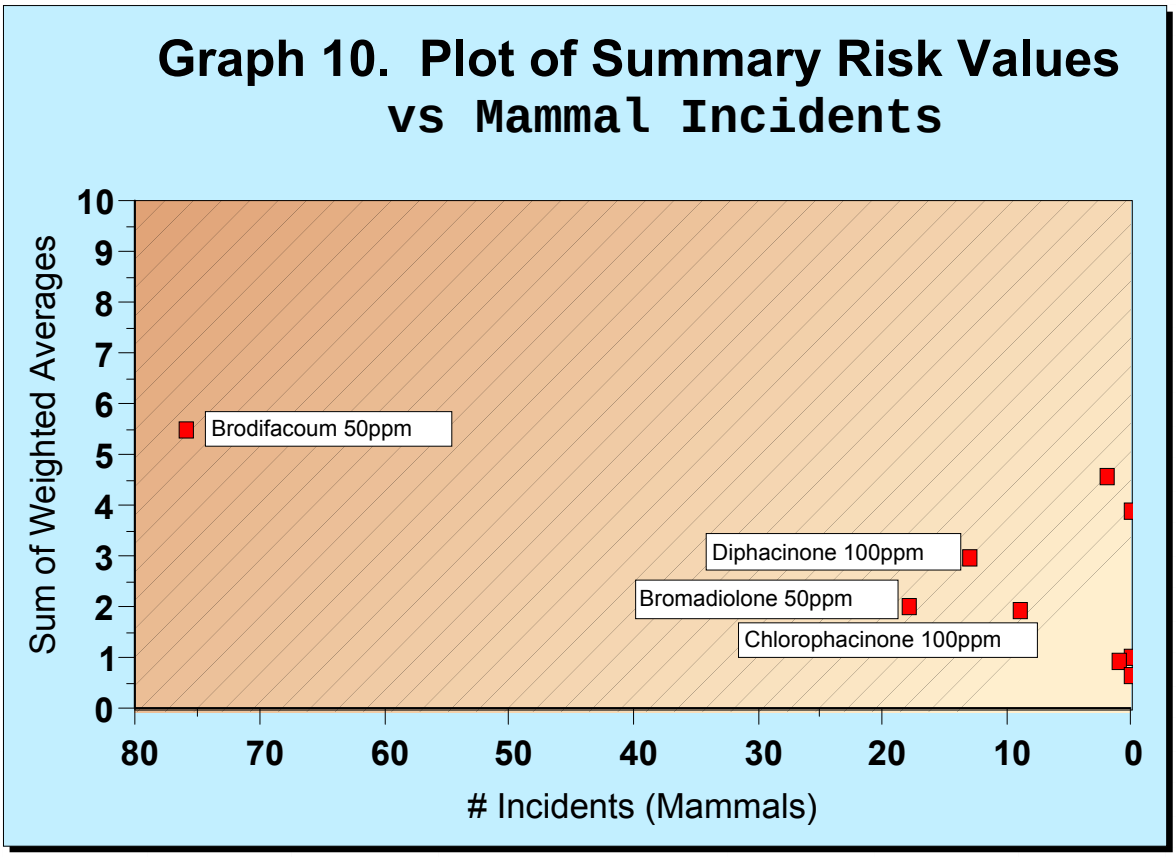
The graphs confirm that brodifacoum is the rodenticide bait that poses the greatest overall potential risk to birds and mammals. In addition to brodifacoum, Graph 9 also identifies bromadiolone and zinc phosphide as potential concerns for birds, while Graph 10 identifies bromadiolone, diphacinone, and chlorophacinone as potential risk concerns for mammals.

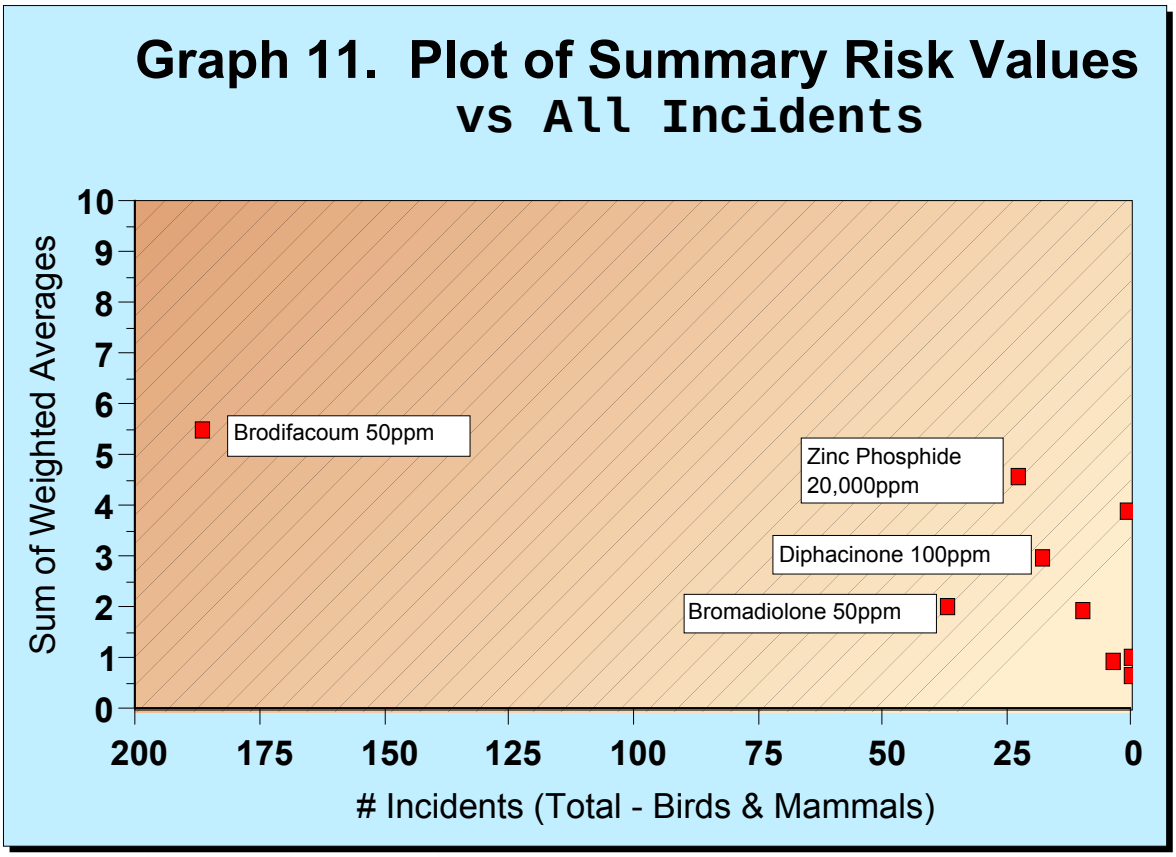
Table 7. Input values for Graph 9	# Incidents - Birds	Summary Values
Brodifacoum 50ppm	111	5.55
Zinc Phosphide 20,000ppm	21	4.63
Difethialone 25ppm	1	3.93
Diphacinone 100ppm	5	3.01
Bromadiolone 50ppm	19	2.06
Chlorophacinone 100ppm	1	1.99
Cholecalciferol 750ppm	0	1.07
Warfarin 250ppm	3	0.98
Bromethalin 100ppm	0	0.71
Sum	161	

Table 8. Input Values for Graph 10.	# Incidents - Mammals	Summary Values
Brodifacoum 50ppm	76	5.55
Zinc Phosphide 20,000ppm	2	4.63
Difethialone 25ppm	0	3.93
Diphacinone 100ppm	13	3.01
Bromadiolone 50ppm	18	2.06
Chlorophacinone 100ppm	9	1.99
Cholecalciferol 750ppm	0	1.07
Warfarin 250ppm	1	0.98
Bromethalin 100ppm	0	0.71
Sum	119	

Table 9. Input Values for Graph 11.	# Incidents - Total	Summary Values
Brodifacoum 50ppm	187	5.55
Zinc Phosphide 20,000ppm	23	4.63
Difethialone 25ppm	1	3.93
Diphacinone 100ppm	18	3.01
Bromadiolone 50ppm	37	2.06
Chlorophacinone 100ppm	10	1.99
Cholecalciferol 750ppm	0	1.07
Warfarin 250ppm	4	0.98
Bromethalin 100ppm	0	0.71
Sum	280	


Graph 9. Plot of Summary Risk Values vs Birds Incidents
Sum of Weighted Averages
10
9
8
7
6
5
4
3
2
1
0
Brodifacom 50ppm
Zinc Phosphide 20,000ppm
Bromadiolone 50ppm
120
110
100
90
80
70
60
50
40
30
20
10
0
Incidents (Birds)


Graph 10. Plot of Summary Risk Values vs Mammal Incidents
Sum of Weighted Averages
10
9
8
7
6
5
4
3
2
1
0
Brodifacoum 50ppm
Diphacinone 100ppm
Bromadiolone 50ppm
Chlorophacinone 100ppm
80
70
60
50
40
30
20
10
0
Incidents (Mammals)


Graph 11. Plot of Summary Risk Values
vs All Incidents
Sum of Weighted Averages
10
9
8
7
6
5
4
3
2
1
0
Brodifacoum 50ppm
Zinc Phosphide
20,000ppm
Diphacinone 100ppm
Bromadiolone 50ppm
200
175
150
125
100
75
50
25
0
Incidents (Total - Birds & Mammals)

Conclusions

Based on the comparative analysis model called the simple multi-attribute rating technique or SMART, the potential risks of 11 rodenticide baits are compared based on a number of measures of effect values for primary and secondary risk to birds and mammals. Of all the rodenticide baits considered, three are considered to pose the greatest overall potential risk to birds and mammals: brodifacoum, zinc phosphide, and difethialone. Brodifacoum poses the greatest overall potential risk to birds and mammals, and by a substantial margin over the other rodenticide baits. Brodifacoum has higher summary risk values than zinc phosphide for both secondary risk to birds and secondary risk to mammals. Zinc phosphide has higher summary risk values than difethialone for both primary risk to birds and primary risk to mammals.

A sensitivity analysis is performed to identify the most sensitive measure of effect(s) and to determine if changes of 50% or more in these sensitive measures of effect would change the results of the analysis. This analysis shows that the ranking for the rodenticide baits which pose the greatest risk to birds and mammals is robust when the measures of effect are changed by +/- 50%. The ranking is generally robust when the measures of effect are changed by +/- 99%, with the following exceptions: a reduction of greater than 67% in the Mean Dietary Risk Quotient for brodifacoum, 64% in the Mean (%) Mortality of Secondary Lab Studies on Birds for brodifacoum, and 76% in the Mean (%) Mortality of Secondary Lab Studies on Mammals for brodifacoum, would result in zinc phosphide moving ahead of brodifacoum as posing the greatest overall risk to birds and mammals; and, an increase of 99% in the Mean (%) Mortality of Secondary Lab Studies on Mammals for difethialone would result in difethialone moving ahead of zinc phosphide as posing the second greatest overall potential risk to birds and mammals. Thus, the sensitivity analysis shows that the ranking for the rodenticide baits is generally robust. With few exceptions, we can say that brodifacoum poses the greatest overall potential risk to birds and mammals, followed by zinc phosphide and difethialone.

Acute toxicity reference values for rodenticides to birds and an alternative approach are also considered. The toxicity reference values from a recent publication are substituted for the avian LD50 values for bobwhite quail and mallard ducks that were used in one of the avian measures of effect. The results show that the overall ranking remains the same and the use of these toxicity reference values do not affect the analysis. When unequal weighting of measures of effect for each type of risk is ignored and all measures of effect are considered together, again the results show that the overall ranking does not change. Unequal weighting of type of risk over another, in this case, does not appear to have a significant effect on the overall ranking.

There are two factors which could contribute the greatest uncertainty to the analysis: (1) missing data, especially field mortality data for difethialone, and blood and liver retention values for a number of rodenticides; and (2) the assumption that field mortality to birds and mammals due to difethialone would likely equal 80% of that reported for brodifacoum. This assumption is based on the many chemical similarities between these two rodenticides, because difethialone is formulated at a lower % ai than brodifacoum, and the fact that less difethialone is used compared to brodifacoum.

The available incidents for birds and mammals are analyzed and compared the summary of the weighted average risk values. The results confirm that brodifacoum is the rodenticide bait that poses the greatest overall potential risk to birds and mammals, but they also identify bromadiolone and zinc phosphide as potential concerns for birds, and bromadiolone, diphacinone (100 ppm), and chlorophacinone (100 ppm) as potential concerns for mammals.

References

1. Tashman, L. and S. Munro. 1997. Software Review, January 15, 1997- DecideRight. In *The Forum*, the newsletter of the International Association of Business Forecasting [http://www.loyola.edu/iabf/decide.htm]

2. Goodwin, P. and G. Wright. 1998. Decision analysis for management judgement, 2nd Ed. John Wiley & Sons, England. pp.454.

3. Mineau, P. A. Baril, B. T. Collins, J. Duffe, G. Joerman, R. Littik. 2001. Pesticide acute toxicity reference values. Rev. Environ. Contam. Toxicol. 170: 13-74.

Attachment D: Incident Data For Birds and Nontarget Mammals

The incidents reported here are summarized for each rodenticide from incident reports in the EPA/OPP Environmental Fate and Effect Division's Ecological Incidents Information System. Unless otherwise noted, an incident is included here only if confirmation of exposure is reported. For the anticoagulants, detection of residue in the liver is the criterion of exposure unless otherwise stated. Hemorrhaging and other signs of toxicosis also generally are included in incident reports, but details are not tabulated here (see Stone et al. 1999, 2003; Hosea 2000). For the non-anticoagulants, detection of bait in the stomach or crop contents are typical evidence of exposure. Most of the incidents are based on carcass recovery; however, as noted, 3 incidents involved mammals that were live-trapped and sacrificed. Reported residue levels are provided only as confirmation that animals were exposed to a rodenticide. There are no incident data for bromethalin and cholecalciferol.

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Owls						
Great horned owl	NY	Erie	4/04	1	0.026	the owl was observed on the ground in a lethargic state for 3 days before its death
Great horned owl	NY	Saratoga	2/02	1	0.44	"Little blood in heart (blood watery)"
Great horned owl	NY	Erie	12/01	1	0.82	
Great horned owl	NY	Delaware	10/01	1	0.84	
Great horned owl	NY	Rockland	9/01	1	0.24	
Great horned owl	NY	Ulster	4/01	1	0.49	
Great horned owl	CA	Los Angeles	2000	1	0.34	
Great horned owl	CA	Los Angeles	2000	1	0.05	also bromadiolone (0.8 ppm)

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Great horned owl	NY	Rensselaer	11/00	1	0.09	
Great horned owl	NY	Warren	10/00	1	0.15	also bromadiolone (0.32 ppm)
Great horned owl	NY	Suffolk	7/00	1	0.37	also bromadiolone (0.4 ppm)
Great horned owl	NY	Albany	10/99	1	0.14	
Great horned owl	CA	San Bernardino	10/99	1	0.35	also bromadiolone (0.065 ppm)
Great horned owl	NY	Washington	7/99	1	0.42	bird was a fledgling
Great horned owl	NY	Dutchess	2/99	1	0.64	brodifacoum also detected in an egg (0.008 ppm)
Great horned owl	NY	Suffolk	2/99	1	0.23	
Great horned owl	NY	Ontario	2/99	1	0.16	
Great horned owl	NY	Nassau	2/99	1	0.08	brodifacoum also detected in skeletal muscle (0.02 ppm); 4 dead rats found in owl's nest
Great horned owl	NY	Columbia	1/99	1	0.036	small mammal hair in stomach
Great horned owl	NY	Oswego	12/98	1	0.30	owl may have bled excessively from puncture wound between eyes and into the sinuses, possibly caused by its prey (partially-eaten muskrat carcass found nearby)
Great horned owl	NY	Albany	12/98	1	0.08	also bromadiolone (0.27 ppm); "The owl died from hemorrhaging of minor wounds inflicted by prey";

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Great horned owl	CA	Contra Costa	8/98	1	0.04	also diphacinone (0.6 ppm)
Great horned owl	NY	Niagara	7/98	1	0.03	also bromadiolone (0.77 ppm) and warfarin (0.73 ppm)
Great horned owl	NY	Rensselaer	7/98	1	0.12	a dead rat found nearby owl
Great horned owl	NY	Saratoga	5/98	1	0.06	also bromadiolone (0.24 ppm)
Great horned owl	GA	White	2/98	2	0.099 0.23	
Great horned owl	NY	Dutchess	6/97	1	0.22	
Great horned owl	NY	Genesee	4/97	1	0.09	
Great horned owl	NY	Greene	2/97	1	0.08	
Great horned owl	NY	Monroe	6/96	1	0.35	vole remains in stomach; small laceration on foot
Great horned owl	NY	Chenango	2/96	1	0.36	
Great horned owl	NY	Suffolk	8/95	1	0.53	also bromadiolone (0.14 ppm)
Great horned owl	CA	San Joaquin	1995	1	0.015	
Great horned owl	NY	Albany	12/94	1	0.1	
Great horned owl	NY	Orleans	11/94	1	0.73	bled from punctures on feet
Great horned owl	NY	Erie	10/94	1	0.41	
Great horned owl	NY	Albany	6/94	1	0.64	blood on feet from hole on left foot; brodifacoum bait applied nearby
Great horned owl	NY	Niagara	3/94	1	0.53	

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Great horned owl	NY	Suffolk	10/89	1	0.2	
Great horned owl	NY	Putnam	3/89	1	0.01	
Long-eared owl	NY	Bronx	3/99	1	0.30	
Eastern screech-owl	NY	Suffolk	2/03	1	0.30	unidentified mammal hair and bones in the stomach
Eastern screech-owl	NY	Niagara	9/02	1	0.65	
Eastern screech-owl	NY	New York	1/02	1	0.91	
Eastern screech-owl	NY	Albany	2/00	1	0.16	
Eastern screech-owl	NY	Schenectady	10/99	1	0.16	
Eastern screech-owl	NY	Erie	10/97	1	0.8	
Eastern screech-owl	NY	Suffolk	2/97	1	0.34	
Barn owl	GA	Dawson	11/03	1	0.035	a red-tailed hawk also died, and vitamin K was administered to 2 great horned owls that showed signs of poisoning
Barn owl	CA	Sacramento	11/02	1	0.03	brodifacoum also detected in the ventriculus (4.90 ppb), along with mammal hairs, and in a blood sample taken from the thoracic cavity and ventriculus lining

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Barn owl	CA	San Bernardino	10/99	3	0.35 0.21 0.07	 also bromadiolone (0.38 ppm) also bromadiolone (0.31 ppm)
Barn owl	GA	Madison	11/95	2	0.85 0.75	
Barred owl	NY	Albany	11/01	1	0.04	
Northern spotted owl	WA	Chelan	4/91	1	0.1	NWHC[b] database (case 10128)
Northern spotted owl	WA	Kittitas	7/95	1	0.05	NWHC[b] database (case 13799)
Diurnal Birds of Prey						
Golden eagle	CA	Ventura	2000	3	0.026 0.01 0.004	the 3 eagles were live-trapped for relocation but died in captivity
Golden eagle	CA	Alameda	11/99	1	0.01	
Golden eagle	CA	Contra Costa	11/99	1	trace	
Golden eagle	CA	Stanislaus	7/99	1	0.02	
Golden eagle	CA	Contra Costa	3/99	1	0.04	
Golden eagle	CA	Alameda	2/99	1	0.04	
Golden eagle	NY	Washington	12/97	1	0.016	
Golden eagle	CA	Alameda	11/97	1	0.08	
Golden eagle	CA	Santa Clara	5/97	1	trace	
Golden eagle	CA	San Benito	12/96	1	0.13	

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Golden eagle	NY	Monroe	4/96	1	0.03	tissue analyzed 7 months after death
Bald eagle	WI	Sawyer	10/98	1	detected	residue level reported as "moderate"
Bald eagle	ID	Boise	1/86	1	38	reported by the NWHC[b] (case 6372)
Red-tailed hawk	NY	Schenectady	3/04	1	0.50	probable bite injury on left foot likely source of blood on belly plumage
Red-tailed hawk	GA	Dawson	11/03	1	0.08	residue from unspecified fresh tissue
Red-tailed hawk	NY	Suffolk	3/02	1	0.57	
Red-tailed hawk	NY	New York	3/02	1	0.4	
Red-tailed hawk	NY	Albany	3/01	1	0.03	bled severely from foot lacerations probably inflicted by prey
Red-tailed hawk	WI	LaCrosse	2/01	1	0.02	
Red-tailed hawk	WI	Dane	1/01	1	0.04	unidentified meat/muscle in crop
Red-tailed hawk	WI	LaCrosse	1/01	1	0.11	
Red-tailed hawk	WI	Outagamie	1/01	2	0.008	6 other hawks found alive but ill
Red-tailed hawk	WI	Iowa	1/01	1	0.04	
Red-tailed hawk	CA	San Luis Obispo	1/01	1	0.015	

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Red-tailed hawk	AL	Morgan	1/01	4	0.01	8 red-tailed hawks and 24 undidentified hawks reported in this incident in the NWHC[b] database (case 13799)
Red-tailed hawk	WI	Buffalo	12/00	1	0.014	rodent hair, meat, bones in crop
Red-tailed hawk	NY	Rockland	12/00	1	0.32	
Red-tailed hawk	CA	San Joaquin	12/00	1	0.12	
Red-tailed hawk	WI	Dane	8/00	1	0.009	
Red-tailed hawk	WI	Adams	7/00	1	0.003	
Red-tailed hawk	WI	Columbia	5/00	1	0.02	
Red-tailed hawk	NY	Rensselaer	4/00	1	0.94	
Red-tailed hawk	NY	New York	3/00	1	0.24	small mammal hair and bone in stomach
Red-tailed hawk	NY	Westchester	3/00	1	0.377	
Red-tailed hawk	NY	Westchester	3/00	1	0.08	
Red-tailed hawk	WI	Manitowoc	3/00	1	0.03	
Red-tailed hawk	WI	Columbia	2/00	1	detected	residue level not reported
Red-tailed hawk	WI	Vernon	1/00	1	detected	residue level not reported
Red-tailed hawk	WI	Dane	1/00	1	detected	residue level not reported
Red-tailed hawk	NY	Rensselaer	6/99	1	0.69	
Red-tailed hawk	NY	Albany	4/99	1	0.32	

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Red-tailed hawk	CA	Stanislaus	3/99	1	0.01	
Red-tailed hawk	NY	Nassau	3/99	1	1.28	
Red-tailed hawk	NY	Suffolk	2/99	1	0.80	this hawk apparently "bled out" through a minor leg wound possibly inflicted by its prey
Red-tailed hawk	NY	New York	1/99	1	0.23	
Red-tailed hawk	NY	Suffolk	1/99	1	0.13	
Red-tailed hawk	NY	Saratoga	1/99	1	0.16	severe blood loss may have been from minor bites on feet
Red-tailed hawk	NY	Albany	10/98	1	0.04	
Red-tailed hawk	NY	Nassau	1/98	1	0.56	
Red-tailed hawk	NY	Suffolk	10/96	1	0.5	mouse parts in GI tract
Red-tailed hawk	NY	Onondaga	6/96	1	0.65	small mammal fur in stomach
Red-tailed hawk	NY	Suffolk	12/95	1	1.6	blood stains on right foot and belly; rodenticide applied nearby
Red-tailed hawk	NY	Nassau	3/95	1	0.76	bled from foot punctures "probably inflicted by prey"
Red-tailed hawk	NY	Richmond	1/95	1	0.43	
Red-tailed hawk	NY	Westchester	12/94	1	0.23	

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Red-tailed hawk	NY	Westchester	11/94	1	0.46	"The bird seemed to have exsanguinated through a minor toe wounds"
Red-shouldered hawk	NY	Westchester	4/02	1	0.23	
Red-shouldered hawk	CA	Stanislaus	3/99	2	0.15 0.01	also bromadiolone (0.28 ppm)
Cooper's hawk	NY	Dutchess	9/03	1	0.28	
Cooper's hawk	NY	Rensselaer	2/02	1	0.37	
Cooper's hawk	NY	Schenectady	2/01	1	0.18	
Cooper's hawk	NY	Albany	9/00	1	0.21	
Cooper's hawk	CA	Los Angeles	2000	1	0.03	
Cooper's hawk	WI	Manitowoc	3/00	1	0.03	
Sharp-shinned hawk	NY	Steuben	1/02	1	0.023	
Sharp-shinned hawk	NY	Schenectady	1/00	1	0.17	
Black vulture	NY	Westchester	4/02	1	0.13	
Turkey vulture	NY	Ulster	3/01	1	0.26	
Perching Birds						
Raven	NY	Rensselaer	4/96	1	1.04	
American crow	NY	Albany	1/02	1	1.73	

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
American crow	NY	Oneida	10/01	1	1.9	
American crow	NY	Chautaugun	10/01	1	0.07	
American crow	NY	Erie	9/01	1	0.70	
American crow	NY	Oneida	9/01	1	1.5	
American crow	NY	Erie	7/01	1	0.52	
American crow	NY	Erie	6/01	1	0.35	
American crow	NY	Erie	5/01	1	1.3	
American crow	NY	Albany	3/01	1	0.45	
American crow	NY	Albany	2/01	1	0.4	
American crow	NY	Onondaga	8/00	1	0.08	
American crow	NY	Suffolk	6/00	1	1.0	
American crow	NY	Westchester	4/00	1	1.2	
Crow	NY	Dutchess	10/99	1	1.67	
Crow	NY	Westchester	9/98	2	0.14	pooled sample from both birds
Crow	CT	Norwalk	1/97	1	1.34	gizzard contained blue-green granular material believed to be bait
Other Birds						
Geese	VA	Fauquier	10/92	2	not reported	VA Dept. Game and Inland Fisheries attributed deaths to brodifacoum; no residue values provided

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Rock dove	CA	Ventura	5/03	1	0.01	also diphacinone (0.9 ppm)
Denver Zoo:	CO		11/86-	10		liver residues were determined at the
Plover			1/87		0.8	Denver Federal Center; deaths
Sissa					0.5	coincided with bait application and a
Franklin's gull					1.5-1.6	massive mouse die-off
Laughing gull					1.6	
National Zoo:	VA		4/84	~12	confirmed	birds apparently died after eating
Avocet						crickets that had consumed bait;
Ant pitta						according to EPA memo, "residues in
Golden plover						birds were confirmed by ICI, the
Honey creeper						registrant"; memo also notes that a
Finch						similar incident occurred at the
Thrush						Philadelphia Zoo 3 years earlier
Warbler						
Crake						
Carnivores						
Coyote	CA	Los Angeles	2000	1	0.08	also bromadiolone (0.44 ppm)
Coyote	NY	Warren	5/99	1	0.93	
Coyote	CA	Santa Clara	2/99	5	0.47	also bromadiolone (0.46 ppm)
					0.36	also chlorophacinone (trace)
					0.30	also bromadiolone (0.07 ppm)
					0.23	also bromadiolone (0.09 ppm)
					0.33	all 5 coyotes were live-trapped and sacrificed

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Coyote	CA	Santa Clara	1999	1	0.07	
Coyote	CA	Santa Clara	1999	1	0.03	
Coyote	CA	Santa Clara	1999	1	0.28	
Coyote	CA	Santa Clara	1999	1	0.06	
Coyote	CA	San Mateo	1998	1	0.08	
Coyote	CA	Ventura	1998	1	0.04	
Coyote	CA	Los Angeles	1998	1	0.08	also chlorophacinone (0.43 ppm) and diphacinone (0.08 ppm); coyote live-trapped and sacrificed
Coyote	CA	Orange	1998	2	0.5 0.66	also bromadiolone (0.22 ppm); coyotes live-trapped and sacrificed
Coyote	CA	Los Angeles	12/97	1	0.28	also detected in blood (0.019 ppm)
Coyote	CA	Ventura	10/97	1	0.083	also diphacinone (1.3 ppm)
Coyote	CA	Los Angeles	8/97	2	0.054 trace	
Coyote	CA	Ventura	8/97	1	trace	
San Joaquin Kit Fox	CA	Kern	8/03	1	11.0	
San Joaquin Kit Fox	CA	Kern	2002	1	0.706	
San Joaquin Kit Fox	CA	Kern	2002	1	0.381	
San Joaquin Kit Fox	CA	Kern	2002	1	0.373	

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
San Joaquin Kit Fox	CA	Kern	2002	1	0.296	
San Joaquin Kit Fox	CA	Kern	2002	1	0.161	
San Joaquin Kit Fox	CA	Kern	2002	1	0.132	
San Joaquin Kit Fox	CA	Kern	2002	1	0.191	also pival[c] (6.93 ppm) and coumatetralyl[d] (0.368 ppm)
San Joaquin Kit Fox	CA	Kern	2002	1	0.122	also coumatetralyl[d] (1.42 ppm)
San Joaquin Kit Fox	CA	Kern	2002	1	0.019	coumatetralyl[d] (0.4 ppm)
San Joaquin Kit Fox	CA	Kern	2002	1	0.091	coumatetralyl[d] (1.1 ppm)
San Joaquin Kit Fox	CA	Kern	2002	1	0.009	coumatetralyl[d] (0.134 ppm)
San Joaquin Kit Fox	CA	Kern	2002	1	0.008	
San Joaquin Kit Fox	CA	Kern	2002	1	0.007	
San Joaquin Kit Fox	CA	Kern	2002	1	trace	
San Joaquin Kit Fox	CA	Tulare	2001	1	0.042	
San Joaquin Kit Fox	CA	Kern	2001	1	0.18	
San Joaquin Kit Fox	CA	Kern	2001	1	0.075	
San Joaquin Kit Fox	CA	Kings	2001	1	trace	
San Joaquin Kit Fox	CA	Kern	2000	1	1.0	
San Joaquin Kit Fox	CA	Kern	2000	1	0.11	
San Joaquin Kit Fox	CA	Kern	2000	1	0.1	

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
San Joaquin Kit Fox	CA	Kern	1/00	1	0.13	also bromadiolone (0.14 ppm); roadside carcass
San Joaquin Kit Fox	CA	Kern	12/99	1	0.67	roadside carcass
San Joaquin Kit Fox	CA	Kern	11/99	1	0.22	animal hit by car and died
San Joaquin Kit Fox	CA	Kern	8/99	1	0.47	also bromadiolone (0.72 ppm)
San Joaquin Kit Fox	CA	Kern	9/99	1	0.07	also chlorophacinone (0.27 ppm)
Red fox	NY	Suffolk	3/96	2	4.01 1.32	also detected in alimentary canal contents (0.34 ppm), which contained deer hair; 4 dead deer, not analyzed, also were found
Red fox	CA	Monterey	1999	1	0.04	
Red fox	CA	Fresno	8/97	2	0.05	rodent bones and hair, feathers, and grain present in stomach
Gray fox	NY	Albany	8/99	1	0.35	
Gray fox	NY	Delaware	3/98	1	0.02	small mammal skin and hair in stomach
Gray fox	CA	Los Angeles	1998	1	0.03	
Bobcat	CA	Los Angeles	2/01	1	0.024	
Bobcat	CA	Ventura	9/99	1	0.07	also bromadiolone (0.11 ppm)
Bobcat	CA	Riverside	6/99	1	0.018	
Bobcat	CA	Ventura	12/97	1	0.049	

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Mountain lion	CA	Riverside	4/97	1	0.52	
Raccoon	NY	New York	5/00	1	0.14	
Raccoon	CA	Los Angeles	1998	1	0.082	also bromadiolone (1.1 ppm) and diphacinone (0.13 ppm); raccoon live-trapped and sacrificed
Raccoon	CA	Orange	1998	1	0.011	also bromadiolone (0.41 ppm); raccoon live-trapped and sacrificed
Raccoon	NY	Albany	3/97	1	0.32	
Raccoon	NY	Suffolk	3/96	1	1.0	blue-green granular material, probably bait, in stomach
Raccoon	NY	Nassau	9/92	3	5.3 4.6 3.1	
Raccoon	NY	Niagara	6/92	1	1.8	detected in stomach contents; dyed bait also present in stomach
Long-tailed weasel	NY	Rensselaer	1/00	1	0.07	
Striped skunk	NY	Albany	5/99	1	1.05	
Striped skunk	NY	Delaware	3/98	1	0.3	small mammal fur in stomach
Marsupials						
Opossum	NY	Albany	12/98	1	0.24	

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Opossum	NY	Albany	4/97	1	0.18	
Ungulates						
White-tailed deer	NY	Suffolk	12/97	1	0.16	
White-tailed deer	NY	Suffolk	4/96	1	0.12	
White-tailed deer	NY	Suffolk	5/96	1	0.41	
White-tailed deer	NY	Suffolk	9/95	1	0.37	also coumatetralyl (0.5 ppm)
White-tailed deer	NY	Suffolk	10/94	1	0.38	
Rodents						
Gray squirrel	NY	Albany	2/02	1	0.82	third dead squirrel found in 2 weeks
Gray squirrel	NY	Dutchess	10/01	3	5.5 1.03	
Gray squirrel	NY	Livingston	8/01	1	3.45	second squirrel found dead in a week
Gray squirrel	NY	Schenectady	8/01	1	2.64	
Gray squirrel	NY	Rockland	6/01	1	0.35	
Gray squirrel	NY	New York	2/01	1	0.3	
Gray squirrel	NY	Albany	4/00	2	8.3 4.1	
Gray squirrel	NY	Suffolk	12/99	2	0.70 0.25	

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Gray squirrel	NY	Albany	11/99	1	2.1	
Gray squirrel	NY	Rensselaer	8/99	1	2.4	
Gray squirrel	NY	Albany	7/99	1	0.31	
Gray squirrel	NY	Westchester	5/99	1	6.3	
Gray squirrel	NY	Westchester	5/99	3	2.4	
Gray squirrel	NY	Albany	5/99	1	0.23	
Gray squirrel	NY	New York	5/99	1	3.12	
Gray squirrel	NY	Westchester	4/99	3	6.44 6.93 6.9	also detected in stomach (10.3 ppm)
Gray squirrel	NY	Oneida	9/98	5	detected	reportedly detected at "significant" levels
Gray squirrel	NY	Nassau	3/97	1	0.88	the squirrel was found dead on 3/97 but not necropsied until 1/99
Gray squirrel	WI	Calumet	4-5/97	3	detected	residue level reported as "significant"
Gray squirrel	NY	Albany	12/96	1	1.39	
Gray squirrel	WI	Calumet	9/96	2	detected	residue level not reported
Gray squirrel	WI	Calumet	8/95	1	1.8	~30 other dead squirrels found, but not analyzed, between 2-8/95 in a neighborhood in Appleton, WI

Brodifacoum[a]

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Gray squirrel	NY	Albany	9/93	1	25.8	detected in colon contents; dyed bait also present in alimentary canal
Gray squirrel	NY	Albany	8/93	1	0.53	also chlorophacinone (0.62 ppm)
Gray squirrel	NY	Monroe	6/93	3	5.1	pooled sample
Gray squirrel	VA	Henrico	6/93	4	detected	residue level reported as "significant"; a cat also was treated for poisoning
Gray squirrel	NY	Monroe	7/90	1	4.1	
Gray squirrel	NY	Westchester	6/90	1	0.7	
Fox squirrel	CA	Sacramento	5/99	8	3.1	apparent deliberate misuse
Chipmunk	WI	Oneida	9/98	3	detected	present at "significant levels" in a pooled sample
Chipmunk	NY	Albany	6/92	1	3.8	

[a] two additional incidents were submitted by Syngenta under 6(a)(2) aggregate reporting; the species and number of individuals involved were not reported

[b] National Wildlife Health Center, Madison, WI; incident information from the Center's diagnostic file of individual birds submitted for examination or from their epizootic database (K. Converse, pers comm.)

[c] pival, a first-generation anticoagulant, is no longer registered in the U.S. but might have been used under existing stocks provisions

[d] coumatetralyl, a second-generation anticoagulant, is not registered for use in the U.S.

Difethialone

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Carnivores						
Bobcat	CA	Los Angeles	1999	1	trace	

Bromadiolone

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Owls						
Great horned owl	NY	Warren	10/00	1	0.32	also brodifacoum (0.15 ppm)
Great horned owl	NY	Suffolk	7/00	1	0.4	also brodifacoum (0.37 ppm)
Great horned owl	NY	Albany	7/00	1	detected	
Great horned owl	CA	Los Angeles	2000	1	0.8	also brodifacoum (0.05 ppm)
Great horned owl	CA	San Bernardino	10/99	1	0.065	also brodifacoum (0.35 ppm)
Great horned owl	NY	Albany	12/98	1	0.27	also brodifacoum (0.08 ppm); "The owl died from hemorrhaging of minor wounds inflicted by prey"
Great horned owl	NY	Niagara	7/98	1	0.77	also warfarin (0.73 ppm) and brodifacoum (0.03 ppm)
Great horned owl	NY	Saratoga	5/98	1	0.24	also brodifacoum (0.06 ppm)
Great horned owl	NY	Suffolk	8/95	1	0.14	also brodifacoum (0.53 ppm)
Eastern screech-owl	NY	Cattaragus	1/00	1	4.29	
Eastern screech-owl	NY	Suffolk	3/99	1	0.05	
Northern saw-whet owl	NY	Cattaraugus	3/00	1	0.43	

Bromadiolone

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Barn owl	CA	San Bernardino	10/99	3	0.38 0.31 0.38	also brodifacoum (0.21 ppm) also brodifacoum (0.07 ppm) A total of 29 owls, 6 hawks, and 1 egret were found dead
Diurnal Birds of Prey						
Red-shouldered hawk	CA	Stanislaus	1999	1	0.28	also brodifacoum (0.01 ppm)
Red-tailed hawk	NY	not reported	10/98	1	0.08	
Cooper's hawk	NY	Erie	12/00	1	0.6	
Cooper's hawk	NY	Greene	2/99	1	0.24	several puncture wounds, coated with dried blood, on foot
American kestrel	CA	Yolo	1998	1	trace	detected in a nestling
Herons						
Great blue heron	NY	New York	1/99	1	0.1	
Perching Birds						
Fish crow	NY	Richmond	4/00	1	2.1	
Doves						
Mourning dove	NY	New York	10/99	1	0.42	

Bromadiolone

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Carnivores						
San Joaquin Kit Fox	CA	Kern	1/00	1	0.14	also brodifacoum (0.13 ppm)
San Joaquin Kit Fox	CA	Kern	1999	1	0.72	also brodifacoum (0.47 ppm)
Coyote	CA	Los Angeles	2000	1	0.44	also brodifacoum (0.08 ppm)
Coyote	CA	Santa Clara	1999	3	0.46 0.09 0.07	also brodifacoum (0.47 ppm) also brodifacoum (0.23 ppm) also brodifacoum (0.30 ppm)
Coyote	CA	Orange	1998	1	0.22	also brodifacoum (0.66 ppm); coyote live-trapped and sacrificed
Bobcat	CA	Ventura	1999	1	0.11	also brodifacoum (0.07 ppm)
Raccoon	CA	Los Angeles	1998	1	1.1	also brodifacoum (0.082 ppm) and diphacinone (0.13 ppm); raccoon live-trapped and sacrificed
Raccoon	CA	Orange	1998	1	0.41	also brodifacoum (0.011 ppm); raccoon live-trapped and sacrificed
Striped skunk	NY	Westchester	4/96	3	0.2 0.29 0.08	
Marsupials						
Opossum	NY	Albany	11/96	1	0.8	

Bromadiolone

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Rodents						
Gray squirrel	NY	New York	2/01	1	0.3	
Gray squirrel	NY	Suffolk	6/00	1	0.003	
Gray squirrel	NY		6/00	1	2.92	also detected (0.021 ppm) in stomach contents
Gray squirrel	NY	New York	4/00	3	8.84 3.14 2.46	
Gray squirrel	NY	Erie	11/99	3	2.88 1.43 1.01	all 3 squirrels had undergone considerable autolysis
Gray squirrel	NY	New York	2/99	1	0.05	
Gray squirrel	NY	Onondaga	9/98	1	0.12	
Gray squirrel	VA	Richmond	6/98	2	4.94	pooled sample from 2 of 8 squirrels found dead; also diphacinone (3.41 ppm); several unidentified birds also found dead

Chlorophacinone

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Diurnal Birds of Prey						
Red-tailed hawk	NY	New York	7/99	1	0.18	
Gallinaceous Birds						
Turkey (wild)	KS	Cheyenne	4/02	2	0.69 0.40	bait present in gastrointestinal tract
Turkey (wild)	CA	Nevada	12/94	3	0	residues confirmed in gut contents; also detected in blood (5.5 ppm)
Carnivores						
Coyote	CA	Santa Clara	2/99	1	trace	also brodifacoum (0.36 ppm); the animal was live-trapped and sacrificed
Coyote	CA	Los Angeles	7/98	1	0.43	also brodifacoum (0.08 ppm) and diphacinone (0.081 ppm); the animal was live-trapped and sacrificed
Coyote	CA	Los Angeles	9/97	1	1.2	
San Joaquin kit fox	CA	Kern	9/99	1	0.27	also brodifacoum (0.07 ppm)
San Joaquin kit fox	CA	San Luis Obispo	8/90	4	detected	residue levels not reported

Chlorophacinone

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Bobcat	CA	Marin	7/95	1	0.4	bobcat found dead 1 day after seen feeding on a dead owl; a rodent carcass was recovered in the crop of the owl
Rodents						
Gray squirrel	NY	New York	2/99	1	0.44	
Gray squirrel	NY	New York	1/99	1	0.47	
Gray squirrel	NY	New York	1/99	1	0.29	
Gray squirrel	NY	Albany	8/93	1	0.62	also brodifacoum (0.53 ppm)

Diphacinone

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Owls						
Barred owl	NY	Schenectady	11/99	1	0.62	immediate cause of death apparently was blunt trauma, possibly impact by an automobile
Great horned owl	CA	Contra Costa	8/98	1	0.6	also brodifacoum (0.04 ppm)
Snowy owl	NY	Dutchess	11/93	1	0.26	
Diurnal Birds of Prey						
Red-tailed hawk	NY	Nassau	6/99	1	0.34	
Turkey vulture	CA	Alameda	7/97	1	0.4	
Other Birds						
Rock dove	CA	Ventura	5/03	1	0.9	also brodifacoum (0.01 ppm)
Carnivores						
San Joaquin kit fox	CA	Kern	6/87	1	0.18	anticoagulant baits had been applied in the area for ground squirrel control
Coyote	CA	Ventura	10/97	1	1.3	also in thoracic-cavity blood (0.1 ppm) and stomach contents (0.16 ppm); also brodifacoum (0.083 ppm)

Diphacinone

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Coyote	CA	Los Angeles	1998	1	0.081	also chlorophacinone (0.43 ppm) and brodifacoum (0.08 ppm); the animal was live-trapped and sacrificed
Coyote	CA	Los Angeles	9/97	1	0.043	
Mountain lion	CA		11/86	1	see comment	45 ppm detected in blood
Raccoon	CA	Los Angeles	1998	1	0.13	also bromadiolone (1.1 ppm) and brodifacoum (0.082 ppm); the animal was live-trapped and sacrificed
Raccoon	CA		11/86	1	see comment	44 ppm detected in "blood and liver" sample
Ungulates						
White-tailed deer	NY	Suffolk	12/96	1	0.2	maggots in carcass suggest the deer had probably been dead for several weeks prior to analysis
White-tailed deer	NY	Suffolk	10/96	1	0.93	
Rodents						
Gray squirrel	NY	Albany	3/00	1	1.02	

Diphacinone

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Gray squirrel	VA	Richmond	6/98	2	3.41	pooled sample; also bromadiolone (4.94 ppm); 6 other squirrels and several unidentified birds also found dead
Gray squirrel	NY	Suffolk	4/97	1	2.0	
Heermann's kangaroo rat	CA	Merced	4/94	1	3.5	
Rabbits						
Cottontail rabbit	CA	Kern	8/89	12	not analyzed	reported by CA Dept. Fish and Game as "circumstantially indicated, but not conclusive" - dead rabbits found in area where diphacinone was applied; bleeding and hemorrhaging suggested anticoagulant poisoning

Warfarin

Order/ species	State	County	Date	No. animals analyzed	Liver residue (ppm)	Comments
Owls						
Great-horned owl	NY	Niagra	7/98	1	0.73	also bromadiolone (0.77 ppm) and brodifacoum (0.03 ppm)
Diurnal Birds of Prey						
Bald eagle	NY	Orleans	4/95	1	1.45	
Peregrine falcon	NJ	Sea Isle City	10/86	1	1.48	small bird parts were observed in the gizzard
Rodents						
Gray squirrel	NY	Niagara	9/81	1	0.23	

Zinc Phosphide

Order/ species	State	County	Date	No. animals examined	Comments
Gallinaceous Birds					
Turkey (wild)	NY	Wayne	2/00	2	detected in crop contents
Turkey (wild)	MI	Montcalm	12/97	3	detected in crop contents
Turkey (wild)	NY	Wayne	11/95	1	detected in crop contents
Turkey (wild)	WI	not reported	3/91	2	turkey found dead after bait applied in an orchard
Turkey (wild)	MI	Manistee	12/87	4	27 ppm
Turkey (wild)	MI	Leelanau	11/87	1	170 ppm in gizzard contents
Turkey (wild)	MI	Leelanau	4/87	1	28 ppm in gizzard contents
Turkey (wild)	MI	Missaukee	3/87	1	220 ppm in gizzard contents
Turkey (wild)	MI	Benzie	12/86	9	430 ppm in gizzard contents
Turkey (wild)	MI	Wexford	11/86	4	330 ppm in gizzard contents
Turkey (wild)	MI	Grand Traverse	11/86	4	confirmed by MI Dept. of Agric. lab. analysis
Waterfowl					
Canada goose	NY	Niagra	12/01	4-5	15 geese found dead, with phosphine odor present; 3 of 4 geese analyzed with Draeger apparatus tested positive for phosphine gas
Canada goose	NY	Ulster	12/96	4	phosphine gas detected in ingesta
Canada goose	UT	Summit	4/94	1	information obtained from epizootic database, National Wildlife Health Center, Madison, WI

Zinc Phosphide

Order/ species	State	County	Date	No. animals examined	Comments
Canada goose	CT	Fairfield	3/92	9	information obtained from epizootic database, National Wildlife Health Center, Madison, WI
Canada goose	MI	Grand Traverse	11/86	1	20 ppm residue in gizzard contents
Canada goose	MI	Oakland	12/82	30	confirmed by MI Dept. of Agric. lab. analysis
Canada goose	CA	Siskiyou	10/63	105	Keith and O'Neill[b]
White-fronted goose	CA	Siskiyou	10/63	325	Keith and O'Neill[b]
Snow goose	CA	Siskiyou	10/63	25	Keith and O'Neill[b]
White-fronted and Snow geese	CA	Siskiyou	4/84	~40	information obtained from epizootic database, National Wildlife Health Center, Madison, WI
Mallard	UT	Summit	10/93-4/94	29	information obtained from epizootic database, National Wildlife Health Center, Madison, WI
Carnivores					
Red fox	MI	Grand Traverse	6/87	2	"secondary poisoning from eating mice that had consumed Zn_phosphide treated grain"[a]
Other Mammals					
Eastern cottontail	VA	Augusta	1/04	1	>40 ppm in fresh tissues: ZP pellets had been applied in an orchard
Gray squirrel	MI	Calhoun	6/83	10	information obtained from epizootic database, National Wildlife Health Center, Madison, WI

[a] reported in Johnson and Fagerstone (1992) and Hegdal and Gatz (1977)

Attachment E. USFWS Jeopardy Determinations for Effects of 8 Rodenticides on Threatened and Endangered Species.

In response to a formal consultation requested by EPA (1991b) under Section 7 of the Endangered Species Act, the United States Fish and Wildlife Service issued a Biological Opinion on *Effects of 16 Vertebrate Control Agents On Threatened and Endangered Species* in March of 1993 (USFWS 1993). The Biological Opinion included jeopardy determinations for species potentially exposed (primary or secondary exposure) to brodifacoum, bromadiolone, chlorophacinone, diphacinone, warfarin, bromethalin, zinc phosphide, and cholecalciferol. For each species addressed in the Biological Opinion, the Service determined either that use of the rodenticide "is likely to jeopardize" or "is not likely to jeopardize" the continued existence of the species. For the likely to jeopardize determinations the Service provided "reasonable and prudent alternatives" that preclude jeopardy but still allow use of the rodenticide. These alternatives represent the Service's best professional judgement of the measures necessary to provide the appropriate level of protection to the species. The Service also provided "incidental take" statements and "reasonable and prudent measures" to minimize take. Difethialone, first registered in 1995, is not addressed in this or any subsequent Biological Opinion, but EPA believes the jeopardy determinations for brodifacoum also would be applicable to difethialone. The Service's determinations for each rodenticide are tabulated below. Only the common names of the species are presented in the table for each rodenticide, but scientific names are listed in a final table. Species not included in the tables were presumed by the Service to not be affected by the rodenticide of concern or to have no chance for exposure.

Brodifacoum

Species	Reasonable and Prudent Alternatives/ Reasonable and Prudent Measures
Species for which brodifacoum "is likely to jeopardize" their continued existence:	
Alabama beach mouse Choctawhatchee beach mouse Perdido Key beach mouse Anastasia Island beach mouse Southeastern beach mouse Morro Bay kangaroo rat Salt marsh harvest mouse Fresno kangaroo rat	Prohibit use within 100 yards of these species' occupied habitat
Carolina northern flying squirrel	Prohibit outdoor use within this species' occupied habitat
Florida salt marsh vole	Prohibit use within 100 yards of the landward edge of this species' habitat in Levy County, Florida
Audubon's crested caracara	Prohibit use within this species' occupied habitat
San Clemente loggerhead shrike	Prohibit use on San Clemente Island, California

Brodifacoum

Species	Reasonable and Prudent Alternatives/ Reasonable and Prudent Measures
Species for which brodifacoum "is not likely to jeopardize" their continued existence:	
Giant kangaroo rat Stephen's kangaroo rat Tipton kangaroo rat Point Arena mountain beaver	Incidental take can be minimized by prohibiting outdoor use within 100 yards of these species' occupied habitat
Louisiana black bear	Incidental take can be minimized by prohibiting use within occupied habitat
San Joaquin kit fox	Incidental take can be minimized by requiring that outdoor applications be made in tamper-resistant bait boxes placed in areas not accessible to wildlife
Hawaiian hawk	Incidental take can be minimized by prohibiting use within 100 yards of this species' occupied habitat
Eastern indigo snake	Incidental take can be minimized by conducting laboratory studies using surrogate snake species to obtain toxicity data on the chemical's secondary poisoning hazard to snakes

Bromadiolone

Species	Reasonable and Prudent Alternatives/ Reasonable and Prudent Measures
Species for which bromadiolone "is likely to jeopardize" their continued existence:	
Alabama beach mouse Choctawhatchee beach mouse Perdido Key beach mouse Anastasia Island beach mouse Southeastern beach mouse Morro Bay kangaroo rat Salt marsh harvest mouse	Prohibit use within 100 yards of these species' occupied habitat
Species for which bromadiolone "is not likely to jeopardize" their continued existence:	
Fresno kangaroo rat Stephen's kangaroo rat Tipton kangaroo rat Point Arena mountain beaver	Incidental take can be minimized by prohibiting outdoor use within 100 yards of these species' occupied habitat

Bromadiolone

Species	Reasonable and Prudent Alternatives/ Reasonable and Prudent Measures
San Joaquin kit fox	Incidental take can be minimized by requiring that outdoor applications be made in tamper-resistant bait boxes placed in areas not accessible to wildlife

Chlorophacinone

Species	Reasonable and Prudent Alternatives/ Reasonable and Prudent Measures
Species for which chlorophacinone "is likely to jeopardize" their continued existence:	
Alabama beach mouse Choctawhatchee beach mouse Perdido Key beach mouse Anastasia Island beach mouse Southeastern beach mouse Morro Bay kangaroo rat Stephen's kangaroo rat Amargosa vole Hualapai Mexican vole	Prohibit use within 100 yards of these species' occupied habitat
Salt marsh harvest mouse Tipton kangaroo rat Giant kangaroo rat Fresno kangaroo rat Point Arena mountain beaver	Prohibit outdoor use within 100 yards of these species' occupied habitat unless specific programs for chlorophacinone are approved by the Service and implemented
Carolina northern flying squirrel	Prohibit outdoor use within this species' occupied habitat
Florida salt marsh vole	Prohibit use within 100 yards of the landward edge of this species' habitat in Levy County, Florida
San Joaquin kit fox	Prohibit use within the kit fox range as determined by the Service, except for agricultural areas $\geq$1 mile from any kit fox habitat as determined by the California EPA in consultation with the Service, or areas where applicable surveys have been conducted and yielded negative results

Chlorophacinone

Species	Reasonable and Prudent Alternatives/ Reasonable and Prudent Measures
Florida panther	Prohibit use within 20 miles of the boundary of any Federal and State lands (e.g., National Wildlife Refuge, National Park, State Park, etc.) and Indian Reservations that provide suitable panther habitat south of Charlotte, Glades and Martin counties, Florida; incidental take can be minimized by removing and properly disposing of any dead or incapacitated animal likely to have been poisoned within and including the area extending 5 miles from the edge of the prohibited use zone
Jaguarundi Ocelot	Prohibit use within 3 miles of occupied habitat; incidental take can be minimized by conducting surveys prior to use to determine if habitat is occupied
Audubon's crested caracara	Prohibit use within this species' occupied habitat
Species for which chlorophacinone "is not likely to jeopardize" their continued existence:	
Louisiana black bear	Incidental take can be minimized by prohibiting use within occupied habitat
Grizzly bear Gray wolf Utah prairie dog	None specified
Puerto Rican boa Virgin Island tree boa	Incidental take can be minimized by prohibiting use within the known occupied habitat
Eastern indigo snake	Incidental take can be minimized by conducting laboratory studies using surrogate snake species to obtain toxicity data on the chemical's secondary poisoning hazard to snakes

Diphacinone

Species	Reasonable and Prudent Alternatives/ Reasonable and Prudent Measures
Species for which diphacinone "is likely to jeopardize" their continued existence:	
Alabama beach mouse Choctawhatchee beach mouse Perdido Key beach mouse Anastasia Island beach mouse Key Largo cotton mouse Key Largo woodrat Southeastern beach mouse Morro Bay kangaroo rat Stephen's kangaroo rat Silver rice rat Hualapai Mexican vole Utah prairiedog	Prohibit use within 100 yards of these species' occupied habitat
Salt marsh harvest mouse Tipton kangaroo rat Giant kangaroo rat Fresno kangaroo rat Point Arena mountain beaver	Prohibit outdoor use within 100 yards of these species' occupied habitat unless specific programs for diphacinone are approved by the Service and implemented
Carolina northern flying squirrel	Prohibit outdoor use within this species' occupied habitat
Florida salt marsh vole	Prohibit use within 100 yards of the landward edge of this species' habitat in Levy County, Florida
San Joaquin kit fox	Prohibit use within the kit fox range as determined by the Service, except for agricultural areas $\geq$1 mile from any kit fox habitat as determined by the California EPA in consultation with the Service, or areas where applicable surveys have been conducted and yielded negative results
Florida panther	Prohibit use within 20 miles of the boundary of any Federal and State lands (e.g., National Wildlife Refuge, National Park, State Park, etc.) and Indian Reservations that provide suitable panther habitat south of Charlotte, Glades and Martin counties, Florida; incidental take can be minimized by removing and properly disposing of any dead or incapacitated animal likely to have been poisoned within and including the area extending 5 miles from the edge of the prohibited use zone

Diphacinone

Species	Reasonable and Prudent Alternatives/ Reasonable and Prudent Measures
Jaguarundi Ocelot	Prohibit use within 3 miles of occupied habitat; incidental take can be minimized by conducting surveys prior to use to determine if habitat is occupied
Gray wolf Grizzly bear	Prohibit use within the geographic range of this species until the Service has determined the species is not in the vicinity of the treatment site
Louisiana black bear	Prohibit use within the current known occupied habitat
Black-footed ferret	Prohibit use within 7 km (4.34 mi) from a prairie dog town, except for black-tailed prairie dog colonies <80 acres in size or white-tailed prairie dog colonies <200 acres in size, or urban situations, or colonies that have been surveyed in coordination with the Service and determined that ferrets are absent
Lower Keys rabbit	Prohibit use within 100 yards of this species' occupied habitat
Audubon's crested caracara	Prohibit use within this species' occupied habitat
Species for which diphacinone "is not likely to jeopardize" their continued existence:	
Delmarva fox squirrel	Incidental take can be minimized by placing bait in bait boxes small enough to exclude fox squirrels
Puerto Rican boa Virgin Island tree boa	Incidental take can be minimized by prohibiting use within the known occupied habitat
Eastern indigo snake	Incidental take can be minimized by conducting laboratory studies using surrogate snake species to obtain toxicity data on the chemical's secondary poisoning hazard to snakes

Warfarin

Species	Reasonable and Prudent Alternatives/ Reasonable and Prudent Measures
Species for which warfarin "is likely to jeopardize" their continued existence:	
Alabama beach mouse Choctawhatchee beach mouse Perdido Key beach mouse Anastasia Island beach mouse Southeastern beach mouse Morro Bay kangaroo rat Salt marsh harvest mouse Fresno kangaroo rat	Prohibit use within 100 yards of these species' occupied habitat
Carolina northern flying squirrel	Prohibit outdoor use within this species' occupied habitat
Florida salt marsh vole	Prohibit use within 100 yards of the landward edge of this species' habitat in Levy County, Florida
***Species for which warfarin "is not likely to jeopardize" their continued existence**:*	
Giant kangaroo rat Stephen's kangaroo rat Tipton kangaroo rat Point Arena mountain beaver	Incidental take can be minimized by prohibiting outdoor use within 100 yards of these species' occupied habitat

Bromethalin

Species	Reasonable and Prudent Alternatives/ Reasonable and Prudent Measures
***Species for which bromethalin "is likely to jeopardize" their continued existence**:*	
Alabama beach mouse Choctawhatchee beach mouse Perdido Key beach mouse Anastasia Island beach mouse Southeastern beach mouse Morro Bay kangaroo rat	Prohibit use within 100 yards of these species' occupied habitat
Salt marsh harvest mouse Fresno kangaroo rat	Prohibit use within 100 yards of these species' occupied habitat
Carolina northern flying squirrel	Prohibit outdoor use within this species' occupied habitat
Florida salt marsh vole	Prohibit use within 100 yards of the landward edge of this species' habitat in Levy County, Florida

Bromethalin

Species	Reasonable and Prudent Alternatives/ Reasonable and Prudent Measures
Species for which bromethalin "is not likely to jeopardize" their continued existence:	
Giant kangaroo rat Stephen's kangaroo rat Tipton kangaroo rat Point Arena mountain beaver	Incidental take can be minimized by prohibiting outdoor use within 100 yards of these species' occupied habitat

Zinc phosphide

Species	Reasonable and Prudent Alternatives/ Reasonable and Prudent Measures
Species for which zinc phosphide "is likely to jeopardize" their continued existence:	
Alabama beach mouse Choctawhatchee beach mouse Perdido Key beach mouse Anastasia Island beach mouse Southeastern beach mouse Morro Bay kangaroo rat Silver rice rat	Prohibit use within 100 yards of these species' occupied habitat
Fresno kangaroo rat Stephen's kangaroo rat Tipton kangaroo rat Giant kangaroo rat Salt marsh harvest mouse Point Arena mountain beaver	Prohibit outdoor use within 100 yards of occupied habitat unless a protection program has been approved by the Service and implemented
Carolina northern flying squirrel	Prohibit outdoor use within this species' occupied habitat
Florida salt marsh vole	Prohibit use within 100 yards of the landward edge of this species' habitat in Levy County, Florida
Black-footed ferret	Prohibit use within 7 km (4.34 mi) from a prairie dog town, except for black-tailed prairie dog colonies <80 acres in size or white-tailed prairie dog colonies <200 acres in size, or urban situations, or colonies that have been surveyed in coordination with the Service and determined that ferrets are absent
Hawaiian crow	Prohibit use within 100 yards of occupied habitat unless bait is placed in tamper-resistant bait boxes

Zinc phosphide

Species	Reasonable and Prudent Alternatives/ Reasonable and Prudent Measures
Atwater's prairie chicken	Prohibit use within 100 yards of occupied habitat unless bait is placed in tamper-resistant bait boxes
Hawaiian coot Hawaiian duck	Prohibit use within 100 yards of any water or wetland on or adjacent to any golf course or turf farm on the islands of Kauai, Oahu, and Maui unless bait is placed in tamper-resistant bait boxes
Nene (Hawaiian goose) Mariana crow	Prohibit use in occupied habitat unless bait is placed in tamper-resistant bait boxes
Mississippi sandhill crane Puerto Rican plain pigeon Yellow-shouldered blackbird	Outdoor baiting must use tamper-resistant bait boxes within occupied habitat
Species for which zinc phosphide "is not likely to jeopardize" their continued existence:	
Gray wolf Grizzly bear	Incidental take can be minimized by applying bait in tamper-resistant bait boxes, or contacting the local Service office to ensure that these species are not in the vicinity of the treatment site
Utah prairie dog	None specified
San Joaquin kit fox	Incidental take can be minimized by requiring that outdoor applications be made in tamper-resistant bait boxes placed in areas not accessible to wildlife
San Clemente sage sparrow	Incidental take can be minimized by prohibiting use in occupied habitat unless bait is placed in tamper-resistant bait boxes
Whooping crane	Incidental take can be minimized by ensuring that cranes have not wandered into the treatment area

Cholecalciferol

Species	Reasonable and Prudent Alternatives/ Reasonable and Prudent Measures
Species for which cholecalciferol "is likely to jeopardize" their continued existence:	

Cholecalciferol

Species	Reasonable and Prudent Alternatives/ Reasonable and Prudent Measures
Alabama beach mouse Choctawhatchee beach mouse Perdido Key beach mouse Anastasia Island beach mouse Southeastern beach mouse Morro Bay kangaroo rat Salt marsh harvest mouse Fresno kangaroo rat	Prohibit use within 100 yards of these species' occupied habitat
Carolina northern flying squirrel	Prohibit outdoor use within this species' occupied habitat
Florida salt marsh vole	Prohibit use within 100 yards of the landward edge of this species' habitat in Levy County, Florida
Species for which cholecalciferol "is not likely to jeopardize" their continued existence:	
Giant kangaroo rat Stephen's kangaroo rat Tipton kangaroo rat Point Arena mountain beaver	Incidental take can be minimized by prohibiting outdoor use within 100 yards of these species' occupied habitat

Species addressed in the Biological Opinion[a]:

Mammals:

Alabama beach mouse (*Peromyscus polionotus amnobates*)

Amargosa vole (*Microtus californicus scirpensis*)

Anastasia Island beach mouse (*Peromyscus polionotus phasma*)

Black-footed ferret (*Mustela nigripes*)

Carolina northern flying squirrel (*Glaucomys sabrinus coloratus*)

Choctawhatchee beach mouse (*Peromyscus polionotus allophrys*)

Delmarva fox squirrel (*Sciurus niger cinereus*)

Florida salt marsh vole (*Microtus pennsylvanicus dukecampbelli*)

Florida panther (*Puma (=Felis) concolor coryi*)

Fresno kangaroo rat (*Dipodomys nitratoides exilis*)

Giant kangaroo rat (*Dipodomys ingens*)

Gray wolf (*Canis lupus*)

Grizzly bear (*Ursus arctos*)

Species addressed in the Biological Opinion[a]:

Hualapai Mexican vole (*Microtus pennsylvanicus hualpaiensis*)
Jaguarundi (*Herpailurus (=Felis) yagouaroundi cacomitli*)
Jaguar (*Panthera onca*)
Key Largo cotton mouse (*Peromyscus gossypinus allapaticola*)
Key Largo woodrat (*Neotoma floridana smalli*)
Lower Keys rabbit (*Sylvilagus palustris hefneri*)
Louisiana black bear (*Ursus americanus luteolus*)
Morro Bay kangaroo rat (*Dipodomys heermanni morroensis*)
Ocelot (*Leopardus (=Felis) pardalis*)
Perdido Key beach mouse (*Peromyscus polionotus trissyllepsis*)
Point Arena mountain beaver (*Aplodontia rufa nigra*)
Salt marsh harvest mouse (*Reithrodontomys raviventris*)
San Joaquin kit fox (*Vulpes macrotis mutica*)
Silver rice rat (*Oryzomys palustris natator*)
Southeastern beach mouse (*Peromyscus polionotus niveiventris*)
Stephen's kangaroo rat (*Dipodomys stephensi*)
Tipton kangaroo rat (*Dipodomys nitratoides nitratoides*)
Utah prairie dog (*Cynomys parvidens*)

Birds:

Atwater's prairie chicken (*Tympanuchus cupido attwateri*)
Audubon's crested caracara (*Polyborus plancus audubonii*)
Hawaiian coot (*Fulica americana alai*)
Hawaiian crow (*Corvus hawaiiensis*)
Hawaiian duck (*Anas wyvilliana*)
Hawaiian hawk (*Buteo solitarius*)
Mariana crow (*Corvus kubaryi*)
Mississippi sandhill crane (*Grus canadensis pulla*)
Nene [Hawaiian goose] (*Branta (=Nesochen) sandvicensis*)
Puerto Rican plain pigeon (*Columba inornata wetmorei*)
San Clemente loggerhead shrike (*Lanius ludovicianus mearnsi*)
San Clemente sage sparrow (*Amphispiza belli clementeae*)
Whooping crane (*Grus americana*)
Yellow-shouldered blackbird (*Agelaius xanthomus*)

Reptiles:

Species addressed in the Biological Opinion[a]:
Puerto Rican boa (*Epicrates inornatus*)
Virgin Island tree boa (*Epicrates monensis granti*)
Eastern indigo snake (*Drymarchon corais couperi*)

[a] scientific names are from the U.S. Fish and Wildlife Service's *Endangered and Threatened Wildlife and Plants*, 50 CFR 17.11 and 17.12, current as of December 31, 1998

Risk Mitigation Decision for Ten Rodenticides

May 28, 2008

Risk Mitigation Decision for Ten Rodenticides

May 28, 2008

Approved by: **/s/**
Steven Bradbury, Ph.D.
Director
Special Review and Reregistration Division

Date: **May 28, 2008**

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

June 24, 2008

Certified Mail

Dear Registrant:

The *Risk Mitigation Decision for Ten Rodenticides* was signed on May 28, 2008. A Federal Register Notice announcing its availability was published on June 4, 2008. Since that time, the Agency has determined that some revisions are necessary to the document. These revisions do not affect the risk conclusions, the risk management decision, or the rationale behind the decision, and the requirements imposed by the decision are unchanged. However, there have been some changes to the implementation timeline, to ensure consistency with the required timelines in the Pesticide Registration Improvement Renewal Act of 2007 (PRIA2). In addition, some other minor corrections have been made. The specific changes that have been made to the document are listed below.

1) In Section V.A.2, fourth bullet, the phrase "…but labels of meal, treated whole-grain, or pelleted forms of bait must prohibit use where children, domesticated animals, or non-target wildlife may be exposed" has been deleted.

2) In Section V.A.3, third bullet, the phrase "…but labels of meal, treated whole-grain, or pelleted forms of bait must prohibit use where children, domesticated animals, or non-target wildlife may be exposed" has been deleted.

3) In Section V.A.4, fifth bullet, the phrase "…but labels of meal, treated whole-grain, or pelleted forms of bait must prohibit use where children, domesticated animals, or non-target wildlife may be exposed" has been deleted.

4) In Section VII, the first sentence in the first paragraph now reads "Currently registered rodenticide bait products containing one of the **ten** active ingredients…" ("ten" not "nine")

5) In Section VII, the next-to-last sentence in the second paragraph now reads "If all measures outlined in this document are adopted, then current risks for rodenticide bait products will be adequately mitigated for the purposes of this FIFRA **re**registration determination." ("**re**registration" not "registration")

6) In Section VII.A.1, in the first paragraph, the second sentence now reads "This 90-day response letter must indicate, for each of the registrants' registered **rodenticide** products, whether the registrant intends to amend the registration to conform to this risk mitigation decision." ("rodenticide" not "pesticide")

7) Section VII.A.2 has been rewritten as follows:

2. Applications for Amendment (Deadline: December 4, 2009; 1.5 years from issuance of decision)

Applications for amended registration consistent with the risk mitigation decision are due on or before December 4, 2009. The Agency intends to issue decisions on amendments submitted without supporting data within 3 months. The Agency intends to issue decisions on amendments submitted with supporting data within 4 months. Amendment applications will not be subject to registration service fees required under the Pesticide Registration Improvement Renewal Act of 2007 (PRIA2).

8) Section VII.A.3 has been deleted.

9) Section VII.A.4 has been renumbered to Section VII.A.3.

10) Section VII.B.2 has been revised to include the word "difenacoum".

11) Table 1 has been revised (new text is highlighted).

12) Table 3 has been revised as follows (new text is highlighted):
- The word "non-residential" has been deleted from the "sites" identified for the 1st Generation Anticoagulants (Warfarin, Diphacinone, Chlorophacinone) and Non-Anticoagulants (Zinc Phosphide, Bromethalin, Cholecalciferol) (Products containing ≥4 pounds of bait)
- Under "labeling," for 2nd Generation Anticoagulants (Brodifacoum, Bromadiolone, Difenacoum, Difethialone) (8 pounds and greater) (Agricultural Buildings Only Use) – the prohibition "Do not use in homes or other human residences" has been added.

The revised version of the document is now available on the EPA website at www.epa.gov/pesticides/reregistration/rodenticides. It also is available in docket number EPA-HQ-OPP-2006-0955 through www.regulations.gov. The revised version of the document supercedes the previous versions.

If you have any questions on the rodenticide risk mitigation decision or any of the revisions listed above, please contact Laura Parsons at parsons.laura@epa.gov or (703) 305-5776.

Sincerely,

Steven Bradbury, Ph.D., Director
Special Review and Reregistration Division

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

Risk Mitigation Decision for Ten Rodenticides
May 28, 2008
(revised June 24, 2008)

I. Summary and Background

A. Final Decision

1. Summary of Decision

This document describes the Environmental Protection Agency's (EPA's or Agency's) risk mitigation decision for rodenticide bait products containing one or more of the following ten active ingredients: brodifacoum, bromadiolone, bromethalin, chlorophacinone, cholecalciferol, difenacoum,[1] difethialone, diphacinone (and its sodium salt), warfarin (and its sodium salt), and zinc phosphide. This final risk mitigation decision represents the Agency's final decision on the reregistration eligibility of rodenticide products containing brodifacoum, bromadiolone, bromethalin, chlorophacinone, cholecalciferol, difethialone, diphacinone (and its sodium salt), warfarin (and its sodium salt), and zinc phosphide.. It also constitutes the Agency's final action in response to the remand order in *West Harlem Environmental Action and Natural Resources Defense Council v. U.S. Environmental Protection Agency*, 380 F.Supp.2d 289 (S.D.N.Y. 2005).

EPA's decision includes two major components.

- To minimize children's exposure to rodenticide products used in homes, EPA is requiring that all rodenticide bait products marketed to general and residential consumers be sold only with bait stations, with loose bait (e.g., pellets and meal) as a prohibited bait form. EPA expects that a range of different types of bait stations will meet the new requirements, providing a variety of cost and protection options.

[1] Difenacoum, a second-generation anticoagulant rodenticide, was conditionally registered in September 2007 in accordance with FIFRA section 3(c)(7)(C) provided that all difenacoum products are amended to comply with EPA's Final Risk Mitigation Measures for registered products containing the other second-generation anticoagulants, on the same time schedule as those similar rodenticides.

- To reduce wildlife exposures and ecological risks, the Agency will require sale and distribution limits intended to prevent general consumers from purchasing residential use bait products containing four of the ten rodenticides that pose the greatest risk to wildlife (the second generation anticoagulants – brodifacoum, bromadiolone, difenacoum, and difethialone). Moreover, bait stations will be required for all outdoor, above-ground uses of these second generation-anticoagulants.

EPA expects that the measures described in this risk mitigation document will allow effective and affordable rodenticide products to remain available without causing unreasonable adverse effects to children or wildlife. The Agency has conducted human health and environmental fate and effects risk assessments and has determined that currently registered rodenticide bait products are eligible for reregistration provided that the risk mitigation measures outlined in this document are adopted and the product registrations are amended to reflect these measures.

The purpose of this document is to describe the Agency's decision and the underlying rationale, and outline what registrants need to do to comply with the decision. All supporting documents, including the comparative ecological risk assessment, the mitigation impact assessment, incident reports, and EPA's response to comments can be found at: http://www.regulations.gov under docket number EPA-HQ-OPP-2006-0955.

2. Scope

The risk mitigation decision described in this document applies to rodenticide bait products containing any of the following ten active ingredients: brodifacoum, bromadiolone, bromethalin, chlorophacinone, cholecalciferol, difenacoum, difethialone, diphacinone (and its sodium salt), warfarin (and its sodium salt), and zinc phosphide. These ten rodenticides can be divided into three categories: first-generation anticoagulants, which are warfarin, chlorophacinone, diphacinone; second-generation anticoagulants, which are brodifacoum, bromadiolone, difenacoum, and difethialone; and non-anticoagulants, which are bromethalin, cholecalciferol and zinc phosphide. The anticoagulants interfere with blood clotting and death results from hemorrhage. Bromethalin is a nerve toxicant that causes respiratory distress; cholecalciferol causes hypercalcemia (excessive calcium) in the blood and other body tissues; and zinc phosphide causes liberation of phosphine gas in the stomach. The first-generation anticoagulants require several days of consecutive feedings to deliver a lethal dose, whereas the second-generation anticoagulants can deliver a lethal dose in only one night of feeding, although with either type of anticoagulant, death does not occur until 5-7 days after the feeding.

Products covered by the risk mitigation measures discussed in this document may be used in and around buildings and in alleys, transport vehicles, and sewers. Rodenticides are used in urban, suburban, and rural areas to control a variety of pest mammals including house mice, Norway rats, roof rats, moles, voles, pocket gophers, prairie dogs, ground squirrels, and chipmunks. Chlorophacinone, diphacinone, and zinc

phosphide also have field uses (e.g. in crop land, non-crop areas, ditch banks, river banks, gullies, irrigation ditches, railroad tracks, fence lines, buffer strips, garbage dumps, landfills, orchards, and rangelands). Brodifacoum and diphacinone also have island conservation uses that are managed by the U.S. Fish and Wildlife Service (FWS).

The risk mitigation decision described in this document does not apply to rodenticide field uses or to tracking powder products. Risks associated with field uses and tracking powder products were addressed in the 1998 Zinc Phosphide and Rodenticide Cluster Reregistration Eligibility Decision (RED) documents. In those REDs, the Agency required restricted use classification for all field use products (except those limited to manual underground baiting) and for all tracking powder products.

The decision described in this document also does not impact island conservation uses of rodenticides. These uses are managed by the FWS and applications are performed by certified pesticide applicators. These uses are important in preventing the extinction of native plant and animal species due to rat predation, and in restoring larger and more diverse island ecosystems.

B. Regulatory History

EPA has been working aggressively to apply the best available information and scientific methods in understanding the human health and environmental risks posed by rodenticides, and to weigh those risks against the important public health and other benefits associated with their use. As part of its ongoing work to reassess the safety of older pesticides, EPA issued REDs for Zinc Phosphide and the Rodenticide Cluster in 1998. These documents required further evaluation of several issues, including potential risks to children and potential effects on non-target mammals and birds.

1. Risks to Children

In the Zinc Phosphide and Rodenticide Cluster REDs, the Agency expressed concern about reported exposures of children to rodenticides. The REDs articulated the Agency's determination that rodenticide bait products (other than those used exclusively at agricultural sites) were eligible for reregistration only if certain measures were adopted to reduce risks of harm to children. Among these mitigation measures, EPA specified two interim measures: changing product formulations to incorporate a bittering agent and an indicator dye. The bittering agents were expected to make the baits less palatable to children, and the indicator dyes were expected to show whether a child had come into contact with a rodenticide product by leaving a stain on a child's mouth or hands. These interim measures were intended to reduce risks while new technologies for preventing exposure were assessed by a stakeholder group.

In 1999, EPA formed the Rodenticide Stakeholders Workgroup (RSW) as a subcommittee under the federally-chartered advisory body, the Pesticide Program Dialogue Committee (PPDC), to consider the risks to children of accidental rodenticide exposure and potential measures to reduce such exposures. The RSW membership was

drawn from a broad range of stakeholders and government representatives, including EPA, the Centers for Disease Control (CDC), the U.S. Department of Agriculture (USDA), the medical community, the rodenticide industry, public interest groups, and members of the general public. The RSW met five times in 1999, and ultimately issued a report recommending that EPA not require the indicator dye due to the lack of suitable dye, and not require the bittering agent due to its potential adverse effect on the efficacy of rodenticide baits. The report recommended that EPA allow manufacturers to include the bittering agents on a voluntary basis.[2] The Agency adopted the RSW's recommendations, and in November 2001, EPA issued a Federal Register notice announcing that it was amending the two rodenticide REDs to allow reregistration of rodenticide bait products without requiring the incorporation of a bittering agent and indicator dye.

Since 2001, many rodenticide registrants have voluntarily incorporated a bittering agent into rodenticide products. The Agency maintains, however, that there are some situations involving severe pest pressure and/or substantial competing food sources where a bittering agent may decrease efficacy to an unacceptable degree. EPA's decision not to require inclusion of bittering agents in all rodenticides provides flexibility for such situations.

In November 2004, West Harlem Environmental Action and the Natural Resources Defense Council filed suit in the District Court for the Southern District of New York, challenging EPA's 2001 reversal of its 1998 determination that rodenticide bait products posed an unreasonable risk of harm to children unless they contained a bittering agent and an indicator dye. In August 2005, the District Court upheld EPA's 2001 determination that an indicator dye should not be required. (380 F.Supp.2d 289 (S.D.N.Y. 2005)) But the court reversed EPA's decision to rescind the bittering agent requirement, and remanded the decision to EPA for further consideration. The court's decision gave focus to EPA's ongoing efforts to determine how best to reduce exposure and risks to children from rodenticide products. This final risk mitigation decision constitutes the Agency's final action in response to the remand order.

2. Ecological Risks

In the Zinc Phosphide and Rodenticide Cluster REDs, the Agency concluded that further evaluation of the ecological risks of rodenticides was necessary. As part of this work, the Agency developed a comparative ecological assessment in which nine rodenticide active ingredients were evaluated, compared, and ranked among one another in terms of potential primary and secondary risks to birds and non-target mammals. The risk conclusions from the comparative ecological assessment are based on comparative analysis modeling and multiple lines of evidence including acute toxicity, persistence of compounds in body tissues of primary consumers (i.e., bait eaters), information from laboratory and pen studies in which poisoned prey are fed to predators or scavengers in

[2] The RSW also considered tamper-resistant bait stations, but because at that time there were no ready-to-use bait stations on the market that appeared to meet EPA's criteria for tamper-resistance, the RSW recommended against requiring tamper-resistant bait stations.

various amounts for one or more days, data from field trials and operational control programs, and wildlife mortality incidents.

Due to the public interest in rodenticides, the Agency elected to employ the full six-phase public participation process for the comparative ecological risk assessment. (The public participation process that EPA applies to its reregistration eligibility decisions is described in a May 14, 2004 Federal Register Notice, which is available at http://www.epa.gov/EPA-PEST/2004/May/Day-14/p10985.htm.) Between October 1999 and September 2001, the comparative risk assessment was drafted by Agency scientists and it underwent internal and external peer review. During the Phase 1 comment period that closed in December 2001, the Rodenticide Registrant Task Force raised some issues that required additional technical work by EPA scientists. After that work was completed, the preliminary risk assessment was made available for public comment in January 2003. EPA accepted public comment on the document through May 30, 2003. Then, the Agency reviewed and responded to the public comments and revised the risk assessment based upon those comments.

In September 2004, the Agency opened Phase 5 of the public participation process by publishing the revised comparative ecological risk assessment, which incorporated new ecological incident data and reflected revisions made in response to public comments on the preliminary version of the assessment. Along with the revised ecological assessment, EPA also published a document discussing the benefits associated with rodenticide products and EPA's preliminary position on appropriate risk reduction options. EPA accepted public comments on those documents through January 2005.

In March 2005, EPA initiated informal consultation for the nine rodenticides registered at that time. Several reported incidents have involved Federally listed threatened and endangered species, for example the San Joaquin kit fox and Northern spotted owl, in addition to the Bald eagle, which is protected under the Bald and Golden Eagle Act. The FWS issued a biological opinion on eight of the rodenticides in 1993.[3] The jeopardy determinations for the individual compounds primarily recommend prohibiting use in habitat occupied by listed species and requiring tamper-resistant bait stations for outdoor placements for some uses. The jeopardy determinations can be found in EPA's *"Comparative Ecological Risk Assessment for Nine Rodenticides"* (Erickson and Urban, 7/2004), available under docket number EPA-HQ-OPP-2006-0955 at www.regulations.gov.

Since rodenticide use is widespread and secondary exposure issues with these compounds are complex and may include listed species that migrate, the Federally-defined action area may be extensive. Through informal consultation, EPA and FWS are working together to determine an appropriate plan of action for the rodenticides. Meanwhile, the mitigation measures set forth in this document should have the beneficial effect of reducing non-target wildlife exposures to rodenticides, and thus refining the

[3] The biological opinion does not include difethialone, which was first registered in 1995, or difenacoum, which was first registered in 2007.

scope of the endangered species risk assessment work remaining to be completed, particularly for the second-generation anticoagulants.

C. January 2007 Proposed Risk Mitigation Decision

On January 17, 2007, EPA published a Proposed Risk Mitigation Decision for the nine rodenticides registered at that time.[4] To minimize children's exposure to rodenticide products used in homes, EPA proposed requiring that all rodenticide bait products available for sale to consumers be marketed only in tamper-resistant bait stations with solid bait blocks as the only permissible bait form. To mitigate ecological risks, the January 2007 proposal included a requirement to classify all bait products containing the active ingredients brodifacoum, bromadiolone, difenacoum, and difethialone as restricted use pesticides, thus making them available for purchase and use only by trained, certified pesticide applicators or persons under their direct supervision. These three rodenticides pose particularly significant risks to non-target wildlife.

D. Comments Received on the January 2007 Proposed Risk Mitigation Decision

EPA received more than 700 individual written comments on the January 2007 Proposed Risk Mitigation Decision, plus a letter from an advocacy group that was signed by more than 6,000 of the group's members. Individual comments were received from a diverse range of stakeholders, including government agencies, city governments, non-governmental organizations (NGOs), wildlife rehabilitators, professional pest control operators, livestock producers, rodenticide registrants, and interested citizens.[5]

Many comments, including those received from the U.S. Department of Housing and Urban Development (HUD), the Centers for Disease Control and Prevention (CDC), several non-governmental organizations (NGOs), and some citizens, articulated support for EPA's proposal. Other comments, particularly those received from citizens or NGOs who work with or advocate for wildlife, argued that the Agency's risk mitigation proposal does not provide for sufficient protection for children and/or wildlife. Other comments, mainly those received from rodenticide registrants and livestock producers, claimed that the risks do not warrant the proposed mitigation or that the proposed mitigation is overreaching.

The Agency's responses to the comments received on the Proposed Risk Mitigation Decision can be found at: http://www.regulations.gov under docket number EPA-HQ-OPP-2006-0955. Responses to comments related to ecological risk, human health, economic analyses, and risk mitigation are addressed in separate documents prepared by the Environmental Fate and Effects Division (EFED), the Health Effects Division (HED), the

[4] Difenacoum was not included in the Proposed Risk Mitigation Decision because it was not registered at the time that the proposed decision was issued.

[5] EPA initially provided for a 60-day comment period for the Proposed Risk Mitigation Decision. But after receiving several requests for a comment period extension, the Agency extended the comment period by 60 days. The comment period closed on May 18, 2007.

Biological and Economic Analysis Division (BEAD), and the Special Review and Reregistration Division (SRRD). These documents provide additional detail on the Agency's rationale for this mitigation decision.

II. Summary of Risks

A. Children's Risks

EPA has observed that since 1993, the American Association of Poison Control Centers (AAPCC) annually has received reports of approximately 12,000 to 15,000 rodenticide exposures to children less than 6 years of age. The AAPCC data show that relatively few of the exposed children experienced medical symptoms or suffered adverse health effects as a result of their exposure. However, for the years 1999 through 2003, an average of 115 cases per year were symptomatic, an average of 3,617 cases per year were treated in a health care facility, and an average of 17 cases per year required treatment in an Intensive Care Unit. The Agency believes that the number of exposure incidents resulting in symptomatic diagnoses and/or requiring treatment is unacceptably high given that feasible measures for reducing exposure are available. The Agency also believes that the number of non-symptomatic exposure incidents is unacceptably high because of the social costs associated with evaluating and treating children who might have been exposed.

For more information about human incident data, please refer to the following EPA documents, available at www.regulations.gov under docket number EPA-HQ-OPP-2006-0955: *"Updated Review of Poison Control Center Data for Residential Exposures to Rodenticides"* (Blondell, 3/22/99); *"Updated Review of Rodenticide Incident Reports Primarily Concerning Children"* (Blondell, 6/3/99); *"Updated Review of Rodenticide Incident Reports Primarily Concerning Children"* (Hawkins and Allender, 1/09/07); and *"Addendum to "Updated Review of Rodenticide Incident Reports Primarily Concerning Children""* (Winfield, 5/08/08).

B. Ecological Risks

EPA's comparative ecological risk assessment concludes that each of the rodenticide active ingredients poses significant risks to non-target wildlife when applied as grain-based bait products. The risks to wildlife are from primary exposure (direct consumption of rodenticide bait) for all compounds and secondary exposure (consumption of prey by predators or scavengers with rodenticide stored in body tissues) from the anticoagulants. Secondary exposure to the second-generation anticoagulants is particularly problematic due to these compounds' high toxicity and long persistence in body tissues (e.g., liver retention half-lives of greater than 300 days). The second-generation anticoagulants are designed to be toxic in "a single night's feeding," but since time to death is 5-7 days, the target rodent can feed multiple times before death, leading to a carcass containing residues that may be many times the lethal dose. Additionally, the extended persistence of second-generation anticoagulants in the body of a predator or

scavenger can result in adverse effects from additive exposures through multiple feedings that are separated by days or weeks.

EPA's comparative ecological risk assessment evaluated multiple lines of evidence and concluded that the second-generation anticoagulants have greater potential to adversely affect non-target wildlife, especially birds, than the first-generation anticoagulants. These lines of evidence include acute toxicity, persistence of compounds in body tissues of primary consumers (i.e., bait eaters), information from laboratory and pen studies in which poisoned prey are fed to predators or scavengers in various amounts for one or more days, data from field trials and operational control programs, and wildlife mortality incidents.

In some wildlife mortality incident reports, the relationship between rodenticide exposure and incident outcome is not established, although in many of the cases the examining toxicologist or pathologist concluded that a rodenticide likely caused or contributed to the mortality. Anticoagulants typically do not cause death until 5-7 days or more after a lethal dose is ingested, and exposed individuals become progressively weaker and lethargic due to blood loss. Thus even in incident cases where rodenticide exposure was established but the proximate cause of death may be identified as predation, disease, or automobile collision, a toxicologist or pathologist may be able to conclude that rodenticide-induced blood loss increased the vulnerability of the animals. Even if a cause-effect relationship with rodenticides has not been determined for some of the wildlife mortality incidents reported to the Agency, the routine detection of rodenticides in a wide variety of non-target wildlife, both birds and mammals, confirms that rodenticide exposure routinely occurs.

As discussed in EPA's updated ecological incident report, several monitoring programs have found that major portions of some non-target animal populations are being exposed to second-generation anticoagulant rodenticides. The updated ecological incident report, "*Rodenticide Incidents Update"* (Erickson, 11/15/06), may be obtained at *www.regulations.gov* under docket number EPA-HQ-OPP-2006-0955. Incident reports have identified many taxa of non-target animals exposed to rodenticides, including strict carnivores such as mountain lions, bobcats, hawks and owls; omnivores such as coyotes, foxes, skunks and raccoons; and granivores and herbivores such as squirrels and deer. EPA's updated rodenticide ecological incident report documents anticoagulant residues in 27 avian species and 17 mammalian species. For some species (e.g. bobcats, foxes, great horned owls), carcasses frequently contain residue of two or more anticoagulants, usually second generation compounds. In approximately 50% of those incidents, necropsy results indicate that it is highly probable that a second-generation anticoagulant was the cause of the death. The frequency with which second-generation anticoagulants are found is highly significant.

EPA believes that widespread exposures to second-generation anticoagulants are occurring wherever those rodenticides are being used. Residue analyses indicate that exposure is widespread in non-target populations. In New York, second-generation anticoagulants were detected in 48% of 265 (15 species) diurnal raptors and owls

analyzed, including 81% of 53 great horned owls, 58% of 78 red-tailed hawks, and 45% of 22 Eastern screech-owls. In California, second-generation anticoagulants were detected in 71 to 84% of the 106 bobcats, mountain lions, and San Joaquin kit foxes analyzed. Although comparable data from other states are lacking, EPA suspects that the results from New York and California are representative of non-target wildlife exposures nationwide.

Additionally, second-generation anticoagulants have been identified as an environmental issue in many countries, including Canada, the United Kingdom, France, and New Zealand, through incident monitoring and research.

III. Summary of Benefits of Rodenticides

For more detailed information about the benefits associated with the use of rodenticides, please see EPA's "Analysis of Rodenticide Bait Use" (Chiri et al., 1/23/06).

A. Pest Significance of Rodents

Rodents are among the most significant of all pests on the earth. "Rats and mice take advantage of our food and shelter, multiply into populations of millions, and attempt to co-exist with us in nearly every building we live, eat, or work in." [6] They may be carriers or reservoirs for infectious diseases, and may cause economic damage to crops; consume and contaminate stored food supplies; disturb soil through burrowing activities; damage houses, other types of buildings and man-made structures; and prey on native species, notably birds that nest on oceanic islands. It is generally estimated that commensal rats cause between $0.5 and $1.0 billion of economic losses in the United States annually. This estimate is based on the assumption that there is one commensal rat per every two people in the country, at a time when the population of the United States numbered approximately 200 million, and that each rat consumes or damages between $1 and $10 worth of food and other materials, while contaminating 5 to 10 times more of it.[7] It is estimated that a typical large city in the United States annually receives more than 10,000 complaints about commensal rodent problems and performs tens of thousands of rodent control inspections and baiting services.[8]

In houses and buildings, commensal rodents can gnaw through gas pipes, electric wiring and its insulation, and building insulation, thereby creating a fire risk. They can also damage electronic and computer equipment. White-footed and deer mice often enter cabins and other buildings, where they may build nests and raise their young, causing damage to furniture, clothing, books, paper files, and other belongings. Damage from

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[6] Corrigan, R.M. (2001) *Rodent Control. A Practical Guide for Pest Management Professionals.*

[7] Pratt, H.D., B.F. Bjornson, and K.S. Litting. 1976. Control of domestic rats & mice. U.S. Department of Health and Human Services, Public Health Services, Center for Disease Control, Atlanta, Georgia, HHS Publication No. (CDC) 81-8141. Although these figures are dated, there is no indication that the frequency of rodent damage has significantly changed.

[8] Illinois Department of Public Health, 2004.

commensal rodents to farm buildings and equipment through gnawing, burrowing, and nest-building activities has been estimated at $8.0 million per year.[9] Voles can damage or kill young trees and shrubs by feeding on the inner bark layer of the trunks near the base, both above and below ground. Voles also feed on flower bulbs, on many types of garden plants and vegetables, and on various field and forage crops. Deer mice may cause economic damage to Douglas fir and Ponderosa pine seeds in the West and Northwest, which is of concern in reforesting logged areas by direct seeding. Voles and commensal rodents, if unchecked, will often eat, damage, or contaminate (with urine, droppings, and hair) tons of stored food items, including grain, flour, cereals, sugar, vegetables, fruit, nuts, meat, animal feed, pet food, and any existing kind of stored edible material. Rodents typically contaminate far more stored grain than they consume. Rodents also cause economic losses to livestock and poultry production operations by consuming feed, by causing structural damage to facilities, and by vectoring pathogens. Pocket gophers often damage lawns, golf courses, parks, and other noncrop areas through their burrowing activities. Ground squirrels and other rodents may damage levees, ditch banks, and culverts in agricultural areas.

B. Benefits of Rodenticide Bait Products

Rodenticide baits, along with a variety of habitat modification and other pest management techniques, are used to reduce the damage caused by rodents. Rodenticide baits are especially useful for rapidly reducing rodent numbers in cases of major infestations. For commensal rodent control, rodenticide baits are best used within the context of an integrated pest management (IPM) approach that emphasizes measures such as sanitation, exclusion, habitat modification, trapping, coordination at the community level, public health education, and legal measures such as the enforcement of sanitation codes. IPM approaches are discussed in more detail in Section VI.A of this document.

Rodenticide baits are used, sometimes as part of community rodent-control programs, in situations where major commensal rodent infestations must be reduced rapidly. The baits often are used to control rodents which have entered homes and other buildings. They are also used to eliminate rodents that remain after buildings have been rodent-proofed. Rodenticide baits are commonly used to manage both indigenous and introduced rodents that feed on, contaminate, or cause various types of damage to a wide range of crops and farm infrastructure and equipment, as well as to grain and other stored food. In homes, using rodenticide baits rather than traps may be preferred by those who would rather not deal with dead rodents in traps. When using bait, however, disposing of dead rodents may still be unavoidable. Rodents dying inside a home after eating rodenticide bait may remain undiscovered until the smell of decay becomes noticeable.

[9] Hygnstrom, S.E. 1995. Vertebrate pest damage in grain storage facilities. Pp. 227-238 *In* Stored Product Management, Oklahoma Cooperative Extension Service, U.S. Deportment of Agriculture, Federal Grain Inspection Service, Animal and Plant Health Inspection Service, Circular No. E-912.

IV. Final Decision on Risk Mitigation

A. Children's Exposure Risk Mitigation

1. Summary of Mitigation Measures

The labels for rodenticide bait product labels currently registered in the U.S. instruct users to apply rodenticide bait products in locations out of reach of children, and if that is not possible, to place bait in a tamper-resistant bait station. However, the high number of children exposed to rodenticide bait products indicates that these label instructions are not always being followed and have not been sufficiently effective in keeping rodenticide bait products inaccessible to children. Because a large portion of the rodenticide baits used in the home environment are consumer products applied by residential users, EPA believes that a major cause of the child exposure incidents is residential users' failure to adequately comply with label directions to apply rodenticide bait products in locations inaccessible to children or in tamper-resistant bait stations. The fact that tamper-resistant bait stations are rarely available for sale in retail stores likely contributes to the problem.[10]

For these reasons, the Agency is requiring the following changes to "consumer size" rodenticide products, which are defined as those products containing less than or equal to one pound of bait and available for sale in typical retail outlets (e.g., hardware and home improvement stores, grocery stores, convenience stores, drug stores, club stores, big box stores).

- All "consumer size" rodenticide bait products must be sold packaged together with a ready-to-use (pre-baited) bait station. Bait station design and testing requirements are outlined in Section V.C of this document.

- Bait stations may be 1) non-refillable (disposable, one-time-use stations), or 2) refillable (sold with bait refills). The total amount of bait that may be contained in a "consumer size" product (including the initial bait placement in the bait station, plus any refills) must not exceed one pound. Bait refills may not be sold individually; they must be sold with at least one bait station.

- Meal, treated whole-grain, pelleted, and liquid forms of bait (whether packaged in placepacks or not) are prohibited. Bait must be in a form that is reasonably expected to remain in the bait station, except for bait removed by target rodents and minor quantities of crumbs created by target rodents. Bait blocks (and other solid baits that achieve the safety goal, such as paste forms)

[10] Rodenticide manufacturers that have attempted to market "empty" bait stations (i.e., bait stations sold without bait in them) have commented to the Agency that there is little consumer interest in purchasing bait stations and that stores, therefore, do not want to stock them because of sluggish sales and the fact that bait stations occupy a large amount of shelf space.

are the only forms of rodenticide bait that will be approved for use in "consumer size" products.

2. Below-Ground Uses Excluded from the Requirement for Bait Stations

"Consumer size" products that are labeled solely for use outdoors, below-ground for control of moles and pocket gophers are exempt from the requirement for bait stations and the prohibition on pelleted, meal, and treated whole-grain forms of bait because below-ground baiting of moles and pocket gophers can only be effectively accomplished through the application of bait directly into the underground burrow systems. If below-ground application of bait is performed properly according to product labels, no bait should be available above-ground for exposure to children or non-target animals.

In the case of "consumer size" products that are currently labeled for both below-ground use against moles and pocket gophers, and above-ground use (indoors or outdoors) against other pests, the registrants must either cancel the above-ground uses, or must comply with the requirements for bait stations, solid bait forms, and bait placement amounts discussed above.

3. Comparison with January 2007 Proposed Risk Mitigation Measures

In January 2007, EPA proposed a requirement for tamper-resistant bait stations for all rodenticide bait products marketed to general and residential consumers. In response to the proposal, EPA received comments from a diverse range of stakeholders, including some groups advocating on behalf of minority and low-income communities, expressing concerns about the potential for increased costs of "consumer use" rodenticide products due to the proposed requirement for tamper-resistant bait stations. In response to these comments, the Agency has decided to allow a range of different bait stations, providing a variety of cost and protection options, all of which are expected to meet the EPA's goal of preventing children's access to bait. Specific bait station requirements are detailed in Section V.C of this document.

B. Mitigation for Ecological Risks to Non-Target Birds and Mammals

1. Discussion

Based on an evaluation of the ecological risks associated with the use of rodenticide bait products containing any of the nine rodenticide active ingredients, and consideration of the public health and other important benefits of the use of rodenticide baits, EPA is imposing new requirements on bait products containing the active ingredients brodifacoum, bromadiolone, difenacoum, and difethialone (the second-generation anticoagulants). These requirements further EPA's goal of minimizing the availability of the second generation anticoagulants on the consumer market, and hence the overall amount of use of the second generation anticoagulants, but will not change

how the products are used in livestock production or other professional use settings, where important public health and other benefits may require the use of the second-generation anticoagulants. The new requirements are listed and described below.

- Minimum package size requirements
- Use site restrictions
- Sale and distribution restrictions
- Bait stations required for all outdoor above-ground placements

Minimum Package Size Requirements. The Agency has determined that product size is a significant factor in determining where and to what type of customer a product is sold. Large-size products are generally not sold in grocery stores, drug stores, and hardware stores because shelf space is too limited to accommodate large boxes and because larger products generally carry a price that is too high for typical residential consumers. The Agency generally considers "consumer size" products for rodenticides to be those containing ≤ 1 pound of bait. Larger packages are typically sold in farm stores or through direct sale to professional pest control operators, livestock producers, and other professional users.

In order to minimize the availability of second-generation anticoagulant products on the general consumer market, EPA is imposing minimum package size requirements. Permitting the sale of only large-size packages will minimize the availability of the second-generation products to residential consumers. The Agency is requiring second-generation bait products to be sold in packages that contain ≥ 8 pounds of bait for products that are labeled for use only inside of and within 50 feet of agricultural buildings and not for use in and around homes. For products intended for use by professional applicators, the minimum permissible amount of bait per package is 16 pounds.

The 8-pound and 16-pound size thresholds were selected based on sales information received from several rodenticide registrants, and purchasing and use information received from some livestock groups and professional applicators.

Use Site Restriction. Consistent with EPA's goal of minimizing the availability of the second-generation anticoagulant products on the general consumer market, the Agency is requiring the following use site restriction on all products containing brodifacoum, difethialone, difenacoum, or bromadiolone.

- For products in packages with at least 8 but not more than 16 pounds of bait, labels must state that products may only be used in and around (within 50 feet) of agricultural buildings (e.g., barns, hen houses), and bear the statement "Do not use this product in homes or other human residences."

Sale and Distribution Restrictions. The terms and conditions of registration for products containing brodifacoum, bromadiolone, difenacoum, and difethialone must be amended to specify that the registrants will control distribution of the products so that they shall only be distributed to or sold in agricultural, farm and tractor stores or directly to PCOs and other professional applicators, and that registrants will not sell or distribute products containing brodifacoum, bromadiolone, difenacoum, and difethialone in channels of trade likely to result in retail sale in hardware and home improvement stores, grocery stores, convenience stores, drug stores, club stores, big box stores, and other general retailers.

Bait Stations Required for Outdoor Above-Ground Placements. EPA is also requiring that all outdoor, above-ground placements of bait products containing second-generation anticoagulants be contained in bait stations, in order to deny non-target animals ready access to rodenticide bait. Most baits are grain-based and are therefore attractive to many birds and non-target mammals; those baits with flavor enhancers (e.g. fish flavors) might also attract carnivores. Tamper-resistant bait stations are required if the bait placement would be within reach of pets, domestic animals, non-target wildlife, or children under six years-of-age. Other types of bait stations may be constructed and used in settings, such as around livestock production buildings, where exposure to children and non-target wildlife is unlikely.

2. Comparison with January 2007 Proposed Risk Mitigation Measures

In January 2007, EPA proposed requiring restricted use classification for the second-generation anticoagulants in order to mitigate ecological risks. During the public comment period on the proposal, the Agency received comments and heard concerns from poultry and livestock producer groups indicating that the proposed requirement would place a significant burden on the poultry and livestock industries because most producers do not currently use restricted use pesticides and therefore would either have to stop using second-generation anticoagulants or arrange for employees to become certified pesticide applicators.[11] The poultry and livestock groups stressed the importance of rodent control for their particular industries in terms of productivity since rodents consume and ruin a significant quantity of animal feed. In addition, they indicated that rodent control is critical to biosecurity and the overall health of livestock animals because rodents can carry diseases which can be transmitted to animals.

[11] USDA reports on agricultural chemical usage confirm that swine facilities use a relatively small amount of restricted use pesticides, and that poultry and dairy or cattle facilities do not appear to use restricted use pesticides at all. (U.S. Department of Agriculture – National Agricultural Statistics Service. Agricultural Chemical Usage 2006 Restricted Use Summary. October 2007. Accessible online at: http://usda.mannlib.cornell.edu/usda/current/AgriChemUsRestricted/AgriChemUsRestricted-10-03-2007.pdf. U.S. Department of Agriculture – National Agricultural Statistics Service. Agricultural Chemical Usage Swine and Swine Facilities. December 2006. Accessible online at: http://usda.mannlib.cornell.edu/usda/current/AgChemUseSwine/AgChemUseSwine-12-20-2006.pdf).

The Agency has determined that the benefits of the use of the second-generation anticoagulants by poultry and livestock producers outweigh the risks. Second-generation anticoagulants, which provide a lethal dose to a rodent in a single night's feeding, are critical in livestock settings because the availability of other food sources besides the rodenticide bait reduces the likelihood of rodents consuming bait a sufficient number of times to achieve a lethal dose from first-generation anticoagulants. Also, poultry and livestock producers need to rotate different active ingredients in order to limit the possibility of resistance, since rodents may be a constant problem for livestock facilities and baiting may need to be continuous. This makes it particularly important for these producers to have access to a wide range of products, including in this case second generation anticoagulants.

Based on concerns about the burden on the poultry and livestock industries posed by the proposed decision, and recognizing the importance of second-generation anticoagulants to these industries, EPA has decided to use sale and distribution limitations – rather than restricted use classification – to minimize the use of second generation anticoagulants in settings where the risks outweigh the benefits (i.e., most residential settings). The sale and distribution restrictions (discussed above in Section IV.B.1) will minimize the availability of second-generation anticoagulants on the general retail market, but will not change the availability of these products for poultry and livestock producers, and other professional applicators.

The new packaging and sale and distribution restrictions for the second-generation anticoagulants should allow agricultural and other professional users to maintain unrestricted access to the second-generation anticoagulant rodenticides, and is expected to be nearly as effective as the proposed requirement of restricted use classification in achieving EPA's goal of dramatically reducing the overall use of second generation anticoagulants by limiting the availability of those products on the general consumer market.

By preventing or substantially limiting general consumer access to second generation anticoagulants, EPA expects to substantially reduce the number of rodents bearing "super-lethal" doses of rodenticides, and thereby reduce adverse effects to non-target animals. Because rodents get a lethal dose from a single feeding on a second-generation anticoagulant bait, yet do not die for 5-7 days, super-lethal doses occur where rodents repeatedly feed on second generation anticoagulant baits. Such repeat feeding is unlikely to occur in agricultural and food handling facilities, because there are usually many food sources available despite best management efforts. EPA believes that the majority of super-lethal dosings occur where relatively few food sources are available, as is typical of residential scenarios. EPA expects that shifting residential use away from second-generation anticoagulants (except in circumstances where professional applicators consider them necessary) will substantially reduce the number of rodents bearing super-lethal doses, and will also significantly reduce the total amount of second-generation anticoagulants affecting rodent predators and scavengers.

EPA believes that misuse and overuse of rodenticides is more common among general consumers than occupational users. General consumers are less likely to accurately understand rodenticide risks, rodent behavior, the manner in which particular rodenticides work, and are less likely to read and follow label instructions correctly. Occupational users (including persons who routinely apply pesticides as a minor part of their job, as well as full-time professional pesticide applicators) are more likely to choose a method of pest control appropriate for the specific circumstances, more likely to appreciate the consequences of pesticide misuse, and are in most cases acutely sensitive to the economic consequences of overuse. For these reasons, EPA believes that pesticides generally pose less risk when applied by occupational users than when applied by the general public. In the case of second generation anticoagulants, EPA believes that this difference is significant enough to warrant taking steps to limit access to these products to occupational users.

Although EPA believes that second generation anticoagulants should be applied by occupational users rather than general consumers, EPA has concluded that in this instance this can be accomplished to a satisfactory degree by means other than classifying these products for restricted use. Classifying second generation anticoagulants for restricted use would impose substantial costs on agricultural and commercial enterprises that are major users of rodenticides, and EPA believes that these costs can be avoided by taking advantage of existing natural divisions in the rodenticide market. Pesticide registrants have demonstrated that the agricultural and professional use products are distributed through channels that are distinctly different from those typical of the consumer use products. Rodenticide products intended for consumer residential use generally contain one pound or less of rodenticide bait. Products intended for agricultural use generally are packaged in larger quantities, usually eight pounds of more. Products marketed to pest control operators generally are in larger quantities, 16 pounds or more. In order to limit general consumer access to second generation anticoagulants, EPA intends to approve these products only where packaged in quantities of 8 pounds or more when labeled for agricultural use, and 16 pounds or more when labeled for other uses. EPA believes that these size limits will effectively discourage residential users from obtaining second generation anticoagulants for their own use. In order to promote market segregation, EPA will not register second-generation anticoagulant products in packages containing less than eight pounds of bait, or other agricultural and professional use rodenticides in packages containing less than 4 pounds of bait. Although this approach will not absolutely prevent members of the general public from obtaining and applying second-generation anticoagulants, EPA believes that such use will be uncommon and that the consequences of such incidental use would not rise to a level warranting restricted use classification.

In deciding not to classify second-generation anticoagulants for restricted use at this time, EPA has also taken into account the low applicator risks and relatively simple use instructions. Most pesticides classified for restricted use present substantial risk to applicators or require training for proper use. These factors are absent from the second generation anticoagulant bait products. Although the risks of misuse by general consumers are of concern to the Agency, EPA expects the limitations on sale and

distribution to make adverse effects infrequent. However, if these mitigation measures fail to achieve the intended risk reductions, EPA will reconsider classification for restricted use.

V. Implementation of Risk Mitigation Measures

The Agency has structured the rodenticide mitigation measures to take advantage of existing natural distinctions in the rodenticide market. Rodenticide products intended for consumer residential use generally contain one pound or less of rodenticide bait. Products intended for agricultural use generally are sold in larger quantities, usually eight pounds or more. Products marketed to pest control operators generally are sold in larger quantities, 16 pounds or more. EPA has identified mitigation measures specific to each of these classes of products as discussed below, and intends to approve agricultural and professional use products only for sale in quantities of at least 8 pounds of bait and of at least 16 pounds of bait, respectively. EPA believes that these size limits will effectively discourage residential users from obtaining rodenticides that are not appropriate for residential use or that should be applied only by professionals. In order to promote market segregation, EPA does not intend to approve agricultural and professional use second-generation anticoagulant products that contain less than 8 pounds of bait, and EPA does not intend to approve rodenticide bait products containing any of the six other active ingredients covered by this decision that contain more than one but less than four pounds of bait.

A. Summary of Restrictions

1. "Consumer Size" Products (Containing First-Generation Anticoagulants and Non-Anticoagulants Only)

For the purposes of this risk mitigation decision, the Agency has determined that rodenticide products containing ≤ 1 pound of bait are to be considered "consumer size" products. The following restrictions apply to "consumer size" rodenticide bait products.

- "Consumer size" bait products must be sold with ready-to-use (one-time use or refillable) bait stations, except for products that are labeled solely for use outdoors, below-ground for control of moles and pocket gophers.
- "Consumer size" bait products may contain one or more of the following active ingredients: chlorophacinone, diphacinone, warfarin, bromethalin, cholecalciferol, and zinc phosphide.
- "Consumer size" products may not contain the following active ingredients: brodifacoum, difethialone, bromadiolone, or difenacoum.
- Meal, treated whole-grain, or pelleted forms of bait (whether packaged in placepacks or not) are prohibited, except for products that are labeled solely for use outdoors, below-ground for control of moles and pocket gophers. Bait must be in a form that is reasonably expected to remain in

the bait station, except for bait removed by target rodents and minor quantities of crumbs created by target rodents.
- Bait stations must meet the standards set forth in Section V.C, below, for ability to isolate bait from children.
- Bait stations for mouse control must accommodate bait placements of between 0.25 and 1 ounce of bait.
- Bait stations for rat control must accommodate bait placements of between 4 and 16 ounces of bait for warfarin, diphacinone, or chlorophacinone baits; between 2 and 8 ounces of bait for cholecalciferol baits; between 1 and 6 ounces of bait for bromethalin baits; and between 0.15 and 0.3 ounces of bait for zinc phosphide.
- A retail package containing a bait station may contain up to a maximum of 1 pound of bait for either mouse or rat control (the 1 pound limit includes the initial bait placement inside the bait station, plus any bait refills).

2. First-Generation Anticoagulant and Non-Anticoagulant Products for Agricultural Use and Professional Applicators (Pest Control Operators)

The following restrictions apply to first-generation anticoagulants or non-anticoagulant rodenticide products intended for agricultural use or for use by professional applicators (pest control operators).

- Bait need not be *sold* in or with bait stations, but labels must require use of bait stations where children, domesticated animals, or non-target wildlife may be exposed (this is not a new requirement).
- Products may contain the following active ingredients: warfarin, diphacinone, chlorophacinone, zinc phosphide, bromethalin, and cholecalciferol.
- Products may <u>not</u> contain the following active ingredients: brodifacoum, difethialone, bromadiolone, or difenacoum.
- Any form of bait is acceptable, including meal, pelleted, or block forms.
- Products must contain at least 4 pounds of bait.

3. Second-Generation Anticoagulant Products for Agricultural Use

The following restrictions apply to rodenticide products intended for agricultural use other than field use and containing any of the second-generation anticoagulants (brodifacoum, difethialone, bromadiolone, and difenacoum):

- Bait need not be *sold* in bait stations, but labels must require use of bait stations for indoor applications where children, domesticated animals, or non-target wildlife may be exposed (this is not a new requirement).
- Product labels must require use of bait stations for all outdoor, above-ground placements.

- Any form of bait is acceptable, including meal, pelleted, and block forms.
- Product labels must state, "For use in and around agricultural buildings only. Do not apply further than 50 feet from agricultural buildings.**"**
- Product labels must state, "Do not use in homes or other human residences."
- Products must be labeled specifically for use in and around agricultural buildings.
- Products must contain at least 8 pounds of bait.
- Registrants must agree to terms and conditions of registration specifying that the registrants will control distribution of the products so that they only be distributed to or sold in agricultural, farm and tractor stores or directly to PCOs and other professional applicators, and that registrants will not sell or distribute the product in channels of trade likely to result in retail sale in hardware and home improvement stores, grocery stores, convenience stores, drug stores, club stores, big box stores, and other general retailers.

4. Second-Generation Anticoagulant Products for Professional Applicators (Pest Control Operators)

The following restrictions apply to rodenticide products intended for the professional market (commercial pest control operators (PCOs), public health officials, Federal, State, or municipal employees charged with rodent control, etc.) other than field use and containing any of the second-generation anticoagulants (brodifacoum, difethialone, bromadiolone, and difenacoum).

- Bait need not be *sold* in bait stations, but labels must require use of bait stations for indoor applications where children, domesticated animals, or non-target wildlife may be exposed (this is not a new requirement).
- Product labels must require the use of bait stations for all outdoor, above-ground placements.
- Product labels must state "Do not apply further than 50 feet from buildings.**"**
- Bait stations used in residential and institutional settings must meet the standards set forth in Section V.C, below, for ability to isolate bait from children.
- Any form of bait except liquid is acceptable, including meal, pelleted, block, and paste forms.
- Products must contain at least 16 pounds of bait.
- Registrants must agree to terms and conditions of registration specifying that the registrants will control distribution of the products so that they only be distributed to or sold in agricultural, farm and tractor stores or directly to PCOs and other professional applicators, and that registrants will not sell or distribute the product in channels of trade likely to result in retail sale in hardware and home improvement stores, grocery stores, convenience stores, drug stores, club stores, big box stores, and other general retailers.

B. Exclusions

The risk mitigation decision discussed in this document does not affect products that are labeled only for field (non-structural) uses (e.g., agricultural crops, orchards, groves, non-crop sites, ditch banks, gullies, irrigation ditches, garbage dumps, landfills, etc.). Persons holding registrations for field use products must list the products in their 90-day response letter, but indicate that the risk mitigation measures are inapplicable. The risk mitigation measures set forth in the Rodenticide Cluster and Zinc Phosphide REDs remain requirements for the field (non-structural) use products. Products that are labeled for both structural and field (non-structural) uses are subject to the new requirements discussed in this document for structural use products, as well as the requirements imposed in the Rodenticide Cluster and Zinc Phosphide REDs.

C. Bait Stations

1. Ready-to-Use Bait Stations

Rodenticide bait products containing ≤ 1 pound of bait (i.e., the "consumer size" products discussed in Section V.A.1, above) may only be sold packaged with bait stations meeting one of the following four categories of specifications.

Tier 1. Tier 1 bait stations meet the revised criteria for tamper-resistant bait stations that are set forth in Pesticide Registration (PR) Notice 94-7. They have demonstrated the performance features for weather resistance set out in PR Notice 94-7, namely that the station is resistant to destruction or weakening by typical non-catastrophic weather (rain, snow, sunlight). They have also demonstrated an ability to isolate bait from children and dogs, based on successful laboratory testing according to the following three EPA protocols, which are provided as attachments to this document (Attachments A, B, C). Rodenticide bait products that include Tier 1 bait stations may be labeled for indoor and outdoor use, subject to other restrictions regarding use sites and other aspects of product use that appear on the registered label.

- Method for Testing Ready-to-Use Bait Stations with Young Children
- Method for Testing Ready-to-Use Bait Stations with Dogs
- Method for Testing Ready-to-Use Bait Stations with Adults for Facility of Opening, Reclosing, and Securing

Tier 2. Tier 2 bait stations have demonstrated an ability to isolate bait from children and dogs, based on successful laboratory testing according to the following three EPA protocols, which are provided as attachments to this document (Attachments A, B, C). Tier 2 bait stations do not meet the performance standards for weather resistance. Therefore, rodenticide bait products that include Tier 2 bait stations must be labeled for indoor use only.

- Method for Testing Ready-to-Use Bait Stations with Young Children
- Method for Testing Ready-to-Use Bait Stations with Dogs

- Method for Testing Ready-to-Use Bait Stations with Adults for Facility of Opening, Reclosing, and Securing

Tier 3. Tier 3 bait stations have demonstrated an ability to isolate bait from children, based on successful laboratory testing according to the following two EPA protocols, which are provided as attachments to this document (Attachments A and C). Tier 3 bait stations do not meet the performance standards for weather resistance, and either have not been tested or did not meet the standards for ability to isolate bait from dogs. Rodenticide bait products that include Tier 3 bait stations are permitted for indoor use only, and may be applied only in locations inaccessible to pets, domesticated animals, or non-target wildlife.

- Method for Testing Ready-to-Use Bait Stations with Young Children
- Method for Testing Ready-to-Use Bait Stations with Adults for Facility of Opening, Reclosing, and Securing

Tier 4. Tier 4 bait stations have either not been tested or did not meet the standards for ability to isolate bait from children and dogs. Registrants submitting applications for rodenticide bait products that include a Tier 4 bait station must certify that the station meets the following performance standard. Rodenticide bait products that include Tier 4 bait stations are permitted for indoor use only, and may be applied only in locations inaccessible to children, pets, domestic animals, and non-target wildlife.

Tier 4 Bait Station Self-Certification Statement:

> "[Insert company name] certifies that the bait station [insert model number] sold with [insert product name; insert EPA registration number or File Symbol] is a sealed, single-use, non-refillable unit, for indoor use only, containing no more than 1 oz of bait [if for mouse control] or no more than 4 oz of bait [if for rat control]. The bait station is made of a material of sufficient rigidity such that the station is not easily crushed or opened by a child less than 6 years of age, not easily chewed by mice [or rats], and not reasonably anticipated to release rodenticide bait except for bait removed by target rodents and minor quantities of crumbs created by target rodents."

2. Bait Stations Sold Without Bait

Bait stations that are sold without bait are not pesticide products. Such bait stations are considered to be application equipment, and therefore are not regulated directly under the Federal Insecticide, Fungicide and Rodenticide Act. However, labels of registered rodenticide baits require that bait stations be used in certain use situations. In such cases, users of rodenticide baits are required to obtain or construct bait stations that are appropriate for the use situation and consistent with label requirements.

Since 1983, EPA has provided assistance to companies and individuals who seek to design bait stations that conform to the degree of protection that users of rodenticide baits are expected to provide for controlling rats or mice in structural situations. EPA maintains a list of "adequately protective" stations that have been concluded to conform to the criteria for tamper-resistant bait stations that are delineated in PR Notice 94-7.[12] During the assessment process, bait station manufacturers are given the option of testing their products in cases where compliance with one or more of the criteria is not obvious from examination of the unit. Depending upon the specific issue, manufacturers may avail themselves of protocols that EPA has developed for assessing the ability of the stations to deny access to dogs and children under six years of age. A protocol for testing empty bait stations for utility by adults also is available upon request.

It is not mandatory that empty bait station designs be submitted to EPA, that they be listed by EPA as "adequately protective", or that they be tested according to EPA's protocols for bait stations or any other procedures. In situations in which the product's label requires use of bait stations, it is the responsibility of the user to obtain or construct bait stations that conform to the label's requirements. If the label requires use of a "tamper-resistant bait station", the stations used must conform to the criteria for "tamper-resistant bait stations" that appear in PR Notice 94-7.

D. Labeling Changes

Please refer to the label tables in section VII.D of this document regarding the labeling changes required for rodenticide products containing any of the ten active ingredients covered by the risk mitigation decision described herein.

VI. Controlling Rodents

A. IPM Principles

Long-term rodent control, like control of other types of pests, is best achieved through the use of various complementary chemical and non-chemical control techniques. This approach, first articulated for agricultural insect pests by Stern *et al.*

[12] From 1983 until PR Notice 94-7 was issued, bait stations were assessed according to the criteria for "tamper-proof bait boxes" that were listed in PR Notice 83-5.

(1959)[13], is known as integrated pest management (IPM). The selection of methods to use for managing rodent infestations varies according to the nature of the situation, the knowledge and abilities of the applicator, and the tools and approaches available to that person. For example, Timm (1994)[14] outlines factors and control options that may be considered in dealing with an infestation of house mice. If there are no rodents present, rodent-proofing and habitat modification should be implemented to decrease the likelihood that rodents will enter a home. Planning to incorporate rodent stoppage into building designs, seeing to it that stoppage is affected during construction, and regularly maintaining stoppage and sanitation on the premises may prevent rodent infestations from occurring at a site (Frantz and Davis, 1991)[15]. It is clear that sanitation, rodent-proofing, and other non-chemical, non-lethal approaches are important aspects in limiting the conditions that are favorable to the presence of rodents. Where infestations occur, mechanical and adhesive traps may be used to remove some or all individuals, depending on the size and nature of the infestations. However, there are also situations that require the use of rodenticide baits, alone or in combination with non-chemical control methods, to ensure satisfactory rodent control levels.

B. Impact of Risk Mitigation Measures on Resistance

There is no recent information on status of resistance to first-generation anticoagulants in commensal rodents in the United States, as no systematic studies or surveys of resistance have been undertaken for nearly 30 years (Kaukeinen and Prescott, 2007)[16]. However, during 1977-79, a nationwide testing program that focused primarily on Norway rats documented some level of resistance to warfarin in 45 of 98 sites sampled, mainly in urban centers in the eastern half of the country. In most cases, the prevalence of resistant individuals within a given sample was less than 20% of the rats tested, the exception being Chicago, where resistance exceeded 50% (Jackson, et al., 1985).[17] Although that study focused on Norway rats (*Rattus norwegicus*), small samples of house mice (*Mus musculus*) were also tested, revealing that about 50% of house mice from 14 sites tested were resistant to warfarin. Resistance to warfarin and other anticoagulant rodenticides has been also documented in several European countries. To date, warfarin resistance has been found only in commensal rodents in the United States. Warfarin resistance has not been reported for indigenous rodent species.

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[13] Stern, V. M., R.F. Smith, R. van den Bosch, and K. S. Hagen. 1959. The integrated control concept. Hilgardia 29: 81-101.

[14] Timm, R.M. 1994a. House mice. Pages B-31 - B-46 In: Hyngstrom, S.E., Timm, R.M., and Larson, G.E. (Eds.) Prevention and Control of Wildlife Damage, University of Nebraska Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska, Lincoln, NE; and U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Animal Damage Control, Riverdale, MD.

[15] Frantz, S.C. and D.E. Davis. 1991. Bionomics and integrated pest management of commensal rodents. In: Gorham, J.R. (ed.) Ecology and Management of Food-Industry Pests, FDA Technical Bulletin 4, Association of Official Analytical Chemists, Arlington, VA, 243-313.

[16] Kaukeinen, D. and C. Prescott. 2007. Warfarin Revisited: New Information on an Old Rodenticide. Pest Control Web Exclusive, 3/21/2007.

[17] Jackson, W.B., A.D. Ashton, S.C. Frantz, and C. Padula. 1985. Present status of rodent resistance to warfarin in the United States. Acta Zool. Fennica 173:163-165.

The earliest instance of rodent resistance to warfarin was first documented from a hog farm in England. In the United States, resistance to warfarin in Norway rats was first found in a sample of 25 rats trapped alive at six farms and two rural stores in North Carolina (Jackson and Kaukeinen, 1972),[18] where the abundance of grain and other dry goods likely provided conditions favorable to rat survival. Over-reliance on warfarin as a primary means of rodent control in those localities may have, in turn, resulted in localized warfarin resistance. Similar selection pressures were probably also present in the urban centers where warfarin was used as the main rodenticide during the rat control campaigns that took place in the United States in the 1970s.

Although EPA's risk mitigation decision is expected to result in increased consumer use of first generation anticoagulants, the Agency believes that it is unlikely that any existing warfarin resistance problems in commensal rodents will be exacerbated by the proposed action. Residential users' reliance on first-generation anticoagulants would have little effect on rat populations because rat control is typically carried out by pest control operators (PCOs) and municipal personnel who would continue to have access to second-generation anticoagulant baits. Thus, unlike the over-dependence on warfarin that was the norm during the 1960s and 1970s, rat control will include the use of both first- and second-generation anticoagulants, as well as non-anticoagulant rodenticides and non-chemical control options.

The Agency acknowledges that it is possible that in localized mouse populations that include warfarin-resistant individuals, the prevalence of resistance could increase if a residential user persists in using only first-generation anticoagulant baits, with no other form of control. Under such a scenario, susceptible individuals would die while resistant individuals would survive and reproduce. However, results of the consumer survey submitted by Reckitt Benckiser[19] suggest that this scenario would be unlikely. This is because only 35% of consumers use rodenticides as their first means of controlling rodents, while 42% choose to start with traps. According to the survey, when consumers use a rodenticide that proves to be ineffective, 50% switch to a different control method, whereas 49% switch to another type or brand of bait. Of the 50% who switch to an alternative control method, 44% switch to traps, while the other 6% hire a PCO. Switching from bait to traps or hiring a PCO (who would likely use a second-generation anticoagulant bait) would result in resistant individuals being controlled in localized populations. Therefore, under this scenario, it is unlikely that localized resistant populations will spread. If localized pockets of warfarin resistance do occur, relief could be obtained using other control methods available to consumers. In cases where severe mouse infestations exist (with or without resistance), second-generation anticoagulants could be applied by commercial pest control operators and/or government agencies.

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[18] Jackson, W.B. and D. Kaukeinen. 1972. Resistance of wild wild Norway rats in North Carolina to warfarin rodenticide. Science 176(4041):1343-1344.

[19] Heiden, E.J. and S. McGonegal. 2007. Economic Assessment of EPA Proposed Rodenticide Risk Mitigation Decision. Document submitted to EPA Docket No. EPA.HQ-OPP-2006-0955-0644(1)5.

VII. What Do Registrants Need to Do?

Currently registered rodenticide bait products containing one of the ten active ingredients covered by this risk mitigation decision (bromadiolone, bromethalin, chlorophacinone, cholecalciferol, difenacoum, difethialone, diphacinone (and its sodium salt), warfarin (and its sodium salt), and zinc phosphide) will meet the FIFRA section 3(c)(5) registration criteria if: (i) the risk mitigation measures outlined in this document are adopted; (ii) risk mitigation measures identified in the 1998 Zinc Phosphide and Rodenticide Cluster Reregistration Eligibility Decisions are adopted, except as modified by this document; and, (iii) applications for amended registration to implement these measures are submitted as provided below.

Based on its evaluation of the rodenticide bait products containing one of the active ingredients covered by this risk mitigation decision (brodifacoum, bromadiolone, bromethalin, chlorophacinone, cholecalciferol, difenacoum, difethialone, diphacinone (and its sodium salt), warfarin (and its sodium salt), and zinc phosphide), the Agency has determined that these products, unless labeled and used as specified in this document, would present unreasonable risks inconsistent with FIFRA. Accordingly, should a registrant fail to implement any of the risk mitigation measures identified in this document, the Agency may take regulatory action to address the risk concerns from the use of the affected products. If all measures outlined in this document are adopted, then current risks for rodenticide bait products will be adequately mitigated for the purposes of this FIFRA reregistration determination. Once a comprehensive endangered species assessment is completed, further changes to these registrations may be necessary.

A. Timeline for Compliance

1. 90-Day Response (Deadline: September 2, 2008)

Persons holding a manufacturing-use or end-use registration for a rodenticide product containing one of the active ingredients covered by this risk mitigation decision (brodifacoum, bromadiolone, difethialone, difenacoum, chlorophacinone, diphacinone (and its sodium salt), warfarin (and its sodium salt), zinc phosphide, bromethalin, cholecalciferol) must provide a letter to the Agency on or before September 2, 2008, declaring an intent to comply or not comply with the risk mitigation measures described in this document. This 90-day response letter must indicate, for each of the registrants' registered rodenticide products, whether the registrant intends to amend the registration to conform to this risk mitigation decision. The Agency may initiate cancellation actions against products for which it does not receive notification of the registrant's intent to comply with the risk mitigation measures described in this document.

For each registered product for which a registrant declares its intent not to comply (i.e., not to amend labeling and/or packaging and not to develop a replacement bait station product), the company needs to include a request to cancel that product

voluntarily under FIFRA Section 6(f)(1). Failure to make such a voluntary cancellation request will result in additional regulatory action.

Persons holding registrations for products labeled solely for field uses (for which the risk mitigation measures described in this document do not apply) should list the products in their 90-day response letter, but indicate that the risk mitigation measures are inapplicable. Products that are labeled for both structural and field (non-structural) uses are subject to the new requirements discussed in this document for structural use products, as well as the requirements imposed in the Rodenticide Cluster and Zinc Phosphide REDs.

2. Applications for Amendments and Cancellations (Deadline: December 4, 2009; 1.5 years from issuance of decision)

Applications for amended registration consistent with the risk mitigation decision are due on or before December 4, 2009. The Agency intends to issue decisions on amendments submitted without supporting data within 3 months. The Agency intends to issue decisions on amendments submitted with supporting data within 4 months. Amendment applications will not be subject to registration service fees required under the Pesticide Registration Improvement Renewal Act of 2007 (PRIA2).

3. Last Day for "Release for Shipment" of Product Not Complying with Risk Mitigation Decision (Deadline: June 4, 2011; 3 years from issuance of decision)

Pursuant to the terms of the voluntary cancellations, June 4, 2011 would be the last day for registrants to "release for shipment" (sell or distribute) rodenticide products not complying with the Risk Mitigation Decision. This limitation would apply to those registered both on and after the publication of the Federal Register announcing availability of the decision (June 4, 2008). Rodenticide products that do not comply with this Risk Mitigation Decision that a registrant releases for shipment after June 4, 2011, would be considered misbranded.

B. Product Efficacy Issues for Compliance with this Decision

Existing registered bait formulations that have met the applicable efficacy criteria for the claims made for them will not have to be retested for efficacy if they are to be:

1. packaged in and/or with a bait station;

2. registered as the formulation for a new bait product that is labeled for use only in or within 50 feet of agricultural buildings (≥ 8 pound products containing brodifacoum, bromadiolone, difenacoum, or difethialone); or

3. registered as the formulation for a new bait product intended for professional use (≥ 16 pound products containing containing brodifacoum, bromadiolone, difenacoum, or difethialone).

Applicants for registration of such products must cite all of the efficacy reports that apply to the new product as it is proposed to be labeled. If the new product is claimed to control only one species of commensal rodent (e.g., the house mouse), only the efficacy data pertaining to that species will be required.

Submission of efficacy data will be required for new bait formulations that are proposed for registration.

C. Steps to Comply with Rodenticide Risk Reduction Measures

Please see Table 1 (pages 28-30) and Table 2 (page 31-32).

D. Label Tables

Please see Table 3 (pages 33-36) and Table 4 (page 37).

Table 1

Steps for Complying with Rodenticide Risk Reduction Measures [Response Needed for Each Product]	
90 Days after Publication of the *Federal Register* Notice Announcing the Availability of the Decision (September 2, 2008)	
If company …	**Then it must …**
intends to comply with risk mitigation measures,	inform EPA, in writing, if and how it will comply within the 1.5 years deadline. Options for compliance include: 1. certifying that the product is a technical grade or manufacturing use product that currently complies with the risk mitigation decision; 2. certifying that the requirements of the May 2008 risk mitigation decision do not apply because the product is: a. labeled solely for outdoor, below-ground control of moles and pocket gophers; b. labeled solely for outdoor, field use; or c. a tracking powder product; 3. certifying that, on or before December 4, 2009, you will submit an application for amended registration consistent with the risk mitigation decision; or 4. submitting a request for voluntary cancellation (cancellation must be effective on or before June 4, 2011).
does not intend to comply with risk mitigation measures,	request a voluntary cancellation (cancellation must be effective on or before June 4, 2011).
Note: Failure to make a timely, complete 90 Day Response for a product will result in EPA issuing a Notice of Intent to Cancel (NOIC) the registration.	

Table 1

Steps for Complying with Rodenticide Risk Reduction Measures [Response Needed for Each Product]	
1.5 Years after Publication of the *Federal Register* Notice Announcing the Availability of the Decision (December 4, 2009)	
If company …	**Then it must …**
intends to revise the labeling and package size (if needed) for a currently registered product,	submit an amended application with proposed, revised labeling.
Note: Failure to make a timely, complete 1.5 Year Response for a product will result in EPA issuing a Notice of Intent to Cancel (NOIC) the registration. **Note:** PRIA does not apply to applications to amend registrations in order to comply with the rodenticide risk mitigation decision. **Note:** EPA intends to issue decisions on amendments not involving the submission of supporting data within 3 months. The Agency intends to issue decisions on amendments submitted with supporting data within 4 months.	
At Any Time	
If company …	**Then it must …**
intends to replace a non-complying product with one or more new products that comply with the risk mitigation decision, **Note:** The addition of a bait station to a product will require a new product registration. **Note:** A change in bait form (i.e., from pellets to bait blocks) will require a new product registration.	1. request a voluntary cancellation of the old product (voluntary cancellations are due on or before September 2, 2008), 2. apply for new registrations for the replacement products, 3. submit bait station testing report and raw data, plus bait station drawings, for any Tier 1, 2, 3 bait station, 4. submit a self-certification statement for any Tier 4 bait station.

3 Years after Publication of the *Federal Register* Notice Announcing the Availability of the Decision (June 4, 2011)	
If company …	**Then it must …**
has a product for which it requested voluntary cancellation effective on or before June 4, 2011,	cease production of the product and use up existing stocks as required under the cancellation order.
has a product for which EPA issued a registration after June 4, 2008 (the date of the publication of the Federal Register Notice announcing the availability of the decision),	cease production of the product and use up existing stocks as required under the time-limited registration.
has a product for which it requested revised labeling on or before December 4, 2009,	cease production of product with the old labeling and use up existing stocks of product with old labeling within six (6) months.
Note: Failure to cease sale and distribution of existing stocks of product on this date would be unlawful acts under FIFRA subject to civil and/or criminal penalties.	

Table 2

Supporting Materials for Applications for Bait Stations	
If company is applying for …	**then it must submit …**
Tier 1 Bait Station	Description of weather-resistant properties consistent with PR Notice 94-7 Reports and raw data from studies conducted according to the following protocols: - Method for Testing Ready-to-Use Bait Stations with Young Children - Method for Testing Ready-to-Use Bait Stations with Dogs - Method for Testing Ready-to-Use Bait Stations with Adults for Facility of Opening, Reclosing, and Securing Drawings of bait station design **Note:** Submit all test data in PR 86-5 format.
Tier 2 Bait Station	Reports and raw data from studies conducted according to the following protocols: - Method for Testing Ready-to-Use Bait Stations with Young Children - Method for Testing Ready-to-Use Bait Stations with Dogs - Method for Testing Ready-to-Use Bait Stations with Adults for Facility of Opening, Reclosing, and Securing Drawings of bait station design **Note:** Submit all test data in PR 86-5 format.
Tier 3 Bait Station	Reports and raw data from studies conducted according to the following protocols: - Method for Testing Ready-to-Use Bait Stations with Young Children - Method for Testing Ready-to-Use Bait Stations with Adults for Facility of Opening, Reclosing, and Securing Drawings of bait station design **Note:** Submit all test data in PR 86-5 format.

Table 2

Supporting Materials for Applications for Bait Stations	
If company is applying for …	**then it must submit …**
Tier 4 Bait Station	1. self-certification statement about packaging: "[Insert company name] certifies that the bait station [insert model number] sold with [insert product name; insert EPA registration number or file symbol] is a sealed, single-use unit, for indoor use only, containing no more than 1 oz of bait [if for mouse control] or no more than 4 oz of bait [if for rat control]. The bait station is made of a material of sufficient rigidity such that the station is not easily crushed or opened by children < 6 years old, not easily chewed by rats/mice, and not reasonably anticipated to release rodenticide bait except for bait removed by target rodents and minor quantities of crumbs created by target rodents."

Table 3

Label Table
Summary of Labeling, Packaging, and Size Requirements and Terms/Conditions of Sale/Distribution for Rodenticides Used in and Around Structures (Buildings) and Inside of Transport Vehicles

Description	Amended Labeling and Other Requirements	Label Location
Manufacturing Use Products		
All Manufacturing Use products	Add "A Rodenticide for Formulating Other Registered Products for the following sites: [list]."	Front Panel under Product Name
All Manufacturing Use products	Add "Only for formulation into a rodenticide for the following uses(s) [Fill blank only with those uses that are being supported by MP registrant]."	Directions for Use
All Manufacturing Use products (optional statement) One of these statements may be added to a label to allow reformulation of the product for a specific use or all additional uses supported by a formulator or user group.	"This product may be used to formulate products for specific use(s) not listed on the MP label if the formulator, user group, or grower has complied with U.S. EPA submission requirements regarding support of such uses(s)." "This product may be used to formulate products for any additional use(s) not listed on the MP label if the formulator, user group, or grower has complied with U.S. EPA submission requirements regarding support of such uses(s)."	Directions for Use

Label Table **Summary of Labeling, Packaging, and Size Requirements and Terms/Conditions of Sale/Distribution for Rodenticides used in and Around Structures (Buildings) and Inside of Transport Vehicles**		
Solid Baits Applied in and around Structural Sites (Buildings) and Inside Transport Vehicles		
"Consumer Size" Products 1st Generation Anticoagulants (Warfarin, Diphacinone, Chlorophacinone) and Non-Anticoagulants (Zinc Phosphide, Bromethalin, Cholecalciferol) Products containing ≤1 pound of bait	**Applicator:** Anyone **Bait Form:** Block or other solid form only. Meal, treated whole-grain, or pelleted forms of bait are prohibited. The Agency will consider another bait form, like a paste, if the registrant shows that it has the same protective features as the block form. **Packaging:** Contains 1 pound of bait or less. **Bait Stations:** Bait must be sold packaged in a bait station meeting the requirements of Tiers 1, 2, 3, or 4. Bait stations for mouse control must accommodate bait placements of between 0.25 and 1 ounce of bait. Bait stations for rat control must accommodate bait placements of between 4 and 16 ounces of bait for warfarin, diphacinone, or chlorophacinone baits; between 2 and 8 ounces of bait for cholecalciferol baits; or between 1 and 6 ounces of bait for bromethalin baits. **Refills:** Products for either mouse or rat control may not contain more than 1 pound of bait. The one pound limit includes the initial bait placement in the bait station, plus any refills. Tier 4 bait stations are not refillable. **Labeling:** Include additional mandatory text found in next table, **"Mandatory Labeling Requirements to Distinguish Residential, Preloaded, Refillable Bait Stations, Tier 1, Tier 2, Tier 3, and Tier 4."** **Sites:** Residential use sites (e.g., inside homes). **Labeling:** For products with outdoor use sites (Tier 1 bait stations only), add: "Do not apply further than 50 feet from home or building."	Front Panel and Use Restrictions
1st Generation Anticoagulants (Warfarin, Diphacinone, Chlorophacinone) and Non-Anticoagulants (Zinc Phosphide, Bromethalin, Cholecalciferol) Products containing ≥4 pounds of bait	**Applicator:** Professional applicators **Bait Form:** Meal, pellet, block, paste **Packaging:** Contains greater than four pounds of bait. **Sites:** In and Around Buildings and Inside of Transport Vehicles **Bait Stations:** Mandatory for outdoor, above-ground use **Labeling:** 1. Add "This product may only be used inside and within 50 feet of buildings or inside of transport vehicles (ships, trains, or aircraft)." 2. Add "Do not sell this product in individual containers holding less than 4 pounds of bait." **Terms/Conditions of Sale/Distribution:** 3. Product may not be sold in packaging that holds less than 4 pounds of bait.	1. Front Panel immediately under Product Name 2. Use Restrictions in Directions for Use 3. Notice of Registration or Amendment Approval

Label Table **Summary of Labeling, Packaging, and Size Requirements and Terms/Conditions of Sale/Distribution for Rodenticides used in and Around Structures (Buildings) and Inside of Transport Vehicles**		
Solid Baits Applied in and around Structural Sites (Buildings) and Inside Transport Vehicles		
2nd Generation Anticoagulants (Brodifacoum, Bromadiolone, Difenacoum, Difethialone) 8 pounds and Greater (Agricultural Buildings Only Use)	**Applicator:** Professional user working in livestock production. **Form:** Meal, pellet, block, paste **Packaging:** Must contain at least 8 pounds of bait **Sites:** In and\ Around Agricultural Buildings Only. (Not for Use in and around Residential sites) **Bait Stations:** Bait stations are mandatory for outdoor use. Tamper-resistant bait stations must be used if children, pets, non-target mammals, or birds may access the bait. **Labeling:** 1. Add "For Use In and Around Agricultural Buildings Only." 2. Add "Do not use in homes or other human residences." 3. Delete any non-agricultural use sites (e.g. homes, schools, childcare centers, or any other location where children or pets may be exposed). 4. Add "Do not apply further than 50 feet from agricultural buildings." 5. Add "Do not sell this product in individual containers holding less than 8 pounds of bait." **Terms/Conditions of Sale/Distribution:** 6. Prohibited for Sale in Stores Oriented towards Residential Consumers: Grocery, Drug, Hardware and Home Improvement. Acceptable for Sale in Stores Oriented toward Agricultural Consumers: Farm, Agricultural, Tractor Stores. 7. Product may not be sold in packaging that holds less than 8 pounds of bait.	1. Front Panel immediately under Product Name 2. and 3. Use Restrictions in Directions for Use 4. and 5. Use Restrictions in Directions for Use 6. and 7. Notice of Registration or Amendment Approval
2nd Generation Anticoagulants (Brodifacoum, Bromadiolone, Difenacoum, Difethialone) 16 pounds and Greater (PCO Use)	**Applicator:** For use by professional applicators only. **Form:** Granular, pellet, block, paste **Packaging:** Must contain at least 16 pounds of bait **Sites:** In /Around Buildings and Inside Transport Vehicles; In sewers (select products) **Bait Stations:** Bait stations are mandatory for outdoor, above-ground use. Tamper-resistant bait stations must be used if children, pets, non-target mammals, or birds may access the bait. **Labeling:** 1. Add "Do not apply further than 50 feet from buildings." 2. Add "Do not sell this product in individual containers holding less than 16 pounds of bait." **Terms/Conditions of Sale/Distribution:** 3. Prohibited for Sale in Stores Oriented towards Residential Consumers: Grocery, Drug, Hardware and Home Improvement. Acceptable for Sale in Stores Oriented toward Agricultural Consumers: Farm, Agricultural, Tractor Stores. 4. Product may not be sold in packaging that holds less than 16 pounds of bait.	1 and 2. Use Restrictions in Directions for Use 3 and 4. Notice of Registration or Amendment Approval

Label Table **Summary of Labeling, Packaging, and Size Requirements and Terms/Conditions of Sale/Distribution for Rodenticides used in and Around Structures (Buildings) and Inside of Transport Vehicles**		
Non-Restricted Use (Unclassified) Products Used to Control Pocket Gophers and Moles Around Residential Sites by Underground, Hand Application		
1st Generation Anticoagulants, Zinc Phosphide, Bromethalin	"This product may only be used to control [moles and/or pocket gophers] in manual, below-ground applications."	Immediately under Product Name
	"This product may only be applied at the use sites and by the application methods indicated on this label."	Use Restrictions in Directions for Use
	"Bait must be applied directly into [moles' and/or pocket gophers'] burrow systems."	Use Restrictions in Directions for Use
	Note: If products contain uses for species requiring bait application above ground, delete such uses and apply for a new registration for these uses.	
Concentrated Products to be Diluted into Solid or Liquid Baits and Applied in and around Structural Sites (Buildings)		
Diphacinone, Sodium Salt Warfarin, Sodium Salt Products containing ≥4 pounds of bait	**Applicator:** Professional applicators **Form:** Concentrate to be diluted **Packaging:** Must contain at least 4 pounds of concentrate **Sites:** In Agricultural or Non-Residential Buildings and Inside Transport Vehicles **Bait Stations:** Tamper-resistant bait stations must be used if children, pets, non-target mammals, or birds may access the bait. **Labeling:** 1. Add "Do not use in homes or other human residences. Do not use outdoors." 2. Delete any residential sites (e.g., "homes"). 3. Add "For indoor use only. Do not use in areas accessible to children, pets and nontarget wildlife." **Terms/Conditions of Sale/Distribution:** 4. Prohibited for Sale in Stores Oriented towards Residential Consumers: Grocery, Drug, Hardware and Home Improvement. Acceptable for Sale in Stores Oriented toward Agricultural or Professional Consumers: Farm, Agricultural, Tractor Stores.	
	Add "Do not use in homes or other residential settings. Do not use outdoors."	Immediately under Product Name
	Delete any residential sites (e.g., "homes"). Add "For indoor use only. Do not use in areas accessible to children, pets and nontarget wildlife."	Use Restrictions in Directions for Use

Table 4

Mandatory Labeling Requirements to Distinguish Residential, Preloaded, Refillable Bait Stations (Tier 1, Tier 2, Tier 3, and Tier 4)

Tier	This Unit is:	May Use:	Front Panel Text:[20]	Use Restriction Text:
1	Tamper-resistant and Weather-resistant	Indoors and Outdoors (within 50 feet of buildings)	**This Bait Station is Resistant to Weather and to Tampering by Children and Dogs. For Use Indoors and Outdoors.**	This bait station may be used in and around (within 50 feet of) buildings accessible to children and pets, consistent with all use restrictions and other requirements indicated on this label.
2	Tamper-resistant (but not weather-resistant)	Indoors	**This Bait Station is Resistant to Tampering by Children and Dogs. Use Indoors Only.**	This bait station may be used in indoor areas accessible to children and pets, consistent with all use restrictions and other requirements indicated in this label. **DO NOT USE THIS PRODUCT OUTDOORS.**
3	Tamper-resistant for young children (only)	Indoors	**This Bait Station is Resistant to Tampering by Children. Use Indoors Only.**	This bait station may be used in indoor areas accessible to children, consistent with all use restrictions and other requirements indicated in this label. **DO NOT USE THIS PRODUCT OUTDOORS OR IN AREAS ACCESSIBLE TO PETS.**
4	Untested or tested without meeting any criteria for tamper-resistance	Indoors	**THIS BAIT STATION IS NOT TAMPER-RESISTANT. Use Indoors Only in Areas Inaccessible to Children and Pets.**	**DO NOT USE THIS PRODUCT OUTDOORS OR IN AREAS ACCESSIBLE TO CHILDREN, PETS, DOMESTIC ANIMALS, OR NONTAGET WILDLIFE.**

[20] Place required text, 1) **bolded** 2) on Front Panel 3) immediately under product name, 4) in a box, 5) in type size equal to "Keep Out of Reach of Children" or 8 Point Type (which ever is larger), 6) on contrasting background, and 7) clearly readable by average person at the point of sale.

Attachment A:

READY-TO-USE BAIT STATION PROTOCOLS

METHOD FOR TESTING READY-TO-USE BAIT STATIONS
WITH YOUNG CHILDREN

METHOD FOR TESTING READY-TO-USE BAIT STATIONS WITH YOUNG CHILDREN[1]

OPP Designation: 1.229 (10-29-87)

1. Purpose

1.1 This protocol is designed to test the abilities of ready-to-use bait stations to isolate bait from children of pre-school age.

2. Rationale

2.1 Thousands of incidents of known or suspected rodenticide exposures to children under six years of age are reported each year (e.g., Litovitz and Veltri, 1985; Litovitz, *et al*, 1987). It is suspected that many more exposure incidents are not reported. This protocol has been developed to test the extent to which ready-to-use bait station designs prevent young children from being exposed to rodenticide baits.

2.2 While many reported incidents involve children under two years of age, older pre-school age children are better equipped mentally and physically to attack and compromise bait stations. Subject test ages and many other aspects of this protocol are adapted from the methods used for evaluating Child-Resistant Packaging (CRP). CRP performance standards and procedures (16 CFR §1700.15 and §1700.20) have been in use for many years. EPA has applied these methods and criteria to Child-Resistant Packaging for certain pesticides (40 CFR §157) and believes that CRP methods can be adapted for evaluating protective qualities of bait stations with children.

2.3 This protocol has been adapted from Child-Resistant Packaging test protocols developed by the Consumer Product Safety Commission (CPSC) and described in 16 CFR §1700.15 and §1700.20. The procedures described in this protocol may be modified in the future based upon knowledge gained through testing, comments from concerned parties, changes in EPA's policies, changes to CPSC methods which are appropriate for inclusion in this protocol, and other factors. If EPA determines that changes in procedures are sufficient to call into question the results of tests conducted under earlier versions of this protocol, the Agency may require the stations affected to be retested.

2.4 This protocol describes test methods that can be used with bait stations that are secured to the substrate, a wall, or other virtually immovable object and with stations that are not secured. Because young children may encounter ready-to-use bait stations in situations such as store displays, in shopping bags, in improper storage, or in improper use in which units are not secured, groups of children must be tested with units that are not secured. Testing children with secured stations also is necessary because it is possible that some designs could be more vulnerable to children's attacks when secured. Child-testing secured stations also provides a means for determining whether there are weaknesses in the securing features for a station which enable children to remove "properly secured" stations from their moorings.

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2.5 EPA will consider sequential testing of groups of 50 children as an alternative to the 200-child test. (See Federal Register, 48:13, 2389-2392.) Because the performance standards of this protocol are higher than those currently used for CRP, fewer failures can be tolerated for passing or continuing in sequential tests with ready-to-use bait stations. (See 6.3.)

3. Subjects

3.1 Use 200 healthy children, 42-51 months of age, inclusive, for the test with secured stations and 200 healthy children, 42-51 months of age, inclusive, for the test with unsecured stations. Do not use children who have had more than one previous experience in testing bait stations. Do not use the same subjects for testing secured and unsecured stations of the same design. Follow procedures outlined in 16 CFR §1700.20(a)(2) for age and sex distribution requirements for test subjects.

4. Procedures

4.1 Use production models of ready-to-use bait stations or models from early runs on preproduction molds. Do not use toxic bait in stations that are to be tested with children. Instead, use a placebo bait identical in composition and physical form to the toxic bait except for the absence of the toxicant. If the toxic bait contains a dye, the dye may also be omitted from the placebo bait formulation. To help determine whether children have contacted the bait, coat bait with a nontoxic material that will adhere to the child's skin and that will wash off easily. This material may be a visible agent or an agent that can only be detected by use of special equipment such as an ultraviolet light. Take care to apply the material only to the bait and not to areas of the bait station that are more accessible than the bait area. Inspect children's hands prior to the test to determine whether there are any materials present which could affect the reliability of the method used to determine whether the bait has been contacted. If the bait in the station is enclosed in a chamber or pouch through which rodents must chew to gain access to bait, coat the outside of the chamber or pouch with the indicator substance.

4.2 If the bait station is of a refillable design, each station tested must be subjected to simulated repeated use before it is tested with children. Prior to testing with children, each station must be opened and closed (as necessary for refilling) ten times, or more if a larger number of openings and closings would be more representative of use in the normal life of the product.

4.3 Use at least five different test sites and at least four different interviewers. Do not test more than 20% of test subjects at any one test site. No interviewer should test more than 30% of all subjects used.[2] Test children in circumstances in which they feel at ease. Do not use "hostile" or imposing test environments.

4.4 Test children in pairs. Allow each child to challenge only the station presented to him (her). Children should be on the floor or seated at a table so that the interviewer can observe them simultaneously.

[2] These stipulations regarding sites, subjects, and interviewer also hold for sequential tests.

4.5 Beginning Tests

4.5.1 For tests with unsecured stations, hand a station, free from its box or other outer packaging, to each child. A test begins when both children have been presented with stations and have been given the appropriate verbal instructions such as

> "I have just given you a box that has something in it. When I say 'Start', I want you to try to get something out of the box."

4.5.2 For tests with secured stations, present each child with a station secured using the securing method of first choice (as discussed in paragraph 4.1.2 of Protocol 1.228). A test begins when both children have been presented with stations and have been given the appropriate verbal instructions such as

> "I have just given you a box that has something in it. When I say 'Start', I want you to try to get something out of the box."

4.6 Do not encourage or discourage any specific approach by children to compromising the station unless their activities endanger themselves or each other, or involve trading stations or working together on one station. Prohibit such activities. Interviewers may gently encourage children who seem to be reluctant to participate in the test. Children may talk to each other about the stations.

4.7 Test Duration

4.7.1 If the ready-to-use station is not of a refillable design, continue the test for ten minutes. After five minutes, interviewer may remind children that they may use their feet or their teeth.

4.7.2 If the ready-to-use station is of a refillable design, suspend the test after five minutes and give the pair of subjects a demonstration, without explanation, of how to open the station. (If a special tool designed to be used with the bait station is required to open it, do not demonstrate how to open it or give the children access to the tool.) Use a separate, identical station for the demonstration. Conduct this demonstration at normal speed for opening the unit under use conditions. Do not exaggerate or protract movements. At this time, the interviewer also may remind children that they may use their feet or their teeth. After the demonstration, give subjects five more minutes to try to compromise the station.

4.8 At the conclusions of each trial, inspect child's hands, feet, mouth, clothing, and the immediate test environment for evidence of the placebo bait. Examine station carefully to determine existence and nature of any damage sustained by the unit and to assess whether bait was contacted or moved within the station by the child. If placepacks are in station, look for evidence that placepacks have been broken. Look for the marker substance (described in paragraph 4.1) on each subject's fingers, feet, mouth, and clothing.

5. Reporting Results

5.1 Report the age, sex, height, and weight of each test subject. Describe test environment and exact test procedures followed. Provide raw data sheets which indicate the performance of each test subject. Summarize the means used by children to attack stations. Describe the techniques used by each child who succeeded in compromising the station.

5.2 Report the total numbers of station failures, numbers of instances in which stations did not fail, and the percent of child-resistant effectiveness.[3] Report test results for each individual subject including whether there was a failure and the time that elapsed from the start of the test until the time, if any, that failure occurred. For refillable units, report the numbers of failures which occurred before or following the demonstration. A failure occurs when any child compromises the bait station or gains access to its contents. Examples of failures include (but are not limited to) instances in which:

a. Subject touches bait or gains access to bait in bait compartment.

b. Through any action, subject is able to move bait to an area of the station where bait can be touched by subject.

c. Subject removes bait from station.

d. Subject opens station or pulls it apart.

e. Subject cracks or breaks station with the result that the placebo bait is moved to more accessible areas or that the bait in any other way becomes more accessible to the subject.[4]

6. Performance Standards

6.1 Non-refillable Stations: Stations pass if child-resistant effectiveness is 85% or greater for the entire 10-minute test.

6.2 Refillable Stations: Stations pass if child-resistant effectiveness is 90% or greater before the demonstration and 85% or greater for the entire 10-minute period.

6.3 If sequential testing of units of 50 subjects is done, use the table below for making decisions regarding whether the station has passed or failed, or whether testing must be continued.

Sample	Sample Size	Cumulative Sample Size	Acceptance and Rejection Criteria (based upon number of failures) PASS	CONTINUE	FAIL
First	50	50	0 to 2	3 to 13	$\geq$ 14
Second	50	100	3 to 7	8 to 22	$\geq$ 23
Third	50	150	8 to 13	14 to 30	$\geq$ 31
Fourth	50	200	14 to 30	---	$\geq$ 31

[3] For a 200-subject test, percent child-resistance effectiveness is calculated as "the number of children tested, less the test failures, divided by two."

[4] For this type of failure, it is not necessary that the subject touch or remove bait. For example, if the subject put a big hole in the unit, the station would fail, even if the subject did not reach in for the bait immediately or at all.

7. References

Litovitz, T.L., Martin, T.G., and Schmitz, B. (1987) 1986 annual report of the American Association of Poison Control Centers National Data Collection System. American Journal of Emergency Medicine, 5, 405-445.

Litovitz, T.L. and Veltri, J.C. (1985) 1984 annual report of the American Association of Poison Control Centers National Data Collection System. American Journal of Emergency Medicine, 3, 423-450.

Attachment B:

READY-TO-USE BAIT STATION PROTOCOLS

METHOD FOR TESTING READY-TO-USE BAIT STATIONS WITH DOGS

METHOD FOR TESTING READY-TO-USE BAIT STATIONS WITH DOGS[1]

OPP Designation: 1.230 (10-29-87)

1. Purpose

1.1 This protocol is designed to assess the abilities of ready-to-use bait stations to isolate bait from dogs.

2. Rationale

2.1 Thousands of incidents of known or suspected exposures of dogs to commensal rodenticides are reported each year (e.g., Buck, *et al*, 1985). It is suspected that many more exposure incidents are not reported. This protocol has been developed to test the extent to which bait station designs prevent dogs from being exposed to rodenticide baits.

2.2 Dogs' chief weapons for attacking bait stations are their teeth. While dogs of all breeds and sizes may be exposed to rodenticides, larger dogs have greater capacities for damaging bait stations. Consequently, this protocol requires use of relatively large dogs. Subjects should be relatively hungry and otherwise strongly motivated to attack the test station. Dogs used in tests under this protocol should be accustomed to being fed once a day at the same time every day. Each test dog shall be exposed to stations at its normal feeding time, before being fed its daily ration.

2.3 This protocol has been adapted from methods used by manufacturers of bait stations which are sold without bait in them to test their products with dogs. The procedures used by these manufacturers were developed through dialogue with OPP staff. The procedures described in this protocol may be modified in the future based upon knowledge gained through testing, comments from concerned parties, changes in EPA's policies, and other sources. If EPA determines that changes in procedures are sufficient to call into question the results of tests conducted under earlier versions of this protocol, the Agency may require the affected stations to be retested.

3. Subjects

3.1 Use at least six adult dogs weighing at least 60 lbs for each test. Select healthy dogs 1-6 years of age. Do not use excessively fat dogs. Each group of six subjects shall include at least two females and at least two males. Use mongrels or dogs of any breed as long as size and age requirements are met. Do not use dogs with small or weak mouths or dogs which have misaligned jaws, or misaligned, missing, or small canine or molar teeth. The group of dogs tested must include at least two different breeds. Mongrels count as one "breed". At least two different breeds should be represented for each sex. It is not necessary that male and female subjects tested include examples of the same breed. For purposes of this protocol, a dog shall be considered to be of a particular breed if its characteristics are consistent with those generally

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recognized for the breed. It is not necessary that the subjects have "papers". Use each subject only once with a specific bait station design. Do not use the same subjects for testing more than two different bait station designs.

3.2 Test dogs may wear flea collars. If other ectoparasite control (e.g., dusting, spraying, dipping, bathing) is needed, wait at least seven days from the conclusion of the treatment before starting the test.

4. Procedures

4.1 Test two groups of six dogs. For one group, use bait stations that are secured to an immobile substrate or object by use of the securing method of first choice for the station. (See paragraph 4.1.2 of Protocol 1.228.) For the other group, use stations that are not secured.

4.2 Test dogs in surroundings that are familiar to them. Dogs may be tested on their owners' premises if the conditions of this protocol can be met and its procedures can be followed. If dogs are kenneled, use enclosures that are at least 40 square feet in area. Larger areas are preferred.

4.3 Condition each dog to being fed once a day at a fixed time every day. Exclude dogs that do not feed vigorously and rapidly when food is presented. Persons handling bait stations and feeding and exercising dogs should be familiar to the animals. Dog owners may perform these tasks if they can do so in accordance with the requirements of this protocol. A tester must be present on test day to instruct owner on the method of presenting the station. The tester must record all observations during the test period.

4.4 On the day before test with bait station, remove food dish 30-60 minutes after it has been offered. Remove bones or any other possible sources of food. Instruct others likely to encounter the subject that it is not to be fed. If this condition is violated, do not test the subject. Do not remove water source.

4.5 At normal feeding time on test day, present station to dog at or near location where dog normally is fed. At the time that station is to be presented, the dog will have been without food for 23-23.5 hr. The ready-to-use bait station must contain non-toxic bait otherwise identical in composition to the toxic bait offered in the ready-to-use station.[2] For the test with secured units, build a structure, if necessary, that will permit securing the station according to the method of first choice and otherwise presenting it to the dog in the manner prescribed for baiting rodents by the product label. This structure must be sturdy and heavy enough to prevent the dog from tearing it apart or lifting it along with the station.

4.6 After presenting the station to the dog, withdraw from area to place from which observations are to be made. Avoid actions that might distract the dog. Do not interfere with or encourage dog’s efforts to reach bait in the station. Observe the dog continuously for 60

[2] If the toxic bait contains a dye, this dye also may be omitted from the placebo bait used in the dog test.

minutes. For the next hour, check the dog and the condition of the station at 10-minute intervals.[3] Terminate the test after two hours and provide dog with its normal food ration.

4.7 Photograph top, sides, and bottom of each station tested, paying particular attention to any areas where there is visible evidence (scratches, holes, saliva, etc.) that the station has been attacked.

4.8 Record number and nature of attempts to gain access to material in the station. Determine and record the amount of time spent by the dog in attacking the station and in attempting to get at its contents.

5. Reporting Results

5.1 Report breed, age, weight, and general health of all test subjects. Describe holding and test areas, and general procedures used in handling and maintaining animals. Describe animals' feeding schedules, foods normally fed, and general temperament. Describe each test subject's reactions to station and report number and nature of attempts to gain access to material in the station. Report lengths of time that each dog interacted with the station and techniques used to attempt to get at bait. Describe conditions and provide photographs of stations at start and at conclusion of test. (See paragraph 4.7.) Provide photographs of each test subject. Submit copies of all raw data sheets. If trials are videotaped or otherwise visually recorded, submit copies of such videotapes or discs.

5.2 Report and describe all failures that occur in this test. Failures occur when the station fails to isolate the bait from the dog or when the dog compromises the protective features of the unit. Examples of failures include (but are not limited to) instances in which the dog:

a. contacts or eats the placebo bait;

b. cracks or breaks the station;

c. punctures the station;[4]

d. pulls the station off of its moorings (secured unit tests only); or

e. pulls the station apart (e.g., by defeating tabs or other locking mechanisms).

5.3 Report results and retain records as prescribed by EPA's Good Laboratory Practice (GLP) regulations (40 CFR §160.185, §160.190, §160.195) and by paragraph 5.1 (above).

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[3] If trial is video-recorded, observer should remain on site for the 2-hr period as indicated here (i.e., observing dog continuously for 1 hr and at 10-minute intervals for second hour).

[4] Scratches and holes that do not go all the way through the surface contacted are not considered to be punctures. All dog-caused scratches and partial punctures of stations must be noted in reports.

6. Performance Standard

6.1 To pass this test, stations must completely deny access or potential access to bait for 100% of test subjects. There may be no failures.

7. Reference

Buck, W.B., Beasley, V.R., Trammel, J.L., and Carlson-Stark, C. (1985) National Animal Poison Control Center annual progress report 1984. College of Veterinary Medicine, University of Illinois, Urbana, IL, 181 pp.

Attachment C:

READY-TO-USE BAIT STATION PROTOCOLS

METHOD FOR TESTING READY-TO-USE BAIT STATIONS WITH ADULTS FOR FACILITY OF OPENING, RECLOSING, AND SECURING

METHOD FOR TESTING READY-TO-USE BAIT STATIONS WITH ADULTS FOR FACILITY OF OPENING, RECLOSING, AND SECURING[1]

OPP Designation: 1.228 (10-29-87)

1. Purpose

1.1 This protocol is designed to assess the reliability with which untrained adults can perform tasks necessary for proper use of ready-to-use bait stations.

2. Rationale

2.1 Thousands of incidents of known or suspected exposures of nontarget organisms to commensal rodenticides are reported each year. It is suspected that many more exposure incidents are not reported. Most known nontarget rodenticide exposures involve children under six years of age and dogs (c.f., Buck, et al, 1985; Litovitz, et al, 1987; Frantz, *et al*, 1984). Most exposures appear to result from use of rodenticide products that are bought almost exclusively by persons who are not professional pest control operators (NCPCC, 1970-1982). Data developed in a survey of "private" pesticide users indicate that many people do not read pesticide labels for information related to how products should be used in pest control and steps to be followed to limit hazards associated with using pesticides (Savage, et al, 1980). Whether consumers read use directions is beyond the control of the registrant and the EPA, but whether persons who read directions can and will follow them could be related to the clarity of the directions and the complexities of the tasks required.

2.2 Ready-to-use bait stations have been developed to provide homeowners and other private users of rodenticides with products that can be applied without touching or measuring bait. Whether use of such stations will lead to a safer use environment when bait is applied in areas accessible to children or nontarget animals depends upon the protective qualities of the stations and the likelihood that applicators will use the stations properly. Nearly all of the bait stations developed to date could have bait shaken out of them if they were lifted. This problem exists even for ready-to-use bait stations designed to hold paraffinized blocks because these blocks tend to crumble or break somewhat after rodents have begun to feed on them. The shake-out problem can be avoided if the bait station is secured, or otherwise immobilized, while in use. If users do not secure stations adequately or ignore directions to do so, bait shake-out could occur.

2.3 Some ready-to-use bait station designs cannot be refilled and must be discarded after the initial quantity of bait contained in them has been eaten. Other ready-to-use bait stations are refillable. Whether a refillable unit will remain as protective as it was when first packaged depends upon the durability of the unit and on the likelihood that users will reclose it properly.

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2.4 This protocol consists of two different methodologies: a test to be used for non-refillable ready-to-use bait stations and a test to be used for ready-to-use bait stations that are designed to be refillable. Select the methodology appropriate for the type of station to be tested. These procedures should be used for testing ready-to-use bait stations with "parent-aged" adults (18-45 years) and "grandparent-aged" adults (60-75 years). Adult effectiveness requirements are similar for both age groups. (See 4.3 and 5.3.)

2.5 This protocol has been developed from child-resistant packaging test protocols developed by the Consumer Product Safety Commission (CPSC) and described in 16 CFR 1700.15 and 1700.20. The procedures described in this protocol may be modified in the future based upon knowledge gained through testing, comments from concerned parties, changes to CPSC methods which are appropriate for inclusion in this protocol, and other factors. If EPA determines that changes in procedures are sufficient to call into question the results of tests conducted under earlier versions of this protocol, the Agency may require the stations affected to be retested.

3. Subjects

3.1 For the "parent-aged" tests, use 100 healthy adults, 18-45 years of age, who have no obvious physical or mental handicaps. Seventy percent of the test subjects shall be females. Within each gender, numbers of subjects used shall be approximately equal for the age ranges 18-27 years, 28-36 years, and 37-45 years.

3.2 For the "grandparent-aged" tests, use 100 healthy adults, 60-75 years of age, who have no obvious physical or mental handicaps. Seventy percent of the test subjects shall be females. Within each gender, numbers of subjects used shall be approximately equal for the age ranges 60-64 years, 65-69 years, and 70-75 years.

4. Test for Non-Refillable Stations

4.1 Procedures

4.1.1 Use at least three different test locations and at least three different interviewers.

4.1.2 Direct subjects to use the method of first choice for securing stations. The method of first choice must be one of the securing methods mentioned in the product literature. If all materials needed to secure a station by a particular method are shipped in the box with the station, that method shall be considered to be the method of first choice and shall be the method tested. If all necessary materials are not shipped in the box for any of the securing methods mentioned on the label, the manufacturer shall select the method of first choice. Provide subjects with all items (tools, nails, screws, etc.) needed for securing station by the method of first choice, if these materials are not provided with the product.

4.1.3 Test subjects individually. Give subjects the printed instructions for putting the bait station into use that are intended to appear on the package to be delivered to the consumer. If available, use the printed product label. Give subjects limited instructions such as

"When I say 'Begin', you will have 30 minutes to place this station into use and secure it according to the instructions for (the method of first choice) on the package. Indicate when you have completed the job by saying 'Done.'"

4.1.4 Allow each trial to continue for 30 minutes unless subject indicates that she or he is finished at an earlier time.[2] Record the amount of time taken from the start until
subject is finished, the amount of time that the subject appears to spend reading directions, and what the subject does with the unit.

4.1.5 After the subject is finished, determine whether the unit has been secured properly (i.e., that the method of first choice for securing the station has been executed in accordance with label directions). Note any shortcomings (e.g., failure to use the required number of screws, failure to apply tape at the required number of locations, failure to move tabs to the point where they "catch", etc.). Determine whether tasks necessary for proper use, aside from those associated with securing the unit, have been performed properly.

4.2 Reporting Results

4.2.1 Report number of persons tested, the gender and age of each subject, the securing method of first choice (and the rationale for selecting it), the time taken for each individual to secure the unit and put it into use, the amount of time that the person appeared to devote to reading directions, and what the subject did with the unit. Summarize results for the entire group and for each sex. Provide tables summarizing results and copies of all original raw data sheets.

4.2.2 Report adult failures for each sex and for all subjects together. Describe each adult failure in detail. Examples of failures include, but are not limited to, the following events:

a. The subject makes no attempt to secure the station.

b. The subject "gives up" after failing to secure the station.

c. The subject does not secure the station properly or completely.

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[2] Although 30 minutes are allowed for this test, the time required to secure stations could vary greatly depending upon the tasks that subjects are required to perform. Experimenters desiring to fix test durations to facilitate the scheduling of subjects may employ a pilot test to estimate the longest time that subjects will require before they either have secured the station of have abandoned efforts to do so. A pilot test shall include 20 "grandparent-aged" subjects, 13-15 of which shall be female. Run the subjects through the procedures prescribed in the protocol for this test. Record times, in seconds, to completion or resignation for each subject. Calculate the mean and standard deviation for test durations for the group. The duration of the main test may be limited to the nearest (or most convenient) whole number of minutes that is more than two standard deviation units beyond the mean time, in seconds, for completing the pilot test and more than 60 seconds beyond the longest test duration observed in the pilot test. Report results of pilot test separately from the results of the main 100-subject tests.

d. The subject damages the station while attempting to secure it, making securing impossible or making the bait potentially more accessible to children or nontarget animals.

e. The subject does not put the station into proper use (i.e., fails to perform acts, apart from securing, that are required for proper use).

4.2.3 Calculate and report the level of effectiveness for the test and for each sex. The level of adult effectiveness is the percent of adults who successfully secure the bait station and put it into proper use.

4.3 Performance Standards

4.3.1 90% or more of "parent-aged" test subjects must secure stations adequately as defined in paragraph 4.1.5 and put them into use properly.

4.3.2 90% or more of "grandparent-aged" test subjects must secure stations adequately as defined in paragraph 4.1.5 and put them into use properly.

5. Test for Refillable Bait Stations

5.1 Procedures

5.1.1 Use at least three different test locations and at least three different interviewers.

5.1.2 Test subjects individually.

5.1.3 Use placebo bait instead of the toxic bait. The placebo shall be identical to the toxic bait except for the absence of the toxicant. If the toxic bait contains a dye, the dye may also be omitted from the placebo bait formulation.

5.1.4 To test subjects' abilities to secure stations and put them into use, follow procedures outlined under 4., the test for Non-Refillable Stations. Follow all procedures in that method including determining time required to compete the test, evaluating the quality of the job performed, determining whether the subject has passed of failed, and completing all data recording requirements associated with the individual subjects.

5.1.5 Evaluate the quality of the securing and putting into use. (See 4.1.5 and 4.2.2.) If station has been secured and deployed properly, the same station may be used for the "refilling" portion of the test. If station has not been secured and put into use properly, the subject has failed already and does not have to be tested further. Provide tools (if any) needed to open, refill, reclose, and/or resecure (using the method of first choice as described in paragraph 4.1.2) the station in accordance with the product label. (Note: It may be possible to refill some stations without removing them from the "secured" condition.) Provide safety gloves if required by the label.

5.1.6 Give subjects the printed instructions for opening, refilling, reclosing, and resecuring bait station that are to appear on the package when delivered to the consumer. If available, use printed product label. Subjects may be given limited verbal instructions such as

"When I say 'Begin', you will have 30 minutes to open this station, remove bait, replace the old bait with new bait, reclose station, and resecure it (if necessary). Indicate when you have completed the job by saying 'Done.'"

5.1.7 Allow each trial to continue until the subject indicates that she or he is finished or until 30 minutes have passed (whichever comes first).[3] For each subject, record the time taken from the start of the refilling phase of the test until the subject is finished, the time spent in reading (or appearing to read) use directions, the time taken to open the station, the time taken to remove the old bait and to refill the station, the time taken to reclose the station, and the time taken to resecure the station (if necessary). Describe the general methods used by each subject while attempting to refill the unit.

5.1.8 After the subject is finished, evaluate the quality of the refilling, reclosing, and resecuring. Examine the unit and determine whether it has been closed properly (e.g., with all tabs in proper slots), it has been locked properly, and all bait added is confined to the appropriate places (e.g., bait hoppers) within the station. If resecuring is necessary, assess the quality of the effort at resecuring the station. (See 4.1.5 and 4.2.2.) Note any failures to execute the required activities properly and completely.

5.2 Reporting Results

5.2.1 Report number of persons tested, the gender and age of each subject, and the time taken for each individual to secure and put the station into use. Report the times taken by each individual to complete the entire refilling and resecuring job, and the times taken by each individual to do each of the following activities: to open the unit, to remove the old bait, to refill the unit, to reclose the station, and to resecure it (if necessary). Report the amount of time that the person appeared to devote to reading directions for the securing and for the refilling phases of the test. Report the methods used by each subject while attempting to refill the unit. Summarize results for the entire group and for each sex. Provide tables summarizing results and copies of al original raw data sheets.

5.2.2 Report all failures for each sex and for all subjects together. Describe each adult failure in detail. Examples of failures include, but are not limited to, the following events:

a. The subject fails to secure the station or to put it into use properly. (See 4.2.2.)

[3] Experimenters desiring to fix test durations to facilitate the scheduling of subjects may employ a pilot test to estimate the longest time that subjects will require before they either have refilled and resecured the station of have abandoned efforts to do so. A pilot test shall include 20 "grandparent-aged" subjects, 13-15 of which shall be female. Run the subjects through the procedures prescribed in this protocol for the "Refill" test. Record times, in seconds, to completion or resignation for each subject. Calculate the mean and standard deviation for test durations for the group. The duration of the main test may be limited to the nearest (or most convenient) whole number of minutes that is more than two standard deviation units beyond the mean time, in seconds, for completing the test and more than 60 seconds beyond the longest test duration observed in the pilot test. Report results of pilot test separately from the results of the main 100-subject tests.

b. The subject is not able to open the station.

c. The subject damages station while attempting to open, empty, refill, reclose, or resecure it.

d. The subject spills bait while refilling station and fails to clean it up.

e. The subject puts bait in areas other than the bait hoppers.

f. The subject fails to reclose bait station completely (including locking, if necessary).

g. The subject fails to resecure station (if necessary).

h. The subject abandons efforts before entire job is completed.

i. The subject does not complete all required tasks within allotted period of time.

5.2.3 Calculate and report the level of effectiveness for the test and for each sex. The level of adult effectiveness is the percent of adults tested who successfully and properly complete all of the tasks associated with refilling the bait station and returning it to proper use.

5.3 Performance Standards

5.3.1 90% or more of "parent-aged" test subjects must secure, put into use, refill, reclose, and resecure stations adequately and return them to use.

5.3.2 90% or more of "grandparent-aged" test subjects must secure, put into use, refill, reclose, and resecure stations adequately and return them to use.

6. Post-Test Interviews (Optional)

6.1 After the test period is over, the interviewer may ask the subjects questions concerning the ease or difficulty of the tasks that they were required to perform. The post-test interview should be structured so that the subjects give these opinions first, before they are asked more "loaded" questions such as whether they would take as much time with the units if they were not being tested or whether they would buy the product if they had a rodent problem.

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Annual Report on the Research and Management of Florida Panthers: 2017-2018

Florida Fish and Wildlife Conservation Commission

18 October 2018

FWC Contributors and Contact Information:

The compilation of this report was the result of the combined efforts of multiple FWC staff members currently working on the Florida Panther Project. Further analyses of these data will be conducted and results published in the scientific literature by the FWC and collaborators. Persons interested in obtaining the most current data should contact the FWC at:

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This report and previous annual reports can be downloaded as a pdf file at the Florida Fish and Wildlife Conservation Commission Florida Panther Website

Citation:

Florida Fish and Wildlife Conservation Commission. 2018. Annual report on the research and management of Florida panthers: 2017-2018. Fish and Wildlife Research Institute & Division of Habitat and Species Conservation, Naples, Florida, USA.

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Executive Summary

This report, prepared by the Florida Fish and Wildlife Conservation Commission (FWC), highlights information collected on the Florida panther (*Puma concolor coryi*) during fiscal year 1 July 2017 through 30 June 2018. In some cases, data (e.g., diagnostic or genetic test results) are presented from samples collected in prior fiscal years due to lag times involved with processing. Historic data are included as appendices. Panther research and management is a cooperative effort. We acknowledge the involvement of other agencies, including the U.S. Fish and Wildlife Service (USFWS) and particularly Big Cypress National Preserve (BCNP) and Everglades National Park (EVER) of the National Park Service (NPS). BCNP and EVER have located radiocollared panthers by plane within their respective park boundaries and resulting data have been incorporated into a telemetry database and are used with permission in this report. However, no panthers were equipped with radiocollars during the reporting period in EVER. Population status within EVER was monitored by trail cameras during the fiscal year. Beginning in 2003, BCNP was permitted by the USFWS and FWC to conduct panther capture activities. These activities have been occurring within BCNP boundaries south of I-75. BCNP assembled their own capture team and have captured previously uncollared panthers, replaced radiocollars due to expected battery failure, marked neonatal kittens at den sites, and recovered carcasses. While some data (e.g., biomedical, demographic) of panthers handled by BCNP are contained herein for completeness of datasets, more specific information may be found in the BCNP annual report compiled by BCNP staff.

There was no designated capture season during the 2017-2018 reporting period. Telemetry data were collected on 17 radiocollared Florida panthers in southern Florida by FWC and BCNP staff. Four panther dens were sampled by FWC and BCNP staff resulting in the documentation of 10 (5♂, 5♀) neonate kittens. Kittens handled at their natal dens were permanently marked with subcutaneous transponder chips and tissue samples were collected for genetic analyses. Three panthers needing immediate management action (FP224♀, FP251♂, FP252♂) were captured. A total of 252 panthers have been captured since 1981 and 490 neonate kittens have been handled at dens since 1992.

Thirty-three free-ranging panther deaths were documented during the reporting period including: six radiocollared panthers (5♂, 1♀) and 27 (16♂, 11♀) uncollared panthers. Causes of mortality included: 28 by vehicular trauma (16♂, 12♀), two from intraspecific aggression (2♂), three from unknown causes (3♂). Significant biomedical findings in necropsied panthers included an atrial septal defect (ASD; 1♂), encephalitis (1♂), leukoencephalomalacia (1♀), and dermatophytosis (1♂).

Panthers were confirmed to be involved in 47 depredation events during the reporting period. Animals killed or injured by panthers included: goats (31), calves (14), cat (8), sheep (5), miniature horse (5), donkey (3), turkey (3), goose (3), pigs (2), emu (1), and dog (1). A human-panther incident is defined as when a panther displays potentially threatening behavior to a human. One incident was confirmed by the Interagency Florida Panther Response Team during the reporting period.

Introduction

The Florida panther historically ranged throughout most of the southeastern United States from western Louisiana to the swamps of South Florida (Young and Goldman 1946; Onorato et al. 2010). Loss and fragmentation of wilderness and unregulated killing in the southeastern United States over the past two centuries reduced panthers to the point where only one population persisted at the tip of peninsular Florida by the mid-1900s (Onorato et al. 2010). Florida panthers were listed as endangered in 1967 by the Federal Government on the inaugural list of endangered plants and animals published in the Federal Register (Federal Register 1967). Subsequently, Florida panthers were afforded protection under the U.S. Endangered Species Act (Public Law No. 93-205) in 1973.

The Florida panther currently exists as a single population located in southern Florida and represents the only population of puma east of the Mississippi River. Panthers have been documented in 24 Florida counties based on occurrence records verified by FWC. A single, dispersing male panther was killed by a hunter in central Georgia near the Alabama state line in 2008. Telemetry, mortality, depredation, human interaction, and sighting records indicate that panthers currently are distributed into central Florida at least as far north as Interstate 4, but most of these records are transient adult or subadult males that are not part of a breeding population. From 1980 to 2017, all occurrence data demonstrated that female panthers were present only south of the Caloosahatchee River and most reproduction occurred in Collier, Hendry, Lee and Miami-Dade counties. On 15 January 2017, a lactating female panther was documented via trail cameras deployed on the Babcock Ranch Preserve in Charlotte County, Florida. FWC trail cameras subsequently documented a female with a minimum of two kittens on the Preserve on 15 March 2017 and several subsequent occasions that spring. A second female was documented with a trail camera on Platt Branch Wildlife and Environmental Area in Highlands County, Florida in March 2017 (FWC unpublished data). These were the first females that have been confirmed north of the Caloosahatchee River since a female was captured in Glades County in 1973 (Nowak and McBride 1974, FWC 2017). While this documentation of females north of the River is encouraging and has the potential

to have a major impact on recovery, it's prudent to remain cautiously optimistic given the varied hurdles panthers face when expanding range into portions of Florida north of the Caloosahatchee River.

Today, Florida panthers persist on < 5% of their historic range and are endangered by a combination of small population size, isolation, and loss of habitat (USFWS 2008a). Small population size and geographic isolation increase the chance for extinction of Florida panthers due to demographic instability inherent in small numbers and erosion of genetic diversity from restricted gene flow and inbreeding. Natural exchange of genetic material occurred historically among the Florida panther population in the southeastern United States and contiguous populations of *P. c. couguar* to the north, *P. c. hippolestes* to the northwest, and *P. c. stanleyana* to the west (Young and Goldman 1946). Genetic exchange between Florida panthers and other populations ceased as the Southeast was settled. Florida panthers steadily declined in abundance and distribution (Alvarez 1993), likely a result of persecution and habitat loss (but see Alvarez 1993, pp. 35-61, for competing theories on the decline of panthers). Gene flow is reliant upon individuals that immigrate and breed, but habitat fragmentation generally disrupts dispersal. Dispersal and immigration serve as a natural mechanism for mixing the gene pool and help minimize inbreeding within populations. Elevated levels of inbreeding can result in inbreeding depression, which can have varied implications for populations including: loss of genetic variation, declining health, reduced survivability, decreased fecundity, and an increased risk of extinction (Laikre et al. 1996, Crnokrak and Roff 1999, Frankham et al. 2002).

It was exactly such a scenario that was playing out in south Florida in the late 1980s and early 1990s (Roelke et al. 1993). Inbreeding depression, habitat loss, and isolation had taken their toll on the remaining population of panthers. The complex interplay of social, demographic, genetic, and health factors dictated that a timely and aggressive program be implemented to address the multitude of problems faced by the 20-30 Florida panthers that persisted into the early 1990s (McBride et al. 2008; Onorato et al. 2010). A plan for genetic restoration and management of the Florida panther was developed in September 1994 (Seal 1994; Johnson et al. 2010) and implemented in 1995 with the release of 8 female pumas initially captured in West Texas. Five of the 8 Texas pumas produced litters with

resident male Florida panthers and a minimum of 20 F_1 kittens were born in Florida as a result (Johnson et al. 2010; Onorato et al. 2010). None of the released Texas females remain in the wild today.

Assessment of the genetic restoration project has shown that this management program was successful and had a positive impact on the Florida panther population. Genetic variation has doubled, survival and fitness measures have improved, and physical correlates of inbreeding have declined significantly (Johnson et al. 2010; Hostetler et al. 2010). After genetic restoration, the panther population has increased in size from the 20-30 individuals that remained in the early 1990s (McBride et al. 2008). Using a combination of density estimates and estimates of available habitat in south Florida, the FWC has quantified the current panther population size (inclusive of independent aged panthers [i.e., adults and subadults]) to be within the range of 120-230 individuals (FWC Statement on Estimating Panther Population Size). Knowledge gained from the genetic restoration project will undoubtedly influence future management strategies for panthers and may have far reaching implications to varied conservation projects worldwide.

The FWC's current panther research and management priorities include, but are not limited to: monitoring genetic variation and correlates of inbreeding; evaluating the long-term impacts of genetic restoration; assessing the presence and impacts of diseases and parasites; delineating statistically robust methods to estimate the panther population size; evaluating the utility of new GPS collar technology; assisting with the development of new panther recovery criteria with USFWS, minimizing loss of existing panther habitat; addressing human-caused and other mortality factors; and reducing human-panther conflicts.

Our overall research goal is to complement historical data sets with ongoing, objective driven research to provide the information necessary to manage and conserve panthers. The melding of information on demographics, genetics, biomedical, and land management challenges has ultimately assisted in the implementation of effective management plans that have promoted the long-term survival and recovery of the panther in Florida.

Acknowledgements

FWC's panther research and management activities are funded almost entirely by the Florida Panther Research and Management Trust Fund (FPRMTF). This trust fund is supported principally by the sale of Florida panther license plates. The FWC panther research and management group would like to thank the citizens of Florida that continue to support our efforts to conserve and manage panthers via contributions to this fund. Specifics concerning the current financial status of the FPRMTF can be found at the end of this annual report.

We would like to acknowledge the following individuals, businesses, and agencies for their assistance provided to this project: Roy and Cougar McBride (Livestock Protection Company); Drs. Ashley Ayoob and Marc Havig (Animal Specialty Hospital of Naples [ASH], Naples, FL); Dr. Ray Ball (ZooTampa [ZT], Tampa, FL); Dr. Lizzy Arnett-Chin and Liz Harmon (Naples Zoo [NPZ], Naples, FL); Dr. Scott Citino and Karen Meeks (White Oak [WO], Yulee, FL); Dr. Justin Rosenberg and Jim Wellehan (University of Florida – College of Veterinary Medicine, Gainesville, FL); and David Shindle (USFWS) for assistance on varied aspects of panther fieldwork, management, and research collaborations. We thank staff at the Immokalee Ranch (IMR, Immokalee Florida) including employees of Barron Collier Companies and Collier Enterprises, for permitting the FWC Panther Team to conduct panther capture and research activities on the IMR during 2017 and 2018. We would also like to extend our appreciation to the staffs at BCNP, Big Cypress Seminole Indian Reservation (BCSIR), Collier Seminole State Park (CSSP), Corkscrew Regional Ecosystem Watershed (CREW), Corkscrew Swamp Sanctuary (CSS), Dinner Island Ranch Wildlife Management Area (DIWMA), EVER, Florida Panther National Wildlife Refuge (FPNWR), Fakahatchee Strand Preserve State Park (FSPSP), Immokalee Ranch, Lee County Port Authority (LCPA), Picayune Strand State Forest (PSSF), and Okaloacoochee Slough State Forest (OSSF)

for their continued cooperation and support of our research and management efforts. We thank Dr. Michael Warren (CA Pound Laboratory) for the forensic examination of panther skeletal remains, the Southeastern Cooperative Wildlife Disease Study (SCWDS) for identification of ticks removed from Florida panthers, and Mike Kinsella for the identification of helminths recovered at necropsy. White Oak and ZT continue to play vital roles in the care and rehabilitation of panthers for release back into the wild. Finally, we are deeply appreciative of the many folks involved in the efforts to save and care for injured or orphaned panthers, including staff from ASH, NPZ, Ellie Schiller Homosassa Springs Wildlife State Park (Homosassa, FL) and USFWS.

Study Area

The study area encompassed most of interior southern Florida south of Orlando and extended to southern EVER. The area included large blocks of low-lying public lands such as CREW, EVER, BCNP, FSPSP, PSSF, and the FPNWR. Significant private lands, primarily used for cattle and crop production, lie on higher terrain to the north of public lands and are important habitat for Florida panthers. The overall study area was divided into 3 Agency Monitoring Areas (AMA) for purposes of conducting aerial relocations and capture/recovery efforts. The FWC AMA was statewide excluding BCNP south of I-75 and EVER. The BCNP AMA encompassed the area within the BCNP boundary south of I-75. The EVER AMA encompassed the area within the EVER boundary.

Methods

Monitoring

FWC staff was responsible for capturing and fitting panthers with radiocollars, handling neonates at dens, recovering carcasses from the field and roadside within the FWC and EVER AMA, and obtaining aerial relocations (i.e., pinpointing panthers fitted with radio-transmitters from aircraft) three times per week within the FWC AMA. BCNP staff was responsible for these same activities within the BCNP AMA. Due to reductions in spending authority associated with the enactment of the U.S. Governments

Budget Control Act of 2011, aerial monitoring of panthers by BCNP staff has been discontinuous since 11 March 2013. During the fiscal year, FWC staff has periodically assisted with locating panthers within the BCNP-AMA when BCNP staff was unable to coordinate a regular flight schedule due to equipment availability or funding shortages. The EVER AMA is currently being monitored for the presence of panthers via trail cameras deployed by EVER personnel at various locations throughout the Park. Responsibility of conducting aerial relocations was coordinated between agencies for those panthers whose home ranges overlap AMAs.

Capture

Free-ranging Florida panthers were captured using trained-hounds and houndsmen provided by Livestock Protection Company (Alpine, TX). Panthers were either treed or bayed on the ground and were then darted with a 3 ml compressed-air dart fired from a CO_2-powered rifle. Panthers were immobilized with a combination of ketamine HCl (10 mg/kg; Doc Lane's Veterinary Pharmacy, Lexington, KY) and xylazine HCl (1 mg/kg; Doc Lane's Veterinary Pharmacy, Lexington, KY). Following immobilization, treed panthers were lowered to the ground by a rope or caught with a net; in some cases, a portable cushion (McCown, 1990) was used to further mitigate the impact of a fall. Propofol (PropoFlo™, Abbott Laboratories, Abbott Park, IL) was administered intravenously (IV) either as a bolus or continuous drip to maintain anesthesia. Midazolam HCl (0.03 mg/kg) was administered intramuscularly (IM) or IV to supplement anesthesia in some panthers. Panthers were left to recover in a shaded area away from water. In some cases, xylazine HCl was reversed with yohimbine HCl (Yobine®, Lloyd Inc., Shenandoah, IA) at ¼ its recommended dose.

Physical Examination

Vital signs (temperature, heart rate, respiration rate, and capillary refill time) and depth of anesthesia were monitored and recorded. A sterile petrolatum ophthalmic ointment (Puralube®, Pharmaderm, Melville, NY) was applied to the eyes for lubrication. All animals underwent a physical examination to assess general health and physical condition. For each panther handled, the skin over the

medial saphenous or cephalic vein was shaved, prepped, and an IV catheter (Abbocath®-T, Abbott Ireland, Sligo, Republic of Ireland) was aseptically placed. Sterile isotonic fluids were administered either subcutaneously (SQ) or IV.

Live-capture Sample Collection

Approximately 70-140 ml of blood (depending on body weight) were collected from the medial saphenous or cephalic veins using a butterfly catheter (19 or 21 ga), luer adapter/hub, and Vacutainer® tubes (approximately 30 ml in serum separator, 30 ml in EDTA, 10 ml in Na Heparin, and 3ml in red top, no additive; Becton Dickinson, Franklin Lakes, NJ). A 4 mm skin biopsy was aseptically collected from the distal pinnae of uncollared panthers and saved in 95% ETOH for DNA analysis. A triple antibiotic ointment was applied to each biopsy site. Hair was plucked from the ventral abdomen for DNA analysis and stored in paper coin envelopes. Other samples, such as bacterial cultures, skin scrapings, and diagnostic biopsies were taken if indicated. Blood smears were made in the field, or as soon as possible, from fresh whole blood. Panthers were implanted with a SQ transponder identification chip (Biomark®, Boise, ID), and were typically measured, and weighed.

Vaccination and Treatment

Depending on vaccine history and, in some cases, titers at previous capture, panthers >6 months old were vaccinated SQ against feline leukemia virus (FeLV), feline viral rhinotracheitis (FVR), feline calicivirus (FCV), feline panleukopenia (FPV) (Fel-O-Vax® LVK III + Calcivirus [FDAH], 1 ml, lower left leg), and rabies (Rabvac^{TM} 3 [FDAH], 1 ml, lower right leg). Depending on body condition, captured panthers were dewormed with ivermectin (0.1 mg/kg, Ivomec®, Merial Limited, Iselin, NJ) and praziquantel (5 mg/kg, Bimeda, Inc., Le Sueur, MN) administered SQ in the lateral aspect of right thigh. Cefovecin sodium (8mg/kg, Convenia®, Pfizer, Inc., New York, NY) and penicillin G procaine/benzathine (22,000 to 44,000 U/kg, Combi-Pen-48®, Bimeda, Inc., Le Sueur, MN) were administered as needed.

Neonatal Kittens

Neonatal kittens <6 weeks-of-age were handled according to Land et al. (1998) and marked with a SQ transponder identification chip. Pyrantel pamoate (5mg/kg, Columbia Laboratories, Lexington, KY) was administered orally and blood was collected from the jugular vein for CBC and serum chemistry if indicated. A 2 mm biopsy sample was aseptically collected from the distal end of each pinna and saved in 95% ETOH for DNA analysis. A triple antibiotic ointment was applied to each biopsy collection site.

Radiocollaring

Captured adult and subadult panthers were fitted with a very-high-frequency (VHF, Advanced Telemetry Systems [ATS], Inc., Isanti, Minnesota) or VHF/GPS (Lotek Wireless Inc., Ontario, Canada) radiocollar and monitored three times weekly (M, W, F) from a Cessna 172 fixed-wing aircraft (aerial relocations). Locations collected by FWC were recorded in the Universal Transverse Mercator coordinate system using customized software that incorporates positional information from digital orthophotographic quarterquads (geodetic referenced to North American Datum 83) loaded onto a Tablet PC linked to an external GPS unit. Mating and denning behavior; aggressive encounters among panthers; movements and home range shifts; dispersal, survival, recruitment, displacements and replacements of individuals; and other social and ecological interactions were interpreted from radiotelemetry data, field investigations, genetic analyses, or a combination of these data sets.

Necropsy

Florida panthers found dead were completely necropsied at the FWC Wildlife Research Laboratory (Gainesville, Florida). Panthers suspected to have been killed illegally were necropsied at the USFWS National Forensic Laboratory (Ashland, OR). When carcass condition allowed, tissue samples were collected at necropsy from all major organs. Fluids collected included heart blood, venous blood, thoracic blood, aqueous humor, and urine. Blood samples were centrifuged at 2000 rpm for 10 minutes and the supernatant was decanted. Representative tissues from fresh (unfrozen) and some previously frozen panthers were placed in 10% neutral buffered formalin. Fixed tissues were embedded in paraffin,

sectioned at 5 to 6 µm, and stained with hematoxylin and eosin. Tissues were microscopically examined by pathologists at the University of Florida – College of Veterinary Medicine (UF-CVM, Gainesville, FL), the Southeastern Cooperative Wildlife Disease Study (Athens, GA), the Bronson Animal Diagnostic Laboratory (Kissimmee, FL), or Northwest Zoopath (Monroe, WA). All tissues from live-captured and necropsied panthers not immediately analyzed were archived at –20° to –70°C.

Diagnostics

Whole blood in EDTA, serum, and diagnostic samples were shipped overnight to Antech Diagnostics (Farmingdale, NY) for a complete blood count (CBC), serum chemistry profile, and appropriate diagnostic procedures (culture, histopathology). Tissue biopsies for DNA analyses were stored at the FWC-Naples Field Lab.

Reciprocal antibody titers and/or presence of antigen in serum were determined for feline leukemia virus (FeLV, ELISA antigen), feline immunodeficiency virus/puma lentivirus (FIV/PLV; Western Blot, Kinetics ELISA, and peptide ELISA), feline rhinotracheitis virus (FVR, serum neutralization [SN]), feline calicivirus (FCV, SN), canine distemper virus (CDV, SN), and feline panleukopenia virus (FPL, SN) at the New York State Diagnostic Laboratory (Cornell University, Ithaca, NY, [NYSDL]). EDTA whole blood from panthers was tested for FeLV, FIV, and feline heartworm in the field using a rapid immunoassay (SNAP Combo, IDEXX Laboratories, Westbrook, ME). Panthers were also tested for FeLV at necropsy using thoracic, venous, or heart blood. Necropsied panthers were tested for rabies by direct fluorescent antibody test at the Jacksonville Central Laboratory (Jacksonville, FL) or Kansas State University (Manhattan, KS). Viral isolation and real-time and conventional PCR for CDV, pseudorabies virus (PRV), Flaviviruses, and Alphaviruses was performed at SCWDS on brain, heart, and other tissues collected from panthers dying of unknown causes. Quantitative PCR for PRV was performed at the Diagnostic Center for Animal and Population Health (DCAPH, Lansing, MI).

Toxicology (organic toxin screens by gas chromatography / mass spectrometry and anticoagulant rodenticide screens, lead) was performed at DCPAH and at the Florida Department of Environmental Protection (organochlorines, mercury, and polychlorinated biphenyls, Tallahassee, FL).

Results and Discussion

2017-2018 Panther Capture Season

Radiocollared Panthers

Telemetry data were collected on 17 radiocollared Florida panthers in southern Florida during the reporting period by FWC and BCNP staff (Figure 1). FWC staff radiocollared 3 panthers with ATS brand VHF collars and 1 panther with Lotek GPS Iridium radiocollar due to management actions. Two panthers, FP224 and FP250, were radiocollared and released from captivity back into the wild after medical treatment and recovery for injuries incurred during vehicle collisions. Panthers FP251 (K474) and FP252 (K476), kittens of FP224, were radiocollared and released from captivity with their dam. These panthers are discussed in more detail in the following sections. Minimum convex polygon home ranges for female and male panthers monitored by FWC during Fiscal Year (FY) 2017-2018 are depicted in Figures 2 and 3, respectively. A complete historical compilation of data associated with the 252 panthers captured since 1981 can be found in Appendix I.

Capture Results

No formal capture season was planned the 2017-2018 FY. Three panthers were opportunistically captured: radiocollared female (FP224) with 2 dependent kittens (K474 [FP251] and K476 [FP252]) in late December/early January (Table 1). A vehicle struck FP224 on 29 December 2017, resulting in a fractured left rear leg. This panther was captured via free-darting, received medical attention at the Animal Specialty Hospital of Naples (ASH), and was then transported to White Oak for convalescence. Cage traps were set 4 days later when photographic evidence revealed the presence of two of FP224s 7-month-old kittens near the collision site. These two kittens, eventually identified as FP251 and FP252, were captured using cage traps on 2 January 2018.

Biomedical Summaries of Florida Panthers Handled in 2017-2018

No significant capture-related injuries occurred during the handling of three panthers in the current FY. One of 33 (3%) necropsied panthers whose hearts were in suitable condition for examination had ASD. Defect diameter was 18.0 mm. Additional significant biomedical findings in necropsied panthers included encephalitis (1♂), leukoencephalomalacia (1♀), and dermatophytosis (1♂). No panthers were found to be cryptorchid, and no other congenital defects were observed. No live-captured or necropsied panthers tested positive for FeLV this fiscal year.

One adult female panther (FP224) was captured on 29 December 2017 following injury from vehicular collision. The panther was initially treated at a referral hospital and then transported to WO for continued medical care and rehabilitation. Two dependent male panther kittens (FP251[K474], FP252[K476]) of FP224 were subsequently captured on 2 January 2018 following the injury of their dam. The panthers were transported to WO and eventually reunited with FP224 prior to their release together in the PSSF on 10 April 2018.

Captive Florida Panthers

Florida panthers permanently in captivity this FY included: K180 and K181, 12.5 year-old female siblings at the Jacksonville Zoo (Jacksonville, FL); K255 (“Lucy”), a 10 year-old female at the ZT (Tampa, FL); K434, a 3 year old female kitten (“Mahala”) of FP219, at the Zoo Miami (Miami, FL); UCFP205 (“Yuma”), a 3.5 year old male at Ellie Schiller Homosassa Springs Wildlife State Park (Homosassa, FL); UCFP221 (“Uno”), a 5 year old male and K480 (“Athena”), a 1 year old female at NPZ (Naples, FL);UCFP253 (“Sassy”), a 2 year old female at the Palm Beach Zoo (West Palm Beach, FL); UCFP261 (“Sakata”), a 22 month old male at Ellie Schiller Homosassa Springs Wildlife State Park; UCFP297 (“Walter”), a 3 year old male at ZT (Tampa, FL).

Reproduction

FWC and NPS staff handled 10 kittens (5 males and 5 females) at four dens of four females from 1 July 2017 to 30 June 2018 (Table 2). Mean litter size for these dens was 2.50 (n = 4, SD = 0.29, range

= 2-3). The total number of dens located during the reporting period may have been negatively impacted by reduced monitoring efforts of NPS due to logistical and budget constraints and no formal FWC capture season, which resulted in a lower total number of monitored females. A historical compilation of data collected by FWC and NPS on Florida panther kittens handled at dens (1992-2018) and known dens of radiocollared females (1985-2018) can be found in Appendix II and III, respectively.

Florida Panther Mortality

Deaths of 33 free-ranging panthers were documented during the reporting period including: six (5♂, 1♀) radiocollared and 27 (16♂, 11♀) uncollared panthers (Table 3). Causes of mortality included 28 by vehicular trauma (16♂, 12♀), two from intraspecific aggression (2♂), three from unknown causes (3♂). A historical compilation of all recorded panther mortalities and injuries can be found in Appendix IV.

Management Activities

The increase in the panther population since 1995 and an increasing human population in South Florida has contributed to a rise in human-panther interactions. Depending upon the individual's perspective and the nature of the event, these interactions can be perceived as either positive or negative. Some people are pleased that we have a healthier, more resilient panther population because it means the panther's future is more secure than it was a few decades ago. Other people are concerned about potential panther encounters that may be a risk to public safety or property. Some ranchers and hobby livestock owners have lost livestock due to panther predation.

The public's perception of panthers and support for their conservation varies widely and can be greatly influenced by having experienced some type of interaction with a panther. Education and outreach remains a critical recovery action because conservation efforts will not be achieved without public support. Furthermore, private landowners will play a critical role in conserving panther habitat, which is essential for advancing panther recovery throughout its former range.

Florida Panther Response Plan Activity

Human-panther interactions and depredations of domestic animals are handled following protocols established in the Interagency Florida Panther Response Plan (USFWS 2008b). Confirmed interactions and depredations are expected to continue as human use and development increase near areas occupied by a stable or growing population of panthers. The efforts of FWC and our partners may be able to assist with mitigating some of these interactions. Confirmed human-panther interactions included one incident during the reporting period (Figure 4). An incident is classified as an unexpected direct meeting between a human and a panther where the panther displays *potentially threatening* behavior (USFWS 2008b). In addition to human-panther interactions, 47 depredation events involving domestic animals were confirmed (Figure 4). In some cases, multiple animals were killed during a single event. A depredation does not involve any direct contact with a human and is classified as an event where domestic livestock or pets are preyed upon by a panther (USFWS 2008b).

An incident poses a moderate to high risk to human safety. The one incident entailed a panther that was proximal to a goat it recently killed. Two people approached the goat on the ground, not knowing it was deceased, when the panther was startled out from its hiding place and ran off. As the panther ran out from underneath a Brazilian pepper bush, one of the people threw a bucket of feed at it, further hastening its retreat.

Depredations of domestic animals pose a low risk to human safety because there is typically no direct interaction between a human and a panther. However, panthers preying on hobby farm livestock (primarily goats), pets, and cow calves is an issue that was continually addressed. The majority (39) of depredation events occurred in Collier County, seven occurred in Hendry County, and one occurred in Lee County. Animals killed or injured by panthers included goats (31), calves (14), domestic cats (8), sheep (5), miniature horses (5), donkeys (3), turkeys (3), geese (3), pigs (2), emu (1), and domestic dog (1). Most of these depredations occurred in the Golden Gate Estates east of Naples (Collier County). Golden Gate Estates encompasses approximately 150 square miles and borders the FPNWR, PSSF, and CREW, all public lands occupied by panthers. Lot sizes range typically from 1-5 acres and most lots still

contain natural vegetation. Keeping livestock is permitted under local zoning codes. During depredation investigations, FWC staff provide technical assistance and advice to affected residents on ways they can reduce the risk to pets and hobby livestock. We recommend that hobby animals and pets be secured in barns or pens with roofs or kept indoors, especially at night when predators are typically more active. FWC has produced "A Guide to Living with Florida Panthers" brochure outlining these simple steps.

Land use, habitat impacts, environmental commenting and recovery tasks

Land use changes and development in or adjacent to panther habitat can have long term impacts on Florida panther recovery. FWC staff works cooperatively with state and federal partners to evaluate proposed developments, major road projects, and management plans for local, state, and federal public lands. These evaluations may include measures to avoid, minimize, or mitigate the effects of these projects on panthers.

Panther staff from both FWRI and ISM devoted a significant amount of staff time assisting the US Fish and Wildlife Service with a Florida panther Species Status Assessment (SSA). An SSA is essentially a biological risk assessment to aid decision makers who must use the best available scientific information to make policy-guided decisions. The SSA provides decision makers with a scientifically rigorous characterization of species status that focuses on the likelihood that the species will sustain populations within its ecological settings along with key uncertainties in that characterization. The SSA does not result in a decision directly, but it provides the best available scientific information for comparison to policy standards to guide ESA decisions. This panther SSA is a living document and will be updated as new panther information emerges over time.

Current Research

Research continues to be an important part of Florida panther conservation. Research proposals are vetted with FWC's partners to ensure that the research and monitoring efforts are well-designed, coordinated, and meet priority needs. FWC continues its protocol of disease monitoring and vaccination of all panthers handled as well as monitoring the genetic health of the population via DNA analyses

contracted to the National Genomics Center for Wildlife and Fish Conservation (U.S. Forest Service, Rocky Mountain Research Station, Missoula, MT). During FY2017-2018, FWC obtained genotype data at 16 microsatellite loci from 94 contemporary samples. The FWC is currently involved in several collaborative research projects focusing on issues related to Florida panther conservation and management. Among these are: a population viability analysis that includes individual-based models; assessing levels of genetic variation amongst population of pumas using whole genome sequencing; determining mortality factors; assessing the efficacy of panther rehabilitation; analyzing the long-term benefits accrued to panthers via genetic restoration; evaluating the diet of panthers from scat and stomach contents; using camera trap data to assess differences in panther density between public and private lands; assessing the incident of infectious disease (e.g. dermatophytosis and Leptospirosis) in free-ranging panthers; assessing novel diagnostic tests to evaluate for underlying disease. Research projects involving FWC are also playing an integral role on several sub-teams of the USFWS Panther Recovery Implementation Team in hopes of improving science involved with monitoring progress towards recovery.

FWC assisted with the completion of several collaborative research projects during FY 2017-18 including: movement patterns and rates of panthers determined via GPS collars; surgery on long bone fractures in panthers. Agency staff served as lead or co-authors on two peer-reviewed publications and two published abstracts that were presented at professional conferences or invited seminars (see page 19).

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*Authors in bold represent current FWC panther staff.

Table 1. Florida panthers captured by the Florida Fish and Wildlife Conservation Commission from 1 July 2017 to 30 June 2018.

Panther ID[a]	Sex	Capture Date	Capture Location[a]	Age (yrs)[b]	Wt. (lbs)	Collar type - brand, model	Comments[c]
FP224	F	12/29/2017	Naples	5.5	94	ATS VHF	Hit by vehicle, injured. One fracture surgically repaired. Rehabilitated at White Oak. Released 10 Apr 2018 in PSSF. Yellow collar.
FP251	M	1/2/2018	Naples	7 mo.	30	ATS VHF	Dependent kitten of FP224. Rehabilitated at White Oak. Released 10 Apr 2018 in PSSF. Brown collar.
FP252	M	1/2/2018	Naples	7 mo.	30	ATS VHF	Dependent kitten of FP224. Rehabilitated at White Oak. Released 10 Apr 2018 in PSSF. Green collar.

[a] FP224, FP251 and FP252 were captured in a woodlot near the intersection of Collier Blvd. and City Gate Blvd. in Naples.
[b] mo. = months
[c] PSSF = Picayune Strand State Forest

Table 2. Neonate kittens handled at Florida panther dens by the Florida Fish and Wildlife Conservation Commission and the National Park Service from 1 July 2017 to 30 June 2018.

FP Dam	Kitten ID	Sex	Den location[a]	Date handled	Estimated age in days	Actual weight (grams)
FP239	K481	F	SBCNP	8/19/2017	28	1729
FP239	K482	M	SBCNP	8/19/2017	28	1758
FP247	K483	F	Immokalee Ranch	10/14/2017	23	1600
FP247	K484	M	Immokalee Ranch	10/14/2017	23	1300
FP220	K485	F	SBCNP	3/19/2018	29	2353
FP220	K486	M	SBCNP	3/19/2018	29	2268
FP220	K487	F	SBCNP	3/19/2018	29	2438
FP246	K488	F	Immokalee Ranch	6/16/2018	26	2000
FP246	K489	M	Immokalee Ranch	6/16/2018	26	1900
FP246	K490	M	Immokalee Ranch	6/16/2018	26	2050

[a] SBCNP = Big Cypress National Preserve South of Interstate 75.

Table 3. Verified Florida panther mortalities and injuries recorded between 1 July 2017 and 30 June 2018. Data collected by FWC and BCNP staff. Causes of death include hit-by-car (HBC), intraspecific aggression (ISA), and unknown (U). The presence of atrial septal defects (ASD) and other biomedical and morphometric data are also noted. Sex is male (M), female (F), or unknown (U) and age is in years, months (mo.), or weeks (wks.). Some characteristics were not determined (nd) or not applicable (NA) to specific panthers.

Panther ID	Sex	Date deceased	Cause	Location	Age[a] (yr)	Weight (lbs.)	Kinked tail	Cowlick	ASD	Testes	Rabies FA[b]	Significant necropsy results
UCFP311	M	7/3/2017	HBC	Immokalee Rd, Collier Co.	5	117	N	Y	N	2	N	Encephalitis, injuries consistent with vehicular trauma.
UCFP312	F	7/18/2017	HBC	CR951, Collier Co.	2.5	71	N	N	N	NA	N	Interstitial nephritis, injuries consistent with vehicular trauma.
FP248	F	8/2/2017	HBC	Corkscrew Rd, Collier Co.	3	80	N	Y	N	NA	nd	Cellulitis associated with non-healing surgical wound, Pythium (anal sac), leukoencephalomalacia.
FP234	M	8/13/2017	HBC	I75, Collier Co.	12	85.2	N	Y	nd	NA		Injuries consistent with vehicular trauma.
UCFP313	M	8/14/2017	ISA	CREW, Lee Co.	2	46	N	Y	N	nd	N	Injuries consistent with ISA.
UCFP314	M	8/18/2017	HBC	Ft. Denaud Rd, Hendry Co.	1.5	81	N	N	N	2	N	Injuries consistent with vehicular trauma.
UCFP315	F	8/24/2017	HBC	CR846, Collier Co.	1	50	N	Nd	nd	nd	nd	Carcass was lost due to freezer failure during Hurricane Irma
FP244	M	8/28/2017	U	DIWMA, Hendry Co.	7	118	Y	N	nd	nd	U	Under investigation
UCFP316	M	9/16/2017	HBC	SR98, Highlands Co.	3.5	134	N	N	N	2	nd	Injuries consistent with vehicular trauma.
UCFP317	F	10/15/2017	HBC	CR835, Hendry Co.	1.5	57.8	N	N	N	NA	nd	Injuries consistent with vehicular trauma

Panther ID	Sex	Date deceased	Cause	Location	Age[a] (yr)	Weight (lbs.)	Kinked tail	Cowlick	ASD	Testes	Rabies FA[b]	Significant necropsy results
K411	M	11/7/2017	HBC	Immokalee Rd, Collier Co.	3.7*	129.6	N	N	N	2	N	Injuries consistent with vehicular trauma.
UCFP318 (K364)	M	11/13/2017	HBC	CR833, Hendry Co.	6*	134.6	N	N	N	2	nd	Injuries consistent with vehicular trauma.
FP249	M	11/20/2017	HBC	CR833, Hendry Co.	2	90	N	N	N	2	N	Injuries consistent with vehicular trauma.
UCFP319	M	11/23/2017	HBC	Daniels Pkwy, Lee Co.	2	85.6	Y	N	N	2	N	Injuries consistent with vehicular trauma
UCFP320	M	12/9/2017	HBC	Desoto Blvd, Collier Co.	3mo.	11.6	N	N	N	2	N	Injuries consistent with vehicular trauma.
UCFP321	M	12/20/2017	ISA	SR78, Glades County	2-3	nd	N	N	N	nd	nd	Injuries consistent with ISA.
PC1144	F	1/7/2018	HBC	I75, Collier Co.	4-5 mo.	17	N	N	N	NA	U	Injuries consistent with vehicular trauma
UCFP322	F	1/8/2018	HBC	Josie Billie Hwy, Hendry Co.	3-4	94	N	N	N	NA	U	Injuries consistent with vehicular trauma
UCFP323	M	1/13/2018	HBC	Immokalee Rd, Collier Co.	1.5	102	N	N	Y	2	N	Atrial septal defect, injuries consistent with vehicular trauma.
UCFP324	M	1/30/2018	HBC	SR80, Hendry Co.	2.5	60.2	nd	nd	nd	nd	2	Injuries consistent with severe vehicular trauma.
UCFP325	F	2/2/2018	HBC	CR835, Hendry Co.	3	70.8	Y	N	nd	NA	nd	Necropsy by USFWS
UCFP326	F	2/3/2018	HBC	CR835, Hendry Co.	5mo.	28.2	N	Y	N	NA	nd	Injuries consistent with vehicular trauma.
UCFP327	M	2/5/2018	HBC	Immokalee Rd, Collier Co.	4mo.	20	N	N	nd	2	nd	Injuries consistent with vehicular trauma.

Panther ID	Sex	Date deceased	Cause	Location	Age[a] (yr)	Weight (lbs.)	Kinked tail	Cowlick	ASD	Testes	Rabies FA[b]	Significant necropsy results
UCFP328	F	2/19/2018	HBC	Immokalee Rd, Collier Co.	5-6	62.4	N	N	nd	NA	nd	Injuries consistent with vehicular trauma.
UCFP329	M	2/22/2018	HBC	US27, Hendry Co.	2	99.6	N	N	N	2	nd	Injuries consistent with vehicular trauma.
UCFP330	F	2/28/2018	HBC	SR 29, Collier Co.	5-6	75.6	N	N	N	NA	N	Injuries consistent with vehicular trauma.
UCFP331	F	2/28/2018	HBC	CR846, Collier Co.	3	73	Y	N	N	NA	N	Injuries consistent with vehicular trauma.
FP245	M	3/14/2018	U	Immokalee Ranch, Hendry Co.	7	70	N	N	**	2	nd	Severely decomposed and scavenged
FP236	M	3/21/2018	U	Rock Rd, Collier Co.	9-10	82	N	N	N	2	N	Generalized dermatophytosis and pyoderma, atrophy of body fat.
UCFP332	F	4/3/2018	Vehicle	SR 82, Collier Co.	3	77.4	N	N	N	NA	nd	Injuries consistent with vehicular trauma.
UCFP333	M	5/18/2018	Vehicle	I-75, Collier Co.	2.5	83.8	Y	N	N	2	nd	Injuries consistent with HBC although there were also injuries likely due to recent ISA.
UCFP334	M	6/20/2018	Vehicle	CR833, Hendry Co.	9mo.	50.6	N	N	nd	2	nd	Injuries consistent with vehicular trauma.
UCFP335	M	6/25/2018	Vehicle	SR29, Collier Co.	2	89.8	N	N	N	2	N	Injuries consistent with vehicular trauma.

[a] Ages of panthers followed by * were of known age due to initial handling and marking at the natal den.
[b] Rabies FA= Direct Fluorescent antibody test; u = tested but tissue condition was unsatisfactory for definitive diagnosis, nt = not tested, N = negative.

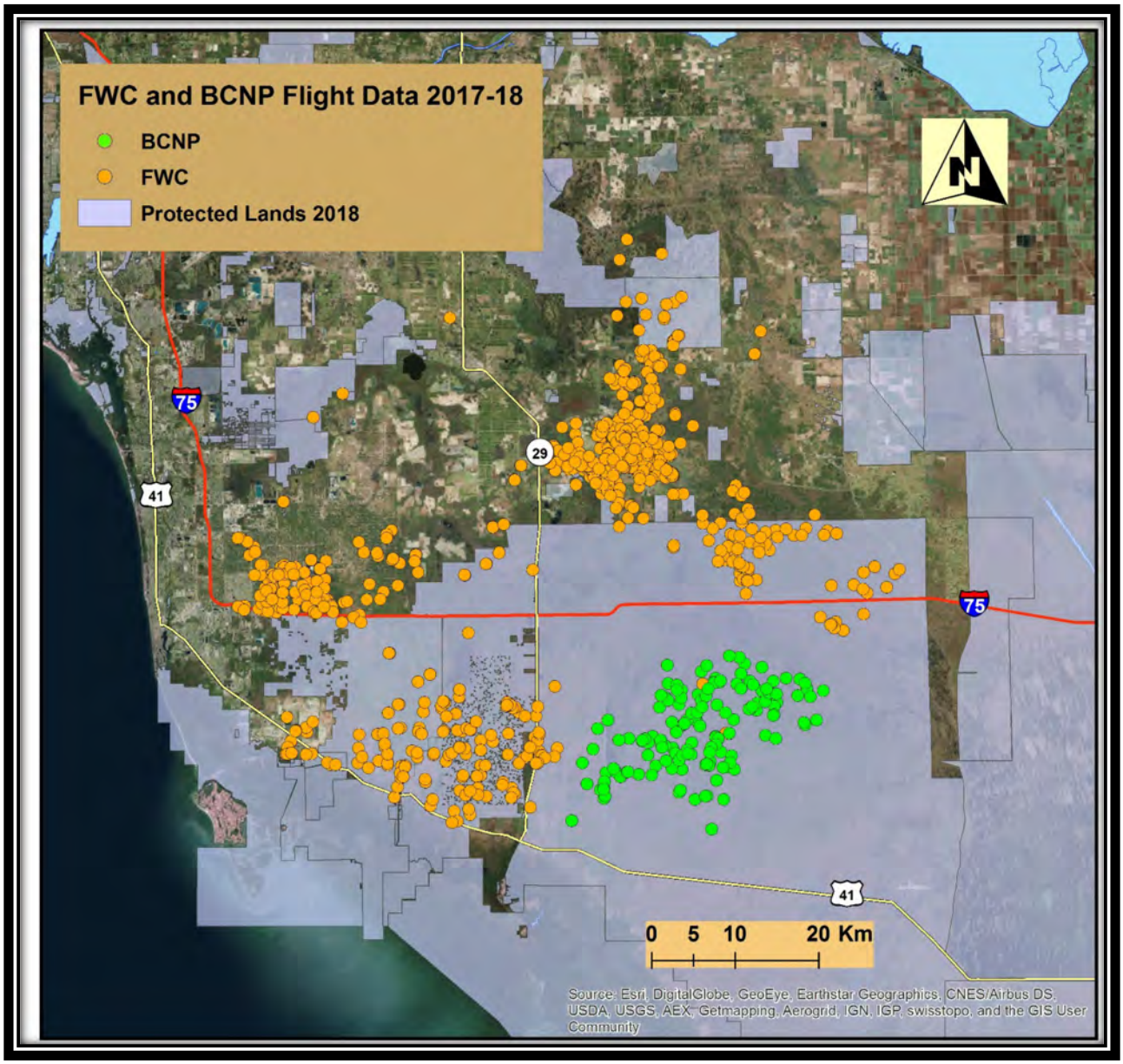

Figure 1. Locations of all radiocollared Florida panthers in southern Florida from 1 July 2017 to 30 June 2018. Data collected via aerial telemetry by FWC and NPS.

Figure 2. Depiction of the 100% minimum convex polygon home ranges for adult female Florida panthers monitored by FWC from 1 July 2017 to 30 June 2018. Data collected via aerial telemetry by FWC.

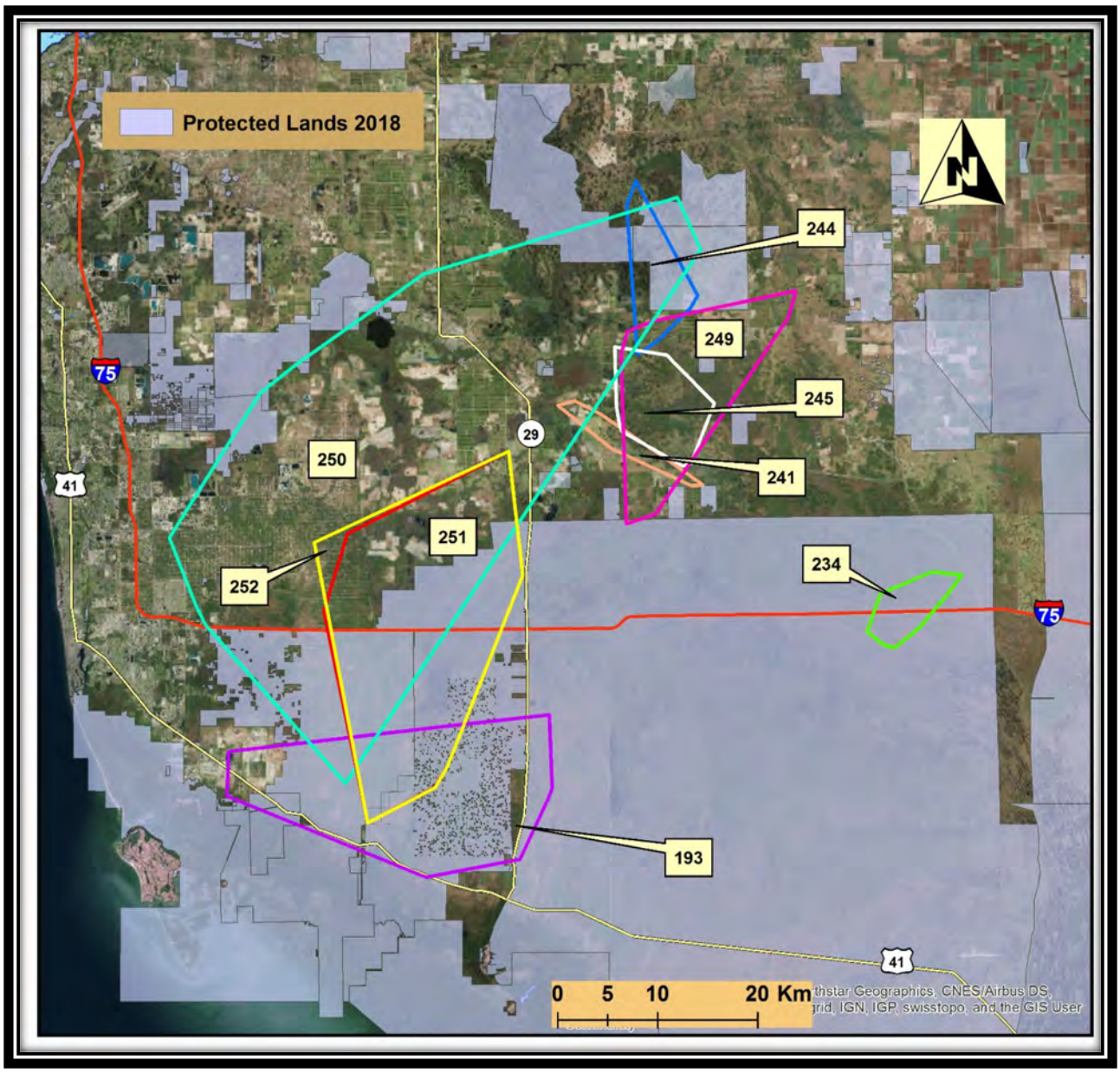

Figure 3. Depiction of the 100% minimum convex polygon home ranges for adult and subadult male Florida panthers monitored by FWC from 1 July 2017 to 30 June 2018.

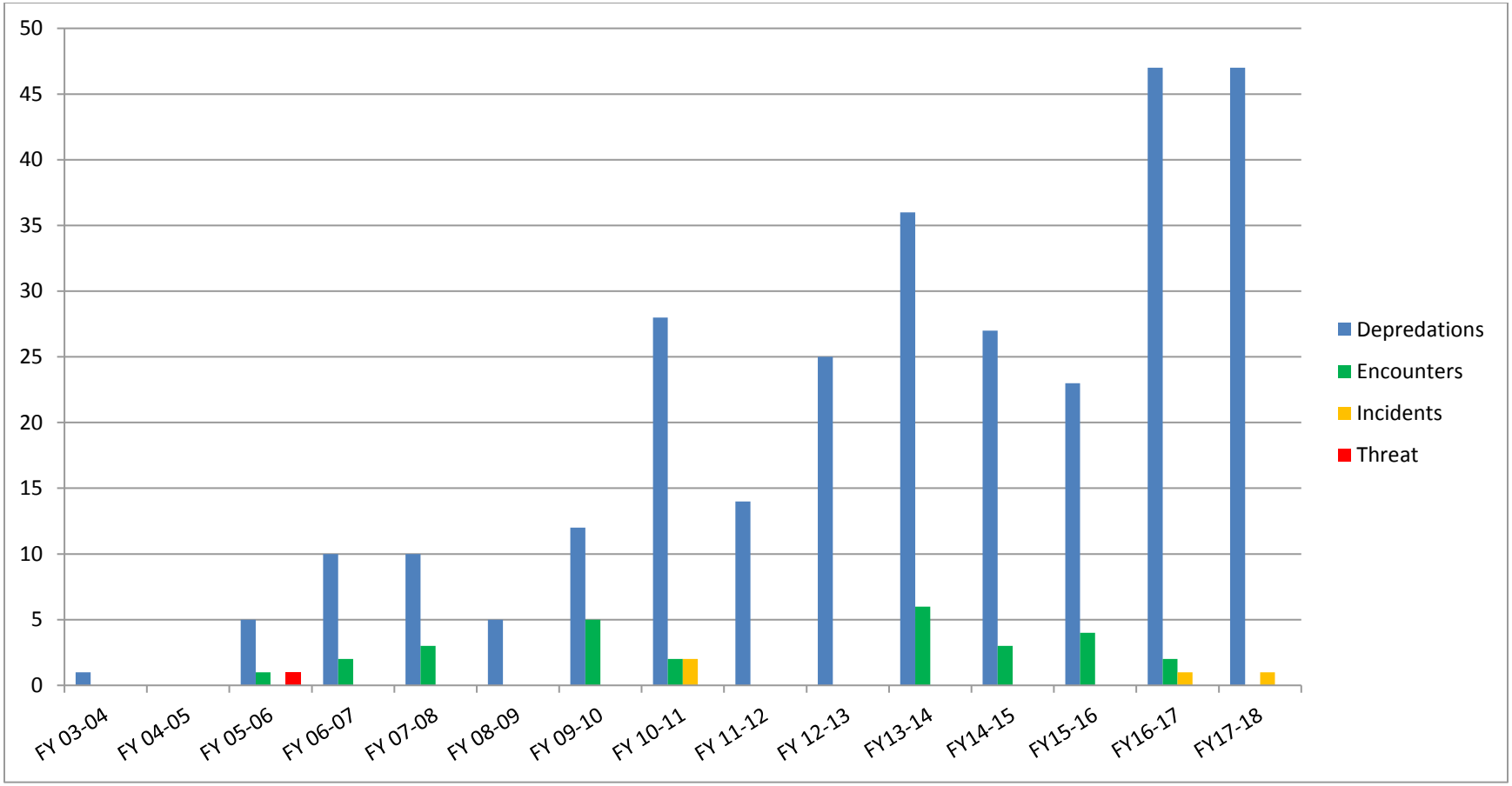

Figure 4. Confirmed human-panther interactions from FY 2003-2004 through 2017-2018. Note: Data in FY 2011-2012 and FY 2012-2013 includes five and six depredations of domestic animals, respectively, that involved radiotagged calves monitored as part of the UF-IFAS calf mortality study (Jacobs and Main 2015). Definitions of conflict categories can be found in Appendix C of the USFWS Environmental Assessment for the "Interagency Florida Panther Response Plan".

Appendix I. List of radiocollared Florida panthers and Texas pumas in southern Florida from 10 February 1981 to 30 June 2017. Data includes panthers captured by FWC and BCNP staff.

Panther ID[a]	Sex	Capture date	Estimated age at first capture	Birth date	Dam	Purported sire	Use area[b]	Death date	Cause of death[c]
FP01	M	10 Feb 1981	10	-	-	-	FSPSP	14 Dec 1983	Vehicle (SR 84 mm 18)
FP02	M	20 Feb 1981	10	-	-	-	FSPSP	28 Nov 1984	Intraspecific aggression
FP03	F	23 Jan 1982	9	-	-	-	FSPSP	17 Jan 1983	Capture
FP04	M	27 Jan 1982	7-8	-	-	-	FSPSP	18 Apr 1985	Vehicle (SR 84 mm17)
FP05	F	23 Feb 1982	7-8	-	-	-	FPNWR	18 Nov 1983	Unknown
FP06	M	27 Feb 1982	6-8	-	-	-	SBCNP	16 Apr 1982	Unknown
FP07	M	02 Mar 1982	6-7	-	-	-	SBCNP, FSPSP	26 Oct 1985	Vehicle (SR 29 C. prison)
FP08	F	25 Mar 1984	9-10	-	-	-	FSPSP	20 Aug 1988	Liver failure, old age
FP09	F	26 Jan 1985	3-4	-	-	-	FSPSP	♦	Collar failed 8/8/1997
FP10	M	15 Jan 1986	5 mo.	Aug 1985	FP09	-	GG Estates, FSPSP	27 Jan 1987	Intraspecific aggression
FP11	F	21 Jan 1986	4-5	-	-	-	NBCNP, Private (Price's)	25 Feb 2001	Intraspecific aggression
FP12	M	28 Jan 1986	5	-	-	-	NBCNP, FPNWR, FSPSP	8 Nov 1994	Intraspecific aggression
FP13	M	27 Feb 1986	4-5	-	-	-	NBCNP, Private (Alico)	14 Dec 1987	Vehicle (SR 29 Sunniland)
FP14	F	07 Dec 1986	5-6	-	-	-	EVER	21 Jun 1991	Unknown
FP15	F	13 Dec 1986	5-6	-	-	-	EVER	10 Jun 1988	Intraspecific aggression
FP16	M	12 Jan 1987	12-14 mo.	-	FP14	-	EVER, SBCNP	3 Jan 2000	Unknown
FP17	M	20 Jan 1987	6-7	-	-	-	SBCNP, NBCNP	20 Jul 1990	Unknown
FP18	F	22 Jan 1987	7-8	-	-	-	Private (Gum Swamp, Scofields), BCSIR	1 Oct 1990	Intraspecific aggression
FP19	F	09 Feb 1987	9 mo.	May 1986	FP11	FP12	NBCNP, Private (Prices), FPNWR	2 Dec 1997	Aortic aneurysm
FP20	M	10 Mar 1987	3-4	-	-	-	Private (Alico), NBCNP	24 Aug 1988	Heart defect

Panther ID[a]	Sex	Capture date	Estimated age at first capture	Birth date	Dam	Purported sire	Use area[b]	Death date	Cause of death[c]
FP21	F	16 Mar 1987	12-14 mo.	-	FP14	-	EVER, White Oak	26 Dec 1997	Vehicle/Captivity/Old age
FP22	F	18 Mar 1987	5-6 mo.	-	FP15	-	EVER	20 Jul 1991	Infection
FP23	F	18 Mar 1987	5-6 mo.	-	FP15	-	EVER, SBCNP	25-26 Nov 2000	Unknown
FP24	M	30 Jan 1988	3-4	-	-	-	Highlands Co.	22 Aug 1988	Unknown
FP25	M	16 Feb 1988	4-5	-	-	-	FPNWR	26 Aug 1988	Intraspecific aggression
FP26	M	01 Mar 1988	5-6	-	-	-	BCSIR, NBCNP	8 Jul 1994	Intraspecific aggression
FP27	F	11 Apr 1988	2-3	-	-	-	EVER	23 Jul 1989	Unknown
FP28	M	29 Nov 1988	1.5	-	-	-	Private (Ft. Myers, Lake Hicpochee, Gum Swamp), NBCNP	25 Sep 1992	Intraspecific aggression
FP29	M	03 Jan 1989	6.5 mo.	May 1988	FP11	FP20	NBCNP, Private (Gum Swamp)	27 May 1992	Pseudorabies
FP30	M	06 Jan 1989	9 mo.	Mar 1988	FP19	FP13	NBCNP, Private (Prices), FPNWR, FSPSP	29 Jan 1990	Intraspecific aggression
FP31	F	12 Jan 1989	7-9	-	-	-	FPNWR	3 Mar 1994	Vehicle (SR 29 Sunniland)
FP32	F	03 Feb 1989	2-2.5	-	-	-	FPNWR	12 Sep 2002	Unknown
FP33	M	05 Mar 1989	1.5-2	-	-	-	SBCNP (Loop Rd.), Private (Gum Swamp)	23 Nov 1989	Rabies
FP34	M	08 Jan 1990	10 mo.	Mar 1989	FP31	FP12	FPNWR, BCSIR, Private (Gum Swamp)	15 Nov 1993	Esophageal puncture
FP35	M	15 Jan 1990	10 mo.	Mar 1989	FP31	FP12	Private (Regency Farms)	24 Jan 1990	Bacterial infection from capture
FP36	F	27 Jan 1990	4-5	-	-	-	NBCNP	10 Oct 1998	Unknown natural causes
FP37	M	30 Jan 1990	3-4	-	-	-	FSPSP, FPNWR, NBCNP	26 Nov 1990	Vehicle (SR 29 Miles City)
FP38	F	08 Feb 1990	4.5	-	-	-	SBCNP, EWMA	4 Aug 1994	Pleuritis in chest
FP39	M	19 Feb 1990	3-4	-	-	-	EVER	18 May 1990	Pyothorax
FP40	F	26 Feb 1990	1.5-2	-	-	-	NBCNP	1 Feb 1998	Intraspecific aggression
FP41	F	28 Feb 1990	1.5-2	-	-	-	NBCNP, BCSIR	22 Sep 1990	Intraspecific aggression
FP42	M	06 Mar 1990	11 mo.	May 1989	FP14	FP16	EVER, SBCNP	22 Jun 1995	Unknown
FP43	M	01 May 1990	9.5 mo.	Jul 1989	FP19	FP12	FPNWR, NBCNP	31 Oct 1991	Intraspecific aggression

Panther ID[a]	Sex	Capture date	Estimated age at first capture	Birth date	Dam	Purported sire	Use area[b]	Death date	Cause of death[c]
FP44	M	30 Apr 1991	6 mo.	Nov 1990	FP40	FP26	NBCNP, Naples, EVER, SBCNP	6 Jul 1993	Intraspecific aggression
FP45	M	08 May 1991	6 mo.	Nov 1990	FP19	FP12	FPNWR, NBCNP, BCSIR	2 Aug 1998	Intraspecific aggression
FP46	M	30 Jan 1992	2-2.5	-	-	-	NBCNP, Private (Gum Swamp), OSSF	3 Feb 1999	Intraspecific aggression
FP47	M	21 Feb 1992	6 mo.	Jul 1991	FP11	FP12	NBCNP, Belle Meade, FSPSP	19 Feb 1993	Intraspecific aggression
FP48	F	24 Feb 1992	4 mo.	Oct 1991	FP31	FP12	NBCNP	23 Oct 2006	Unknown
FP49	F	25 Feb 1992	2	-	-	-	NBCNP	3 Jan 2002	Intraspecific aggression
FP50	M	04 Mar 1992	8 mo.	May 1991	FP36	FP26	NBCNP, Private (Alico, Devils Garden)	6 Dec 1993	Vehicle (CR 846 5 mi E of Immokalee)
FP51	M	26 Mar 1992	3	-	-	-	FSPSP, FPNWR	17 Jul 1998	Vehicle (SR 29)
FP52	F	05 May 1992	6 mo.	Oct 1991	FP31	FP12	FPNWR, Private (Sadie Cypress)	14 Jan 1995	Vehicle (CR 846 & Dupree Rd)
FP53	M	10 Feb 1993	10 mo.	Apr 1992	FP19	FP12	FPNWR	26 Feb 1993	Intraspecific aggression
FP54	M	10 Feb 1993	10 mo.	Mar 1992	FP40	-	FSPSP, FPNWR	♦	Collar failed 10/20/2000
FP55	F	25 Jan 1994	1.1.	Dec 1992	FP23	FP42	SBCNP	12 July 2004	Intraspecific aggression
FP56	F	03 Feb 1994	2-3	-	-	-	NBCNP	♦	Collar failed 2/20/1998
FP57	F	31 Jan 1995	3	-	-	-	FPNWR, FSPSP	♦	Collar failed 4/5/2000
FP58	M	08 Feb 1995	8 mo.	Apr 1994	FP56	-	NBCNP, FPNWR, FSPSP	30 Mar 1997	Intraspecific aggression
FP59	M	04 Jan 1996	6 mo.	Jun 1995	FP48	-	NBCNP, FPNWR, FSPSP	22 Nov 2004	Intraspecific aggression
FP60	M	06 Mar 1996	5 mo.	Oct 1995	FP40	-	NBCNP, FSPSP, FPNWR, SBCNP	14 Dec 2008	Euthanasia (Removed from wild 6/29/2004)
TX101	F	05 Apr 1995	4	-	-	-	BCSIR	29 Mar 2000	Unknown
TX102	F	05 Apr 1995	4	-	-	-	E. Hendry County	22 Sep 1995	Vehicle (CR833 5 mi. N BCSIR)
TX103	F	04 May 1995	4	-	-	-	SBCNP	19 Aug 1999	Metabolic complications from pregnancy
TX104	F	24 Mar 1995	4	-	-	-	FSPSP, Belle Meade	18 Apr 1998	Gunshot
TX105	F	05 Jul 1995	4	-	-	-	EVER	1 July 2014	Renal failure (removed from wild 1/27/2003)
TX106	F	09 Apr 1995	4	-	-	-	PSSF, FPNWR, FSPSP	13 Mar 2012	Cancer (Removed from wild 1/8/2003)

Panther ID[a]	Sex	Capture date	Estimated age at first capture	Birth date	Dam	Purported sire	Use area[b]	Death date	Cause of death[c]
TX107	F	04 May 1995	3	-	-	-	SBCNP	18 Jan 2001	Pneumonia
TX108	F	26 Jul 1995	3	-	-	-	EVER	5 Feb 2014	Removed from wild 11/18/2002
FP61	F	04 Mar 1997	8 mo.	Jul 1996	TX108	FP16	EVER	♦	Collar failed 6/4/2003
FP62	M	18 Mar 1997	6.5 mo.	Sep 1996	FP48	-	Catfish Creek, Polk Co.	♦	Collar failed 7/21/2000
FP63	M	13 Apr 1997	2	-	-	-	BCSIR, NBCNP, Private Lands	15 Jan 2000	Vehicle / Drowning
FP64	M	24 May 1997	8 mo.	Sep 1996	FP48	-	CREW (Corkscrew Marsh)	26 Mar 1999	Intraspecific aggression
FP65	M	19 Nov 1997	11 mo.	Dec 1996	TX101	FP45	OSSF, Private (Collier Enterprise)	♦	Collar failed 11/17/2010
FP66	F	09 Dec 1997	1	Dec 1996	TX101	FP45	Belle Meade, FPNWR, Private Lands	3 Sept 2014	Removed from wild 4/13/2014
FP67	F	19 Jan 1998	8 mo.	Jun 1997	FP56	FP45	BCSIR, Private Lands	15 Jan 2003	Intraspecific aggression (FP65)
FP68	M	23 Jan 1998	4.5	-	-	-	NBCNP	1 Mar 2000	Unknown (possible ISA)
FP69	F	05 Feb 1998	9 mo.	May 1997	FP40	FP45	NBCNP	12 Sep 2005	Unknown
FP70	F	25 Feb 1998	10 mo.	May 1997	TX107	-	SBCNP	14 Jan 2006	Vehicle
FP71	F	05 Mar 1998	10 mo.	May 1997	TX107	-	SBCNP	♦	Collar failed 7/22/2005
FP72	M	24 Apr 1998	2.5	-	-	-	BCSIR	23 Dec 1998	Intraspecific aggression
FP73	F	12 Nov 1998	3	Sep 1995	TX101	-	BCSIR	27 June 2003	Unknown
FP74	M	12 Nov 1998	1.5	-	FP73	-	Fisheating Creek, Glades and Highlands Co.	8 Sep 1999	Vehicle (SR 27 north of Palmdale)
FP75	F	11 Jan 1999	7 mo.	Jun 1998	FP48	FP68	NBCNP	♦	Collar failed 4/5/2006
FP76	M	13 Jan 1999	22 mo.	-	-	-	FPNWR, SBCNP	13 Nov 1999	Intraspecific aggression (FP54)
FP77	F	22 Jan 1999	1.5-2	-	-	-	NBCNP, BCSIR	12 July 2003	Unknown
FP78	F	16 Feb 1999	2.0	-	-	-	FPNWR	17 Oct 2002	Intraspecific aggression
FP79	M	03 Mar 1999	3.5	Sep 1995	TX101	-	SBCNP	31 Aug 2012	Removed from wild 2/21/2006
FP80	F	14 Jan 2000	4.0	-	-	-	BCSIR	10 Feb 2000	Vehicle (BCSIR)
FP81	M	14 Jan 2000	4.0	-	-	-	BCSIR, Hendry Co. Private Lands	♦	Collar failed 9/16/2002

Panther ID[a]	Sex	Capture date	Estimated age at first capture	Birth date	Dam	Purported sire	Use area[b]	Death date	Cause of death[c]
FP82	F	25 Jan 2000	3.0	-	-	-	OSSF	9 May 2003	Unknown (possible ISA)
FP83	F	08 Feb 2000	8 mo.	Jun 1999	TX106	FP54	FSPSP	25 Mar 2011	Vehicle (US41)
FP84	M	11 Feb 2000	1.0	-	FP73	-	Dispersed from BCSIR to Fisheating Creek	20 Apr 2000	Unknown
FP85	M	17 Feb 2000	10-11 mo.	Mar 1999	FP61	FP16	EVER	1 Mar 2004	Unknown
FP86	F	21 Feb 2000	8 mo.	Jun 1999	FP71	FP79	SBCNP	7 Nov 2003	Spinal trauma
FP87	F	28 Feb 2000	10 mo.	Apr 1999	FP55	FP79	SBCNP	19 Jun 2003	Intraspecific aggression
FP88	F	02 Mar 2000	9 mo.	Jun 1999	FP70	FP79	SBCNP	♦	Collar failed 10/18/2002
FP89	M	02 Mar 2000	2.5	-	-	-	SBCNP	9 Nov 2000	Intraspecific aggression
FP90	M	08 Mar 2000	9 mo.	Jun 1999	FP71	FP79	SBCNP	26 April 2001	Vehicle (US27 Terrytown)
FP91	F	17 Mar 2000	9 mo.	Jun 1999	FP70	FP79	SBCNP	12 Dec 2003	Intraspecific aggression
FP92	M	06 Apr 2000	10 mo.	Jun 1999	FP70	FP79	SBCNP, Belle Meade, CREW	16 Sep 2001	Unknown
FP93	F	10 Apr 2000	14 mo.	Feb 1999	TX107	FP79	SBCNP	2 Dec 2015	Unknown
FP94	F	01 May 2000	10 mo.	Jul 1999	TX105	FP16	EVER	♦	Collar released 4/16/2007
FP95	F	07 Nov 2000	2.8	Jan 1998	TX108	FP16	EVER	♦	Collar failed 1/9/2008
FP96	M	07 Jan 2001	9 mo.	Apr 2000	FP78	FP59	FPNWR	17 Jan 2002	Intraspecific aggression
FP97	M	19 Jan 2001	11 mo.	-	FP105	-	FPNWR	2 Dec 2001	Intraspecific aggression
FP98	M	25 Jan 2001	3	-	-	-	NBCNP, Hendry Co. Private Lands	1 July 2002	Vehicle (SR29 N of Pistol Pond)
FP99	M	26 Jan 2001	11 mo.	-	FP105	-	FPNWR	28 Nov 2002	Vehicle (CR846 Collier fairgrounds)
FP100	M	31 Jan 2001	4	-	-	-	NBCNP, BCSIR	25 Jan 2007	Unknown
FP101	F	5 Feb 2001	2	-	-	-	NBCNP, BCSIR	♦	Collar failed 10/17/2003
FP102	F	20 Feb 2001	3	Feb 1998	FP55	-	SBCNP	23 Oct 2010	Intraspecific aggression
FP103	F	13 Mar 2001	8 mo.	Aug 2000	FP102	-	SBCNP	8 Aug 2007	Intraspecific aggression
FP104	M	2 Apr 2001	6-7 mo.	-	FP70	FP79	SBCNP	9 Mar 2006	Unknown

Panther ID[a]	Sex	Capture date	Estimated age at first capture	Birth date	Dam	Purported sire	Use area[b]	Death date	Cause of death[c]
FP105	F	12 Apr 2001	6	-	-	-	FPNWR	15 Jan 2002	Unknown
FP106	F	12 Apr 2001	13 mo.	-	FP105	-	FPNWR	20 Feb 2003	Vehicle (SR29 Sunniland)
FP107	F	01 Nov 2001	19 mo.	Apr 2000	FP78	FP59	FPNWR	4 Aug 2008	Unknown
FP108	M	03 Nov 2001	10 mo.	Jan 2001	FP87	FP79	SBCNP	16 Nov 2002	Unknown
FP109	M	10 Feb 2002	10+	-	-	-	OSSF	23 Feb 2003	Intraspecific aggression
FP110	F	13 Feb 2002	13 mo.	Dec 2000	FP82	FP65	OSSF	♦	Collar failed 10/8/2014
FP111	M	14 Feb 2002	10	-	-	-	OSSF	4 Sep 2002	Intraspecific aggression
FP112	F	25 Feb 2002	3-4	-	-	-	NBCNP	11 Sep 2002	Intraspecific aggression
FP113	F	23 Oct 2002	6 mo.	Apr 2002	FP78	FP59	FPNWR	♦	Collar failed 10/19/2012
FP114	M	23 Oct 2002	6 mo.	Apr 2002	FP78	FP59	FPNWR	17 Oct 2003	Intraspecific aggression
FP115	F	26 Nov 2002	4-5	-	-	-	OSSF	17 May 2003	Pneumonia (FeLV)
FP116	F	20 Jan 2003	7 mo.	Jun 2002	FP67	-	Hendry Co. Private Lands	10 Jan 2007	Intraspecific aggression
FP117	M	25 Feb 2003	11 mo.	-	-	-	BCSIR	28 Jul 2004	Pseudorabies
FP118	F	5 Mar 2003	11 mo.	-	-	-	BCSIR	3 Apr 2003	Pseudorabies
FP119	M	2 Apr 2003	1	Apr 2002	FP93	FP79	FPNWR, FSPSP	♦	Collar failed 2/9/2011
FP120	F	8 Apr 2003	3	-	-	-	SBCNP	7 May 2005	Vehicle (US 41 Turner River)
FP121	F	2 Dec 2003	2.5	-	-	-	BCSIR	♦	Collar released 8/2/2006
FP122	F	30 Jan 2004	2-2.5	-	-	-	OSSF	13 Feb 2004	Pneumonia (FeLV)
FP123	M	2 Feb 2004	3.5	-	-	-	OSSF	15 Mar 2004	Intraspecific aggression
FP124	F	13 Feb 2004	3-4	-	-	-	SBCNP	♦	Collar failed 8/22/2008
FP125	M	13 Feb 2004	8 mo.	-	FP124	-	SBCNP, EVER	♦	Collar found 9/28/2004
FP126	M	13 Feb 2004	8 mo.	-	FP124	-	SBCNP, OSSF	1 Jan 2005	Intraspecific aggression
FP127	M	16 Feb 2004	2	-	-	-	SBCNP	14 Mar 2008	Intraspecific aggression

Panther ID[a]	Sex	Capture date	Estimated age at first capture	Birth date	Dam	Purported sire	Use area[b]	Death date	Cause of death[c]
FP128	F	18 Feb 2004	3.7	Jun 2000	FP77	-	BCSIR, NBCNP	27 Sept 2007	Unknown
FP129	F	20 Feb 2004	3.1	Jan 2001	FP87	FP79	SBCNP	22 Mar 2006	Intraspecific aggression
FP130	M	4 Mar 2004	9.5 mo.	May 2003	FP110	-	OSSF, FEC, BWWMA	21 Mar 2007	Vehicle (I-4 Reedy Creek)
FP131	M	10 Mar 2004	5	-	-	-	FPNWR	16 Apr 2008	Pneumonia
FP132	M	17 Mar 2004	3	-	-	-	OSSF, DIRWMA	22 Jul 2004	Feline leukemia
FP133	M	18 Nov 2004	4.5	-	-	-	NBCNP, SBCNP	27 Feb 2012	Intraspecific aggression
FP134	M	14 Dec 2004	2.5	-	-	-	NBCNP	29 Jan 2007	Intraspecific aggression
FP135	M	17 Dec 2004	1.7	Apr 2003	FP101	FP65	FPNWR, Private Lands	27 Oct 2006	Intraspecific aggression/euthanized
FP136	F	13 Jan 2005	3.5	-	-	-	SBCNP	13 Jun 2005	Spinal fracture
FP137	M	25 Jan 2005	2.5	-	-	-	OSSF, Private Lands, DIRWMA, SWWMA	♦	Collar failed 9/4/2009
FP138	M	31 Jan 2005	4	-	-	-	SBCNP, BCSIR, NBCNP	12 May 2008	Unknown
FP139	M	31 Mar 2005	2.9	May 2002	FP75	FP100	OSSF, Private Lands	♦	Collar released 8/24/2005
FP140	F	14 Nov 2005	3.5	-	-	-	FPNWR	7 Jun 2009	Intraspecific aggression
FP141	M	30 Nov 2005	3.5	-	-	-	BCSIR, NBCNP	3 Jan 2011	Unknown
FP142	F	14 Dec 2005	2.5	-	-	-	EVER	♦	Collar failed 7/11/2007
FP143	M	9 Jan 2006	1.5	-	-	-	BCSIR, Private Lands	♦	Collar failed 7/30/2007
FP144	M	8 Feb 2006	2	-	-	-	NBCNP	21 Jun 2010	Intraspecific aggression
FP145	F	16 Feb 2006	1.7	-	-	-	SBCNP	♦	Collar failed 5/25/2012
FP146	M	27 Feb 2006	3	-	-	-	PSSF	♦	Collar released 7/16/2008
FP147	M	3 Mar 2006	11 mo.	Mar 2005	FP129	-	SBCNP, FSPSP, PSSF, RBNER	♦	Collar failed 8/29/2007
FP148	F	24 Mar 2006	2.5	-	-	-	PSSF	20 Mar 2015	Instraspecific aggression
FP149	F	17 Jan 2007	2	-	-	-	PSSF	♦	Collar released 5/11/2007
FP150	F	8 Feb 2007	3.6	Jul 2003	FP93	FP60	SBCNP	♦	Collar failed 6/6/2008

Panther ID[a]	Sex	Capture date	Estimated age at first capture	Birth date	Dam	Purported sire	Use area[b]	Death date	Cause of death[c]
FP151	F	10 Feb 2007	4.9	Apr 2002	FP93	FP79	SBCNP	♦	Collar failed 5/19/2016
FP152	M	16 Feb 2007	4-5	-	-	-	SBCNP	22 Oct 2008	Intraspecific aggression
FP153	F	19 Feb 2007	6	-	-	-	SBCNP	16 June 2015	Unknown
FP154	M	21 Feb 2007	3	-	-	-	FPNWR	♦	Collar failed 4/2/2008
FP155	M	29 Nov 2007	2.5	-	-	-	OSSF, Private Lands	8 Sept 2008	Unknown
FP156	M	7 Dec 2007	2.5	-	-	-	PSSF, North Belle Meade	29 Jul 2011	Pseudorabies
FP157	M	19 Dec 2007	3	-	-	-	LCPA, CREW (Flint Pen)	9 Apr 2008	Intraspecific aggression
FP158	F	21 Jan 2008	2.5	-	-	-	PSSF, CSSP, RBNERR	22 May 2010	Vehicle
FP159	M	29 Jan 2008	5-6	-	-	-	LCPA, CREW (Flint Pen, Bird Rook), CSS	27 Apr 2015	Unknown
FP160	F	5 Feb 2008	5	-	-	-	CREW (Corkscrew Marsh), CSS	♦	Collar failed 11/12/2008
FP161	F	10 Feb 2008	3.7	May 2004	FP70	-	SBCNP	♦	Collar failed 5/8/2014
FP162	F	18 Feb 2008	3	-	-	-	SBCNP	6 May 2016	Intraspecific Aggression
FP163	M	21 Feb 2008	1	Feb 2007	FP93	-	SBCNP, NBCNP, Private Lands	25 April 2014	Vehicle
FP164	M	24 Feb 2008	2	-	-	-	SBCNP	30 Jun 2008	Unknown
FP165	M	24 Nov 2008	1	-	-	-	OSSF, DIRWMA, Private Lands	♦	Collar failed 9/14/2009
FP166	M	30 Jan 2009	4-5	-	-	-	BCSIR, Private Lands	5 Oct 2009	Intraspecific aggression
FP167	M	6 Feb 2009	2.5	-	-	-	BCSIR, Private Lands	♦	Collar failed 11/25/2009
FP168	F	9 Feb 2009	7	-	-	-	CREW (Flint Pen), LCPA	12 Oct 2010	Intraspecific aggression
FP169	M	25 Feb 2009	4-5	-	-	-	SBCNP	21 May 2010	Vehicle
FP170	F	26 Feb 2009	2.5	-	-	-	PSSF, FSPSP	28 Feb 2011	Intraspecific aggression
FP171	M	27 Feb 2009	2-3	-	-	-	SBCNP, NBCNP	14 Aug 2016	Vehicle
FP172	F	19 Nov 2009	5	-	-	-	NBCNP	22 Mar 2010	Intraspecific aggression
FP173	M	21 Jan 2010	4	-	-	-	CREW, PIMB, LCPA	22 Dec 2010	Pseudorabies

Panther ID[a]	Sex	Capture date	Estimated age at first capture	Birth date	Dam	Purported sire	Use area[b]	Death date	Cause of death[c]
FP174	M	26 Jan 2010	4	-	-	-	PSSF	16 Mar 2010	Vehicle
FP175	F	7 Feb 2010	2.5	Jul 2007	FP150	-	NBCNP, SBCNP	24 Jan 2014	Peritonitis
FP176	M	8 Feb 2010	3-4	-	-	-	OSSF, SWWMA	17 Nov 2010	Vehicle
FP177	M	9 Feb 2010	3	Mar 2007	FP113	FP119	NBCNP	16 Jul 2014	Instraspecific aggression
FP178	F	10 Feb 2010	2	-	-	-	NBCNP	♦	Collar failed 7/2/2014
FP179	M	14 Feb 2010	5	-	-	-	SBCNP	♦	Collar failed 5/5/2010
FP180	F	21 Feb 2010	2	Feb 2008	FP151	-	SBCNP	♦	Collar failed 8/5/2016
FP181	M	28 Feb 2010	9	Mar 2001	TX106	FP60	SBCNP, FSPSP, PSSF	♦	Collar failed 8/2/2010
FP182	F	1 Mar 2010	1	Feb 2009	FP161	-	SBCNP	11 Dec 2012	Vehicle
FP183	M	3 Nov 2010	4.5	-	-	-	FPNWR, FSPSP	25 Feb 2015	Vehicle
FP184	F	8 Nov 2010	3-4	-	-	-	NBCNP, Private Lands	26 Apr 2013	Intraspecific aggression
FP185	F	15 Nov 2010	1.5-2	-	-	-	Private Lands east of County Line Rd	♦	Collar failed 9/25/2017
FP186	M	10 Jan 2011	7 mo.	-	-	-	CREW-Flint Pen, Bird Rookery Swamp	30 May 2011	Intraspecific aggression
FP187	M	5 Feb 2011	7	-	-	-	SBCNP	♦	Collar failed 3/27/2015
FP188	F	8 Feb 2011	3	-	-	-	Alico Grove north of CREW Marsh	10 Sept 2011	Unknown
FP189	M	14 Feb 2011	3	-	-	-	NBCNP, FPNWR, Private Lands	5 Jan 2012	Intraspecific aggression
FP190	F	14 Feb 2011	5	-	-	-	SBCNP	♦	Collar failed 12/21/2012
FP191	F	26 Feb 2011	12	Feb 1999	TX107	FP79	SBCNP	13 Feb 2015	Unknown
FP192	F	28 Feb 2011	1.7	Jul 2009	FP170	-	SBCNP	♦	Collar failed 12/14/2015
FP193	M	7 Mar 2011	2-2.5	-	-	-	PSSF, CSSP, Private Lands	-	-
FP194	M	30 Oct 2010	5 mo.	May 2010	FP102	-	SBCNP	13 Jan 2012	Intraspecific aggression
FP195	F	30 Nov 2011	3.5	-	-	-	PSSF	29 Aug 2016	Intraspecific aggression
FP196	F	20 Jan 2012	2	-	-	-	PSSF	6 Oct 2012	Vehicle

Panther ID[a]	Sex	Capture date	Estimated age at first capture	Birth date	Dam	Purported sire	Use area[b]	Death date	Cause of death[c]
FP197	M	25 Jan 2012	4	-	-	-	CREW/LCPA	18 Jul 2012	Unknown
FP198	F	8 Feb 2012	4	-	-	-	CREW/LCPA	22 Mar 2017	Instraspecific aggression
FP199	F	9 Feb 2012	2	-	-	-	NBCNP	♦	Collar came off 1/17/2018
FP200	M	2 Nov 1984	3-5	-	-	-	Injured by vehicle on US41	3 June 1994	"Big Guy". Died in captivity
FP201♠	M	20 Feb 1991	7 mo.	July 1990	FP31	FP12	FPNWR, SBCNP	11 Mar 1997	Released, unknown cause of death
FP202♠	M	22 Feb 1991	7 mo.	July 1990	FP9	FP37	FSPSP	10 Feb 2002	Died in captivity
FP203♠	M	25 Feb 1991	7 mo.	July 1990	FP9	FP37	FSPSP, SBCNP	26 Feb 1997	Released, intraspecific aggression
FP204♠	F	27 Feb 1991	7 mo.	July 1990	FP31	FP12	FPNWR	28 July 2009	Died in captivity
FP205♠	F	3 May 1991	6 mo.	Dec 1990	FP19	-	FPNWR	11 October 1992	Died in captivity
FP206♠	F	6 May 1991	6 mo.	Dec 1990	FP40	-	Private Lands	2 May 1992	Died in captivity
FP207♠	M	4 Mar 1992	8-10 mo.	Jun 1991	FP36	-	Nobles Ranch	10 Sept 2007	Died in captivity
FP208♠	F	25 May 1992	12-14 days	May 1992	FP32	FP12	FPNWR	18 Feb 2007	Died in captivity
FP209♠	F	20 Aug 1992	10 days	Aug 1992	FP23	FP42	SBCNP	16 Jan 2004	Died in captivity
FP210♠	M	20 Aug 1992	10 days	Aug 1992	FP23	FP42	SBCNP	9 Oct 2008	Died in captivity
FP211	M	10 Feb 2012	2	-	-	-	NBCNP	21 May 2012	Intraspecific aggression
FP212	M	13 Feb 2012	3	-	-	-	OSSF	18 May 2012	Intraspecific aggression
FP213	F	15 Feb 2012	2.5	-	-	-	OSSF	31 Dec 2014	Intraspecific aggression
FP214	F	17 Feb 2012	3-4	-	-	-	SBCNP	-	-
FP215	F	23 Feb 2012	6.8	Apr 2005	FP113	FP131/133	FPNWR	22 Jun 2016	Unknown
FP216	M	11 Mar 2012	1	-	-	-	SBCNP	♦	Collar released 2/27/2014
FP217	F	7 Jan 2013	5	-	-	-	OSSF	♦	Collar failed 6/13/2017
FP218	F	24 Jan 2013	2.5	-	-	-	OSSF/Private	♦	Collar released 1/15/2014
FP219	F	23 Sep 2011	5 mo.	May 2011	FP188	-	FSPSP/PSSF/**Captive**	18 Sep 2015	Vehicle

Panther ID[a]	Sex	Capture date	Estimated age at first capture	Birth date	Dam	Purported sire	Use area[b]	Death date	Cause of death[c]
FP220	F	4 Feb 2013	6	Feb 2007	FP93	-	SBCNP	-	-
FP221	F	22 Feb 2013	9-10 mo.	-	-	-	SBCNP	♦	Collar failed 5/19/2016
FP222	F	26 Feb 2013	8	-	-	-	FPNWR	23 Oct 2015	Vehicle
FP223	M	23 Sep 2011	5 mo.	May 2011	FP188	-	Private Lands/**Captive**	4 Jan 2014	Pneumonia
FP224	F	13 May 2013	8-9 mo.	-	-	-	Golden Gate Estates/**Captive**	-	-
FP225	M	15 Jan 2014	20 mo.	-	-	-	NBCNP	♦	Collar failed 3/13/2015
FP226	F	15 Jan2014	5	-	-	-	NBCNP	♦	Collar released 11/12/2014
FP227	M	10 Feb 2014	2-3	-	-	-	NBCNP	♦	Collar failed 12/24/2014
FP228	M	20Feb 2014	4	-	-	-	NBCNP	17 Mar 2014	Vehicle
FP229	F	27 Feb 2014	3-4	-	-	-	NBCNP	14 Nov 2014	Unknown
FP230	M	8 Mar 2014	5-6	-	-	-	SBCNP	♦	Collar failed 7/29/2014
FP231	M	24 Mar 2014	2	-	-	-	Clam Pass, Naples	4 Aug 2014	Unknown
FP232	M	15 Apr 2014	2.5	-	-	-	Ft. Meade/**Captive**/Central Florida	♦	Collar failed 10/7/2015
FP233	M	6 Jan 2015	1.5	-	-	-	NBCNP	♦	Collar released 7/15/2015
FP234	M	7 Jan 2015	9-10	-	-	-	NBCNP	13 Aug 2017	Vehicle
FP235	M	8 Jan 2015	4	-	-	-	NBCNP/BCSIR	♦	Collar released 8/3/2015
FP236	M	16 Jan 2015	6-7	-	-	-	CREW	21 Mar 2018	Unknown
FP237	M	20 Jan 2015	10-12 mo.	-	-	-	CREW	30 Mar 2015	Intraspecific aggression
FP238	M	3 Feb 2015	1.5-2	-	-	-	RBNER/PSSF/SBCNP	♦	Collar failed 10/2/2015
FP239	F	12 Feb 2015	11 mo.	-	-	-	SBCNP	-	-
FP240	F	18 Feb 2015	2	Dec 2012	FP151	-	SBCNP	10 Aug 2015	Intraspecific aggression
FP241	M	12 Jan 2016	7-8	-	-	-	Immokalee Ranch	♦	Collar failed 10/9/2017
FP242	M	20 Jan 2016	9-10	-	-	-	Immokalee Ranch	5 Aug 2016	Pseudorabies

Panther ID[a]	Sex	Capture date	Estimated age at first capture	Birth date	Dam	Purported sire	Use area[b]	Death date	Cause of death[c]
FP243	M	12 Apr 2016	2	-	-	-	Farmworkers Village, **Captive,** SBCNP, NBCNP, BCSIR, **Captive**	-	Removed from wild 7/21/2016
FP244	M	7 Dec 2016	6-7	-	-	-	OSSF	28 Aug 2017	Unknown
FP245	M	19 Jan 2017	6	-	-	-	Immokalee Ranch	14 Mar 2018	Unknown
FP246	F	7 Feb 2017	2	-	-	-	Immokalee Ranch	-	-
FP247	F	14 Feb 2017	3-4	-	-	-	Immokalee Ranch	-	-
FP248	F	11 May 2017	3	-	-	-	Corkscrew Road	-	Removed from wild 5/11/2017
FP249	M	31 May 2017	1.5	-	-	-	Alva, DIRWMA, Immokalee Ranch	21 Nov 2017	Vehicle
FP250	M	7 June 2017	1.5	-	-	-	GGE, DIR	-	-
FP251	M	2 Jan 2018	6 mo.	5/31/2017	FP224	-	GGE, FSPSP, PSSF	-	-
FP252	M	2 Jan 2018	6 mo.	5/31/2017	FP224	-	GGE, FSPSP, PSSF	-	-

[a] FP denotes panthers captured for radiocollaring. TX denotes female Texas pumas released in 1995 as part of the genetic introgression project.

[b] BCSIR = Big Cypress Seminole Indian Reservation; BWWMA=Babcock Webb Wildlife Management Area; CREW = Corkscrew Regional Ecosystem Watershed; CSS = Corkscrew Swamp Sanctuary; CSSP = Collier Seminole State Park; DIRWMA = Dinner Island Ranch Wildlife Management Area; EVER = Everglades National Park; EWMA; Everglades Wildlife Management Area; FEC=Fisheating Creek; FPNWR = Florida Panther National Wildlife Refuge; FSPSP = Fakahatchee Strand Preserve State Park; GGE = Golden Gate Estates; LCPA = Lee County Port Authority Mitigation Area; NBCNP = Big Cypress National Preserve north of Interstate 75; OSSF = Okaloacoochee Slough State Forest; PIMB=Panther Island Mitigation Bank; PSSF = Picayune Strand State Forest/Wildlife Management Area; RBNER = Rookery Bay National Estuarine Research Reserve; SBCNP = Big Cypress National Preserve south of Interstate 75; SWWMA = Spirit of the Wild Wildlife Management Area.

[c] ISA = Intraspecific aggression

♦Telemetry collar either failed or was released (via timed or remote release mechanisms) prior to the death of the animal.

♠Panthers removed from the wild for a captive breeding program from 1991-1992. Program was eventually dissolved in favor of genetic restoration.

Appendix II. List of Florida panther kittens handled at natal dens in southern Florida by FWC and BCNP staff from 7 April 1992 through 30 June 2018. Litters are sorted chronologically.

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
K1	FP40	4/7/1992	M	None	14-21	FP28	2/10/1993	FP54
K2	FP40	4/7/1992	M	None	14-21	FP28		
K3	FP40	6/18/1993	M	None	21	FP26		
K4	FP40	6/18/1993	F	None	21	FP26		
K5	FP40	6/18/1993	F	None	21	FP26		
K6	FP48	10/30/1993	M	None	8	FP12		
K7	FP48	10/30/1993	F	None	8	FP12		
K8	FP48	10/30/1993	F	None	8	FP12		
K9	FP56	4/21/1994	M	None	14	Unknown		
K10	FP56	4/21/1994	F	None	14	Unknown		
K11	FP56	4/21/1994	M	None	14	Unknown		
K12	FP19	5/17/1994	F	None	14-17	FP51		
K13	FP19	5/17/1994	F	None	14-17	FP51		
K14	FP55	4/8/1995	F	None	12	FP42		
K15	FP55	4/8/1995	F	None	12	FP42		
K16	FP48	6/20/1995	M	12A4640	12	Unknown	1/7/1996	FP59
K17	FP48	6/20/1995	F	129FE45	12	Unknown		
K18	TX101	10/10/1995	F	F82665	21	Unknown	11/12/1998	FP73
K19	TX101	10/10/1995	M	F79CB9	21	Unknown	3/3/1999	FP79
K20	FP56	10/31/1995	M	762141	14	FP45		
K21	FP56	10/31/1995	M	632448	14	FP45		
K22	FP56	10/31/1995	M	F6642F	14	FP45		
K23	TX106	12/1/1995	F	11DFD74	21	FP51		
K24	FP36	2/6/1996	F	12AB55F	14	FP45		
K25	FP36	2/6/1996	M	1147C9B	14	FP45		
K26	FP36	2/6/1996	M	11DF0DA	14	FP45		

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
UCFP44[a]	FP36	2/6/1996	U	none	Unknown	Unknown		
UCFP24	FP32	3/18/1996	F	dead not marked	10-14	Unknown		
K27	FP19	4/17/1996	F	114DAFE (11363DC)	24	FP54/FP51		
K28	FP19	4/17/1996	F	11EOD50	24	FP54/FP51		
K29	FP56	8/14/1996	U	11EAB72T	14	FP45		
K30	FP56	8/14/1996	U	1142876	14	FP45		
K31	FP48	9/18/1996	M	7037C2	14-17	Unknown	3/18/1997	FP62
K32	FP48	9/18/1996	M	11EA2EC	14-17	Unknown	5/24/1997	FP64
K33	FP48	9/18/1996	M	6FFD52	14-17	Unknown		UCFP50
K34	TX105	10/4/1996	F	11EAO30T	30-35	FP16		
K35	TX101	12/21/1996	M	12AFFBF	4	FP45	11/19/1997	FP65
K36	TX101	12/21/1996	F	142581A	4	FP45	12/9/1997	FP66
K37	FP40	5/14/1997	M	1146911	21	FP45		
unmarked1[b]	FP40	2/5/1998	F	none	270	Unknown	2/5/1998	FP69
K38	TX107	6/4/1997	F	1311B3B	30+	Unknown	3/5/1998	FP71
K39	TX107	6/4/1997	F	771B4D	30+	Unknown	2/25/1998	FP70
K40	FP56	6/17/1997	M	1412E16	25-28	FP45		
K41	FP56	6/17/1997	F	14259BF	25-28	FP45		
K42	FP56	6/17/1997	F	1425A07	25-28	FP45	1/19/1998	FP67
K43	FP56	6/17/1997	M	12C2B93	25-28	FP45		
K44	FP55	10/2/1997	M	12A9E4AT	25-30	Unknown		
K45	TX108	2/11/1998	F	1D1DFDOT	21	FP16	11/7/2000	FP95
K46	TX108	2/11/1998	M	143E96ET	21	FP16		
K47	TX106	2/17/1998	M	1D3E32OT	7-10	FP54		
K48	FP55	2/25/1998	F	121134F	14	Unknown	2/20/2001	FP102
K49	FP55	2/25/1998	F	1D2B3AET	14	Unknown		
K50	FP55	2/25/1998	M	12A94A6T	14	Unknown		
K51	FP48	6/27/1998	M	1D2A504T	28	Unknown		
unmarked3[c]	FP48	1/11/1999	F	00013C2DC7T	7 months	Unknown	1/11/1999	FP75

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
K52	FP66	10/2/1998	M	1D21638T	12	FP72		
K53	FP66	10/2/1998	F	1C49E48T	12	FP72		
K54	FP66	10/2/1998	M	1D2CBC3T	12	FP72		
K55	FP49	2/23/1999	M	1211046	25	Unknown		
K56	TX107	3/11/1999	F	1327679T	21+	FP79	2/26/2011	FP191
K57	TX107	3/11/1999	M	14245FOT	21+	FP79		
K58	TX107	3/11/1999	F	12A9FE5T	21+	FP79	4/10/2000	FP93
K59	FP61	4/6/1999	M	1EFF6EFT	14	FP16	2/17/2000	FP85
K60	FP55	5/10/1999	F	1EFFA75T	24-26	FP79	2/28/2000	FP87
K61	FP55	5/10/1999	M	1EFF978T	24-26	FP79		
K62	TX106	6/18/1999	F	114C9D7T	14	FP54/FP60		
K63	TX106	6/18/1999	F	12AFC11T	14	FP54/FP60	2/8/2000	FP83
K64	FP70	6/23/1999	F	1E2EB33T	10-12	FP79	3/2/2000	FP88
K65	FP70	6/23/1999	M	703A4AT	10-12	FP79	4/6/2000	FP92
K66	FP70	6/23/1999	F	1EFFF55T	10-12	FP79	3/17/2000	FP91
K67	FP71	7/4/1999	M	1E2EBFET	17	FP79	3/8/2000	FP90
K68	FP71	7/4/1999	F	20509A9T	17	FP79	2/21/2000	FP86
K69	FP71	7/4/1999	M	1E2F6B7T	17	FP79		
K70	FP71	7/4/1999	F	1E2DF2BT	17	FP79		
K71	FP69	8/1/1999	M	1E2F276T	7	Unknown		
K72	FP69	8/1/1999	F	1F07255T	7	Unknown		
K73	FP69	8/1/1999	F	1FO14C2T	7	Unknown		
K74	FP48	10/25/1999	F	1EFFF38T	14-17	FP63,FP68		
K75	FP48	10/25/1999	F	1FO1BEDT	14-17	FP63,FP68		
K76	FP66	12/24/1999	M	1D2C5F6T	14	FP60		
K77	FP66	12/24/1999	F	1F00067T	14	FP60		
K78	FP66	12/24/1999	F	1E2F2D6T	14	FP60		
K79	FP78	4/26/2000	F	1D1CDD8T	10-14	FP59	11/1/2001	FP107
K80	FP78	4/26/2000	M	1F07DD7T	10-14	FP59	1/7/2001	FP96

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
K81	FP77	6/27/2000	M	1D3B75CT	28	Unknown		
K82	FP77	6/27/2000	F	1433F77T	28	Unknown	2/18/2004	FP128
K83	FP77	6/27/2000	M	1D3A078T	28	Unknown		
K84	FP67	8/19/2000	M	143F34DT	12	Unknown		
K85	FP67	8/19/2000	F	1E2E834T	12	Unknown		
K86	FP82	1/3/2001	F	1E2F17ET	14	FP65	2/13/2002	FP110
K87	FP82	1/3/2001	F	1E2EFB7T	14	FP65		
K88	FP82	1/3/2001	M	1F00D57T	14	FP65		
K89	FP87	2/7/2001	F	20501C5T	14-21	FP79	2/20/2004	FP129
K90	FP87	2/7/2001	M	1E2F06B	14-21	FP79	11/3/2001	FP108
K91	FP87	2/7/2001	M	1F071F4T	14-21	FP79		
K92	TX106	3/17/2001	F	600DBE9	14-16	FP60		
K93	TX106	3/17/2001	M	600CCC4	14-16	FP60	2/28/2010	FP181
K94	FP88	5/25/2001	M	1E2EB3DT	21	Unknown		
K95	FP88	5/25/2001	F	1EFF463T	21	Unknown		
K96	FP88	5/25/2001	M	1F00576T	21	Unknown		
K97	FP88	5/25/2001	F	204F878T	21	Unknown		
K98	FP67	5/26/2001	F	11D5AFD	21	Unknown		UCFP49
K99	FP67	5/26/2001	M	1248B13T	21	Unknown		
K100	FP67	5/26/2001	M	600EFAF	21	Unknown		
K101	FP67	5/26/2001	M	600E363	21	Unknown		
K102	FP75	6/15/2001	M	600E58A	10-12	FP59		
K103	FP75	6/15/2001	M	6000FA1	10-12	FP59		
K104	FP55	6/28/2001	M	1EFFFC5T	17	Unknown		
K105	FP102	7/12/2001	M	1E2DFA4T	21	FP79		
K106	FP102	7/12/2001	M	600E036	21	FP79		
K107	FP49	8/27/2001	M	000600F828	21	Unknown		
K108	FP77	8/30/2001	M	000600F0EA	30	Unknown		
K109	FP73	3/3/2002	M	000600FD77	7	Unknown		

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
K110	FP73	3/3/2002	M	0001E2D9E2T	7	Unknown		
K111	FP73	3/3/2002	F	000600A2C9	7	Unknown		
K112	FP95	4/21/2002	F	0001E2E9D3T	25	FP85		
unmarked2[d]	FP95	not marked	U	none	Unknown	FP85		
K113	FP93	4/23/2002	F	0001EFF813T	18	FP79	2/10/2007	FP151
K114	FP93	4/23/2002	F	000600CC53	18	FP79		
K115	FP93	4/23/2002	M	0001F071E4T	18	FP79	4/2/2003	FP119
K116	FP93	4/23/2002	F	0001F01C76T	18	FP79		
K117	FP78	4/30/2002	F	000600CDB3	21	FP59		
K118	FP78	4/30/2002	F	000600DB01	21	FP59		
K119	FP78	4/30/2002	F	000600E3E3	21	FP59	10/23/2002	FP113
K120	FP78	4/30/2002	M	0001F01D1CT	21	FP59	10/23/2002	FP114
K121	FP101	5/9/2002	M	000204F9EAT	10	Unknown		
K122	FP101	5/9/2002	F	0001E2D6FDT	10	Unknown		
K123	FP83	5/12/2002	M	000631AED6	28	Unknown		
K124	FP106	5/27/2002	F	0001F003A0T	10	Unknown		
K125	FP106	5/27/2002	M	0001D2CBC4T	10	Unknown		
K126	FP106	5/27/2002	M	0001E2E8F6T	10	Unknown		
K127	FP55	5/30/2002	F	000600EAD2	10	FP79		
K128	FP75	6/6/2002	M	000600E84B	10	FP100/FP98		
K129	FP75	6/6/2002	M	00060101BC	10	FP100/FP98	3/31/2005	FP139
K130	FP112	6/15/2002	M	0001EFF497T	7	FP100/FP98		
K131	FP112	6/15/2002	M	000600E4CE	7	FP100/FP98		
K132	FP67	6/18/2002	F	000600D0F1	10	Unknown	1/20/2003	FP116
K133	FP67	6/18/2002	M	000600EBA8	10	Unknown		
K134	FP67	6/18/2002	M	000600E776	10	Unknown		
K135	FP107	7/7/2002	M	0006010509	9-10	Unknown		
K136	FP107	7/7/2002	F	000600F465	9-10	Unknown		
K137	FP102	7/19/2002	F	0006318229	15	FP79		

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
K138	FP102	7/19/2002	M	000630E287	15	FP79		
K139	FP61	9/27/2002	F	000204FBC3T	10	Unknown		
K140	FP61	9/27/2002	M	000600D0D4	10	Unknown		
K141	FP61	9/27/2002	M	000600F2F8	10	Unknown		
K142	FP61	9/27/2002	F	0001D29A56T	10	Unknown		
K143	FP87	3/25/2003	F	000600DD57	15	FP79		
K144	FP87	3/25/2003	M	ID not recorded	15	FP79		
K145	FP87	3/25/2003	F	ID not recorded	15	FP79		
K146	FP101	4/19/2003	F	00062EDF9D	10	FP65/FP100		
K147	FP101	4/19/2003	M	0006328F81	10	FP65/FP100	12/17/2004	FP135
K148	FP101	4/19/2003	F	00062E2A15	10	FP65/FP100		
K149	FP110	6/3/2003	F	000600F8DE	6-10	Unknown		
K150	FP110	6/3/2003	M	000600CCD1	6-10	Unknown	3/4/2004	FP130
K151	FP110	6/3/2003	F	000600C049	6-10	Unknown		
K152	FP93	8/5/2003	F	000600037C	21	FP60	2/8/2007	FP150
K153	FP93	8/5/2003	M	0005FFE2D6	21	FP60		
K154	FP93	8/5/2003	M	0006000B2A	21	FP60		
K155	FP120	2/7/2004	F	0005FFEB0A	14	Unknown		
K156	FP120	2/7/2004	M	0005FFE0DA	14	Unknown		
K157	FP75	3/21/2004	M	0006327AC0	23	Unknown		
K158	FP75	3/21/2004	M	000632781C	23	Unknown		
K159	FP75	3/21/2004	F	00062EE361	23	Unknown		
K160	FP116	5/1//2004	F	0006479F70	14	FP65		
K161	FP116	5/1//2004	F	000647D7A6	14	FP65		
K162	FP116	5/1//2004	M	0006485640	14	FP65		
K163	FP107	5/21/2004	M	0006327255	7	Unknown		
K164	FP107	5/21/2004	M	0006326E04	7	Unknown		
K165	FP107	5/21/2004	F	000632227C	7	Unknown		
K166	FP107	5/21/2004	F	000647A475	7	Unknown		

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
K167	FP70	6/6/2004	F	00064DBAB1	12	Unknown		
K168	FP70	6/6/2004	M	00064DAB32	12	Unknown		
K169	FP70	6/6/2004	F	00064D7C86	12	Unknown	2/10/2008	FP161
K170	FP102	8/5/2004	F	00064DEB7D	15	FP79		
K171	FP102	8/5/2004	M	00064DDEEA	15	FP79		
K172	FP102	8/5/2004	F	00064D918C	15	FP79		
K173	FP121	9/1/2004	F	0006000738	14	Unknown		
UCFP67	FP113	9/2/2004	F	dead not marked	< 7	Unknown		
K174	FP124	9/29/2004	M	000647D79D	21+	Unknown		
K175	FP124	2/10/2005	M	0005FFF5E1	14	Unknown		
K176	FP124	2/10/2005	M	00064D67F9	14	Unknown		
K177	FP124	2/10/2005	F	0006000D6B	14	Unknown		
K178	FP110	3/7/2005	M	000601E07A	12	Unknown		
K179	FP110	3/7/2005	F	00064DD051	12	Unknown		
K180	FP107	3/15/2005	F	000600E4BB	14	FP119/FP131		
K181	FP107	3/15/2005	F	000600F978	14	FP119/FP131		
K182	FP129	4/6/2005	F	0006482822	10	Unknown		
K183	FP129	4/6/2005	M	00064DE502	10	Unknown		
K184	FP129	4/6/2005	M	00064D7610	10	Unknown	3/3/2006	FP147
K185	FP113	4/20/2005	F	000647B5F9	15	FP131/FP133	2/23/2012	FP215
K186	FP113	4/20/2005	F	000647AEBB	15	FP131/FP133		
K187	FP116	6/19/2005	M	00064D6A85	22	Unknown		
K188	FP116	6/19/2005	F	000647AEEE6	22	Unknown		
K189	FP116	6/19/2005	M	000647BC03	22	Unknown		
K190	FP128	7/21/2005	M	64D816A	24	Unknown		
K191	FP128	7/21/2005	M	647C7FE	24	Unknown		
K192	FP75	8/7/2005	M	000647CDE9	7	FP135		
K193	FP75	8/7/2005	F	00064DB63B	7	FP135		
K194	FP75	8/7/2005	F	00064DAC56	7	FP135		

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
K195	FP75	8/7/2005	M	000600E8A6	7	FP135		
K196	FP110	11/1/2005	M	00063DE442	21	Unknown		
K197	FP110	11/1/2005	M	00063DA510	21	Unknown		
K198	FP110	11/1/2005	M	00064339FD	21	Unknown		
K199	FP110	11/1/2005	F	000643666C	21	Unknown		
K200	FP107	2/17/2006	F	0006009668	6	FP131		
K201	FP107	2/17/2006	M	000600F274	6	FP131		
K202	FP121	3/5/2006	F	000600DAB4	14	Unknown		
K203	FP121	3/5/2006	M	000600B508	14	Unknown		
K204	FP121	3/5/2006	M	0006483B07	14	Unknown		
K205	FP94	6/22/2006	F	00064DA2F2	18	Unknown		
K206	FP94	6/22/2006	M	00063D8B9D	18	Unknown		
K207	FP94	6/22/2006	F	00063DD7D8	18	Unknown		
K208	FP145	6/23/2006	F	000647B5DA	12	FP138		
K209	FP145	6/23/2006	F	00064ECCA4	12	FP138		
K210	FP145	6/23/2006	F	000672579C	12	FP138		
K211	FP93	7/1/2006	F	0064068FF	18	FP133		
K212	FP93	7/1/2006	F	00647879D	18	FP133		
K213	FP93	7/1/2006	F	0064D988C	18	FP133		
K214	FP95	7/3/2006	F	00064D852D	10	Unknown		
K215	FP95	7/3/2006	F	00064D5EDC	10	Unknown		
K216	FP95	7/3/2006	M	000647C887	10	Unknown		
K217	FP102	7/12/2006	M	000672358E	18	FP138		
K218	FP102	7/12/2006	M	000671CA33	18	FP138		
K219	FP140	11/15/2006	F	006435A2B	9-11	FP119		
K220	FP140	11/15/2006	M	0006436824	9-11	FP119		
K221	FP148	1/18/2007	F	000647D2EE	21	FP146		
K222	FP148	1/18/2007	M	00064DC433	21	FP146		
K223	FP148	1/18/2007	F	00064E23C	21	FP146		

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
K224	FP124	2/17/2007	M	64EED68	9	Unknown		
K225	FP124	2/17/2007	M	64E00C9	9	Unknown		
K226	FP93	3/8/2007	M	6712488	16	Unknown		
K227	FP93	3/8/2007	M	64DF113	16	Unknown	2/21/2008	FP163
K228	FP93	3/8/2007	F	64EO84F	16	Unknown	2/4/2013	FP220
K229	FP110	3/20/2007	F	0006327849	10-12	FP137		
K230	FP110	3/20/2007	M	00063DD906	10-12	FP137		
K231	FP110	3/20/2007	F	00063DC6F3	10-12	FP137		
K232	FP110	3/20/2007	M	00063218EB	10-12	FP137		
K233	FP113	3/25/2007	F	00063DC1F0	7	FP119		
K234	FP113	3/25/2007	M	00063DC585	7	FP119		
K235	FP113	3/25/2007	M	0006439AB7	7	FP119	2/9/2010	FP177
K236	FP103	4/4/2007	F	0006722801	24	FP127		
K237	FP103	4/4/2007	F	00067142C6	24	FP127		
K238	FP103	4/4/2007	M	000671D047	24	FP127		
K239	FP149	4/13/2007	F	00063DCBCC	11-13	Unknown		
K240	FP149	4/13/2007	F	000631A816	11-13	Unknown		
K241	FP151	4/21/2007	M	67245C4	16	Unknown		
K242	FP151	4/21/2007	F	67216AA	16	Unknown		
K243	FP151	4/21/2007	F	64E6E50	16	Unknown		
K244	FP145	4/26/2007	M	6718E19	16	FP133		
K245	FP145	4/26/2007	M	6718AEE	16	FP133		
K246	FP145	4/26/2007	F	6722453	16	FP133		
K247	FP107	4/27/2007	F	0006437F96	10-12	Unknown		
K248	FP107	4/27/2007	M	0006435576	10-12	Unknown		
K249	FP107	4/27/2007	F	dead not marked	10-12	Unknown		
K250	FP128	5/12/2007	M	0006435419	10-12	Unknown		
K251	FP128	5/12/2007	M	0006434A69	10-12	Unknown		
K252	FP128	5/12/2007	F	0006433EFA	10-12	Unknown		

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
K253	FP150	7/20/2007	M	6726F07	18	Unknown		
K254	FP150	7/20/2007	F	671F6F3	18	Unknown	2/7/2010	FP175
K255	FP150	7/20/2007	F	67231E8	18	Unknown		
K256	FP150	7/20/2007	F	671E895	18	Unknown		
K257	FP110	8/10/2007	M	0006439E20	13-15	Unknown		
K258	FP110	8/10/2007	M	000643422C	13-15	Unknown		
K259	FP151	8/27/2007	M	dead not marked	17-20	Unknown		
K260	FP151	8/27/2007	U	dead not marked	17-20	Unknown		
K261	FP107	9/25/2007	M	000643530F	10-14	Unknown		
K262	FP107	9/25/2007	M	0006435247	10-14	Unknown		
K263	FP107	9/25/2007	M	00063DC5C2	10-14	Unknown		
K264	FP151	3/4/2008	F	6957DE2	21	Unknown	2/21/2010	FP180
K265	FP151	3/4/2008	M	695B244	21	Unknown		
K266	FP140	5/2/2008	M	00063DF3C8	7	FP154		
K267	FP140	5/2/2008	M	00063DEAA1	7	FP154		
K268	FP162	5/23/2008	F	dead not marked	14	FP138		
K269	FP162	5/23/2008	M	dead not marked	14	FP138		
K270	FP158	6/7/2008	F	6435FEC	14-17	FP146		
K271	FP158	6/7/2008	M	6435381	14-17	FP146		
K272	FP158	6/7/2008	M	642652B	14-17	FP146		
K273	FP158	6/7/2008	M	643824C	14-17	FP146		
K274	FP153	7/20/2008	F	695849E	14	Unknown		
K275	FP153	7/20/2008	M	695ACE5	14	Unknown		
K276	FP153	7/20/2008	M	6958EAA	14	Unknown		
K277	FP161	2/25/2009	M	698B098	16	Unknown		
K278	FP161	2/25/2009	M	69581FC	16	Unknown		
K279	FP161	2/25/2009	F	6959939	16	Unknown	3/1/2010	FP182
K280	FP162	5/7/2009	F	695AOB3	25-27	Unknown		
K281	FP153	7/8/2009	M	671F728	30	Unknown		

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
K282	FP153	7/8/2009	M	6958DCD	30	Unknown		
K283	FP168	7/21/2009	M	0006483E5C	7	Unknown		
K284	FP168	7/21/2009	M	0006434DB7	7	Unknown		
K285	FP170	7/28/2009	M	00063DF972	22	Unknown		
K286	FP170	7/28/2009	M	00063DE7FC	22	Unknown		
K287	FP170	7/28/2009	F	000600E52E	22	Unknown	2/28/2011	FP192
K288	FP172	2/20/2010	M	00063DDEB6	15	Unknown		
K289	FP172	2/20/2010	M	0006435874	15	Unknown		
K290	FP172	2/20/2010	M	0006436050	15	Unknown		
K291	FP145	2/25/2010	F	00069577CI	28	Unknown		
K292	FP145	2/25/2010	M	000695BO19	28	Unknown		
K293	FP145	2/25/2010	F	00067214F1	28	Unknown		
K294	FP162	3/23/2010	M	6957879	14	FP133		
K295	FP162	3/23/2010	F	695A869	14	FP133		
K296	FP162	3/23/2010	F	695A5CF	14	FP133		
K297	FP148	4/13/2010	F	00063DFB49	14	Unknown		
K298	FP148	4/13/2010	F	0006436575	14	Unknown		
K299	FP148	4/13/2010	M	0006435550	14	Unknown		
K300	FP161	5/26/2010	M	000695AD83	16	Unknown		
K301	FP161	5/26/2010	F	0006723CE4	16	Unknown		
K302	FP161	5/26/2010	F	000695B151	16	Unknown		
K303	FP102	6/6/2010	M	0006958363	21	Unknown		
K304	FP102	6/6/2010	M	000695A272	21	Unknown	11/29/2011	FP194
K305	FP178	6/22/2010	M	0006434D2E	14-17	Unknown		
K306	FP178	6/22/2010	M	000643461A	14-17	Unknown		
K307	FP113	7/15/2010	F	0001EFF852	5-7	Unknown		
K308	FP113	7/15/2010	M	000643352E	5-7	Unknown		
K309	FP113	7/15/2010	F	0006439939	5-7	Unknown		
K310	FP175	8/2/2010	F	0006959F9E	18	Unknown		

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
K311	FP175	8/2/2010	F	0006959B00	18	Unknown		
K312	FP110	8/4/2010	F	0006436660	10-12	Unknown		
K313	FP110	8/4/2010	F	00063DCB00	10-12	Unknown		
K314	FP110	8/4/2010	M	00064359C2	10-12	Unknown		
K315	FP148	1/17/2011	M	0006433EE1	12	Unknown		
K316	FP148	1/17/2011	M	0006437C54	12	Unknown		
K317	FP178	1/27/2011	M	0006436F25	12-14	Unknown		
K318	FP178	1/27/2011	M	00063DECC8	12-14	Unknown		
K319	FP175	1/27/2011	M	0006959F88	21	Unknown		
K320	FP175	1/27/2011	F	000695A8A8	21	Unknown		
K321	FP113	3/9/2011	M	00063460F7	21	Unknown		
K322	FP162	4/15/2011	F	0006959680	19	Unknown		
K323	FP162	4/15/2011	M	000695A73E	19	Unknown		
K324	FP162	4/15/2011	M	0006959FC4	19	Unknown		
K325	FP162	4/15/2011	M	000695A29B	19	Unknown		
K326	FP184	4/26/2011	M	0006483D1B	12	Unknown		
K327	FP184	4/26/2011	M	00064DB286	12	Unknown		
K328	FP184	4/26/2011	F	000631C890	12	Unknown		
K329	FP184	4/26/2011	M	000647B1C4	12	Unknown		
K330	FP182	4/29/2011	M	0006959053	14	Unknown		
K331	FP182	4/29/2011	M	000695823A	14	Unknown		
K332	FP182	4/29/2011	F	0006957B55	14	Unknown		
K333	FP182	4/29/2011	M	0006958665	14	Unknown		
K334	FP188	5/26/2011	F	0001D3E191T	18	Unknown	1/31/2013	FP219
K335	FP188	5/26/2011	M	00012AA1A2	18	Unknown	4/3/2013	FP223
K336	FP188	5/26/2011	M	0001E2E62ET	18	Unknown		
K337	FP145	6/9/2011	M	00069584D5	12	Unknown		
K338	FP145	6/9/2011	F	000695B041	12	Unknown		
K339	FP145	6/9/2011	F	00069580FE	12	Unknown		

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
K340	FP151	6/10/2011	F	000695B062	21	FP187		
K341	FP151	6/10/2011	M	0006957B2E	21	FP187		
K342	FP113	8/7/2011	F	000631A606	25	Unknown		
K343	FP110	12/15/2011	F	000631FC2A	10-14	Unknown		
K344	FP110	12/15/2011	F	0006321ECF	10-14	Unknown		
K345	FP145	2/16/2012	M	000695AFBA	24	Unknown		
K346	FP145	2/16/2012	F	000695A522	24	Unknown		
K347	FP145	2/16/2012	M	0006958FF1	24	Unknown		
K348	FP153	2/19/2012	M	000695ACD5	9	Unknown		
K349	FP153	2/19/2012	M	00066957F4D	9	Unknown		
K350	FP153	2/19/2012	M	000695A8EO	9	Unknown		
K351	FP153	2/19/2012	M	0006959029	9	Unknown		
K352	FP195	3/3/2012	M	0006328CF1	12	Unknown		
K353	FP191	3/28/2012	M	0007136AE7	14	Unknown		
K354	FP192	4/15/2012	M	0007138FD0	21	Unknown		
K355	FP192	4/15/2012	M	0007135EE2	21	Unknown		
K356	FP192	4/15/2012	M	000713972D	21	Unknown		
K357	FP161	4/25/2012	F	0007136CC3	14	Unknown		
K358	FP161	4/25/2012	M	000695ABF6	14	Unknown		
K359	FP161	4/25/2012	M	0006958D4E	14	Unknown		
K360	FP161	4/25/2012	F	0007136DC5	14	Unknown		
K361	FP190	5/14/2012	F	0007138138	20	Unknown		
K362	FP190	5/14/2012	M	0007136F0C	20	Unknown		
K363	FP190	5/14/2012	F	00071368E2	20	Unknown		
K364	FP213	6/5/2012	M	00063DFC55	6	Unknown		
K365	FP213	6/5/2012	F	00063DD656	6	Unknown		
K366	FP213	6/5/2012	M	0006319AC9	6	Unknown		
K367	FP162	6/26/2012	M	000695B179	22	FP187		
K368	FP162	6/26/2012	F	0006E37AD8	22	FP187		

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
K369	FP178	7/7/2012	F	0006F3DB0E	20	unknown		
K370	FP178	7/7/2012	F	0006E758B9	20	unknown		
K371	FP178	7/7/2012	F	0006E7713A	20	unknown		
K372	FP191	7/11/2012	F	0007138363	14	FP187		
K373	FP175	7/18/2012	F	0006F3D4BC	14	unknown		
K374	FP175	7/18/2012	M	0006F3E3A0	14	unknown		
K375	FP175	7/18/2012	M	0006E7876A	14	unknown		
K376	FP180	8/6/2012	M	0006E3AF4C	18	unknown		
K377	FP180	8/6/2012	M	0007136BD2	18	unknown		
K378	FP180	8/6/2012	M	0007137F02	18	unknown		
K379	FP198	10/9/2012	M	0006F3F8DC	12	FP197		
K380	FP198	10/9/2012	M	0006EE4539	12	FP197		
K381	FP198	10/9/2012	M	0006E78830	12	FP197		
K382	FP198	10/9/2012	F	0006E76595	12	FP197		
K383	FP161	12/11/2012	M	0006959E24	16	unknown		
K384	FP161	12/11/2012	F	0006E373C9	16	unknown		
K385	FP151	1/2/2013	F	000695A4ED	17	unknown	2/18/2015	FP240
K386	FP151	1/2/2013	F	000695830A	17	unknown		
K387	FP192	2/26/2013	M	0007138FC0	19	unknown		
K388	FP192	2/26/2013	M	0006957EEB	19	unknown		
K389	FP148	3/10/2013	M	0006F3D86E	18	unknown		
K390	FP148	3/10/2013	F	0006E7807F	18	unknown		
K391	FP148	3/10/2013	F	0006EE3A7F	18	unknown		
K392	FP215	3/21/2013	F	0006E777C2	13	unknown		
K393	FP215	3/21/2013	F	0006E76F0F	13	unknown		
K394	FP218	5/23/2013	M	0006E766AC	14	unknown		
K395	FP218	5/23/2013	M	0006EE21A2	14	unknown		
K396	FP218	5/23/2013	F	0006F3FA62	14	unknown		
K397	FP218	5/23/2013	F	0006E75162	14	unknown		

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
K398	FP219	6/22/2013	F	0006E75AD7	30	unknown		
K399	FP213	9/10/2013	F	0006F3C3B4	21	unknown		
K400	FP213	9/10/2013	M	0006F3D29F	21	unknown		
K401	FP199	9/28/2013	F	0006E75E37	21	unknown		
K402	FP199	9/28/2013	M	0006E7833D	21	unknown		
K403	FP198	12/11/2013	F	0006F3D86D	18-20	159		
K404	FP198	12/11/2013	M	0006327768	18-20	159		
K405	FP198	12/11/2013	M	0001D278E9	18-20	159		
K406	FP220	3/13/2014	F	0006959321	21+	unknown		
K407	FP220	3/13/2014	M	0006959907	21+	unknown		
K408	FP220	3/13/2014	F	0007136A30	21+	unknown		
K409	FP178	3/22/2014	F	0006E752BD	17	unknown		
K410	FP178	3/22/2014	M	0006E75237	17	unknown		
K411	FP215	3/29/2014	M	0006E7740A	21	unknown		
K412	FP215	3/29/2014	F	0006E759F2	21	unknown		
K413	FP162	4/10/2014	M	00071386E3	28-35	unknown		
K414	FP162	4/10/2014	F	00071396F8	28-35	unknown		
K415	FP162	4/10/2014	M	0006E398E0	28-35	unknown		
K416	FP217	4/15/2014	F	0006F3DB91	6	unknown		
K417	FP217	4/15/2014	M	00066E75239	6	unknown		
K418	FP213	4/30/2014	F	0006EE38CC	21	unknown		
K419	FP213	4/30/2014	M	0006E75165	21	unknown		
K420	FP213	4/30/2014	F	0006E75309	21	unknown		
K421	FP229	5/7/2014	M	0006E7870C	14	unknown		
K422	FP229	5/7/2014	M	0006F3F496	14	unknown		
K423	FP229	5/7/2014	F	0006E7577A	14	unknown		
K424	FP221	5/31/2014	M	00069599FB	14	unknown		
K425	FP221	5/31/2014	M	0007135E88	14	unknown		
K426	FP222	6/24/2014	M	0006DE76D4	9	unknown		

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
K427	FP222	6/24/2014	F	0006E7796A	9	unknown		
K428	FP222	6/24/2014	F	0006DE5FB4	9	unknown		
K429	FP162	8/17/2014	M	0006957D11	12	unknown		
K430	FP162	8/17/2014	M	00071386FA	12	unknown		
K431	FP162	8/17/2014	F	0007138A25	12	unknown		
K432	FP219	9/22/2014	F	0006EE2F81	23	unknown		
K433	FP219	9/22/2014	F	0006F3FCOE	23	unknown		
K434	FP219	9/22/2014	F	0006E7DCDC	23	unknown		
K435	FP226	10/12/2014	F	0006E75367	12	FP177		
K436	FP226	10/12/2014	F	0006E77032	12	FP177		
K437	FP224	2/1/2015	M	0006E773F9	17	unknown		
K438	FP224	2/1/2015	M	0006EE1F04	17	unknown		
K439	FP224	2/1/2015	F	0006DE7DD9	17	unknown		
K440	FP224	2/1/2015	M	0006EE4A0B	17	unknown		
K441	FP192	3/23/2015	M	00074FFB31	18	unknown		
K442	FP192	3/23/2015	M	000728A80A	18	unknown		
K443	FP240	6/10/2015	F	00071366D8	12	FP187		
K444	FP240	6/12/2015	M	0007137658	14	FP187		
K445	FP240	6/12/2015	M	0007135F8F	14	FP187		
K446	FP199	6/12/2015	M	0006E78648	21	unknown		
K447	FP199	6/12/2015	M	0006E77B7E	21	unknown		
K448	FP180	9/17/2015	F	000728885D	19	unknown		
K449	FP180	9/17/2015	M	0006E3B8D0	19	unknown		
K450	FP198	10/28/2015	F	0006E75DB5	11	unknown		
K451	FP198	10/28/2015	M	0006E7672F	11	unknown		
K452	FP214	3/3/2016	M	00074F8594	20	unknown		
K453	FP214	3/3/2016	M	00071371B1	20	unknown		
K454	FP185	3/9/2016	F	0006DE7EDE	12	unknown		
K455	FP185	3/9/2016	F	0006E78822	12	unknown		

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
K456	FP185	3/9/2016	F	0006E771CB	12	unknown		
K457	FP221	3/27/2016	M	00071364A3	25	unknown		
K458	FP221	3/27/2016	M	0007136044	25	unknown		
K459	FP180	5/2/2016	F	00072838B8	14	unknown		
K460	FP180	5/2/2016	F	000728E7C8	14	unknown		
K461	FP180	5/2/2016	F	00072875A0	14	unknown		
K462	FP195	5/10/2016	M	0006E7759A	40	unknown		
K463	FP224	10/5/2016	M	0006E7774B	12	unknown		
K464	FP224	10/5/2016	F	0006F3EE4D	12	unknown		
K465	FP224	10/5/2016	F	0006E7796C	12	unknown		
K466	FP214	1/18/2017	M	0006E372BC	21	unknown		
K467	FP214	1/18/2017	M	0007136CF1	21	unknown		
K468	FP247	4/13/2017	F	0006EE357D	10	unknown		
K469	FP247	4/13/2017	M	0006E7568C	10	unknown		
K470	FP247	4/13/2017	M	0006EE23A4	10	unknown		
K471	FP199	4/25/2017	F	0006EE2125	8	unknown		
K472	FP199	4/25/2017	F	0006E78ADA	8	unknown		
K473	FP199	4/25/2017	M	0006EE4C2B	8	unknown		
K474	FP224	6/16/2017	M	0006E7647F	17	unknown		
K475	FP224	6/16/2017	F	982000406136604	17	unknown	4/10/2018	FP251
K476	FP224	6/16/2017	M	982000406139337	17	unknown	4/10/2018	FP252
K477	FP220	6/22/2017	M	00072A4331	12	unknown		
K478	FP220	6/22/2017	F	00074EFFC5	12	unknown		
K479	FP220	6/22/2017	M	000728A726	12	unknown		
K480	FP220	6/22/2017	F	0007283EDC	12	unknown		
K481	FP239	8/19/2017	F	00075802B7	28	unknown		
K482	FP239	8/19/2017	M	00075A5AB8	28	unknown		
K483	FP247	10/14/2017	F	982.000406136536	23	unknown		
K484	FP247	10/14/2017	M	982.000406137064	23	unknown		

Kitten ID	Dam ID	Date marked	Sex	Transponder ID	Estimated age in days	Purported field sire	Date collared	Eventual panther ID
K485	FP220	3/19/2018	F	00075A5046	29	unknown		
K486	FP220	3/19/2018	M	0007283B8E	29	unknown		
K487	FP220	3/19/2018	F	0007136BB2	29	unknown		
K488	FP246	6/16/2018	F	982.000406135664	26	unknown		
K489	FP246	6/16/2018	M	982.000406137233	26	unknown		
K490	FP246	6/16/2018	M	982.000406137374	26	unknown		

[a] The remains of a sibling to K24-26 were found at the den site. Condition of the carcass made sex identification impossible.
[b] This kitten was not observed or marked at the den, but was captured at the carcass of the dam on 2/5/1998. Eventually released into the wild as FP69.
[c] This kitten was not observed or marked at the den, but was captured near FP48 and collared as FP75 on 1/11/1999. Reunited with FP48 the following day.
[d] FP95 was observed with 2 kittens from the air on 1/2, 3/31, and 4/1/2003, verifying that at least 1 littermate of K112 was not recorded on 4/21/2002.

Appendix III. List of all known dens of radiocollared female Florida panthers and Texas pumas in southern Florida from June 1985 to June 2018. Kitten numbers preceded with "K" indicate natal den was visited. Samples are ordered by female ID and secondarily by year. Data collected by FWC and BCNP.

Panther ID	Den date	Location[a]	Habitat	Minimum number of kittens at den	Kittens handled	Purported field sire
FP009	Jun-1985	S Golden Gate Estates	Unknown	1	FP10♂ den not visited	Unknown
FP009	Jun-1987	FSPSP	Hardwood hammock	1	den not visited	FP12
FP009	May-1989	FSPSP	Mixed swamp	Unknown	den not visited	Unknown
FP009	Jul-1990	FSPSP	Mixed swamp	2	FP202♂, FP203♂ den not visited	FP37
FP009	Jun-1993	FSPSP	Hardwood hammock	Unknown	den not visited	FP51
FP011	May-1986	BCNP - Bear Island	Pine/palmetto	3	FP19♀ den not visited	FP12
FP011	May-1988	BCNP - Bear Island	Pine/palmetto	1	FP29♂ den not visited	FP20
FP011	Apr-1990	BCNP - Bear Island	Palmetto/oaks	1	♀(roadkill) den not visited	FP12
FP011	Jul-1991	Price's	Unknown	1	FP47♂ den not visited	FP12
FP011	Mar-1993	BCNP - Bear Island	Unknown	Unknown	den not visited	FP12
FP014	Apr-1989	Long Pine Key	Pine/palmetto	2	FP42♂, den not visited	FP16
FP014	Mar-1991	Long Pine Key	Pine/palmetto	Unknown	den not visited	FP16
FP015	May-1988	Long Pine Key	Vines/ferns	Unknown	den not visited	FP16
FP019	Mar-1988	Price's	Pine/palmetto	4	FP30♂ den not visited	FP13
FP019	Jul-1989	FPNWR	Palmetto, myrtle	1	FP43♂ den not visited	FP12
FP019	Nov-1990	Rock Spring Island	Pine/palmetto	2	FP205♀, FP45♂ den not visited	FP12
FP019	Mar-1992	NE Hog Pond	Pine/palmetto	2	UCFP21♀, FP53♂ den not visited	FP12
FP019	May-1994	FPNWR	Mixed swamp	2	K12♀,K13♀	FP51
FP019	Mar-1996	Barfield's	Cypress swamp	2	K27♀,K28♀	FP54, FP51
FP023	Aug-1992	SBCNP-Raccoon Point	Pine/palmetto	2	FP209♀,FP210♂	FP42
FP023	Dec-1992	SBCNP-Raccoon Point	Pine/palmetto	1	FP55♀ den not visited	FP42
FP031	Mar-1989	Catherine Island	Pine/palmetto	3	FP34♂, FP35♂ den not visited	FP12
FP031	Jul-1990	Regency Farms	Palmetto/myrtle	2	FP201♂,FP204♀ den not visited	FP12
FP031	Sep-1991	Barfield's	Palmetto	2	FP48♀, FP52♀ den not visited	FP12
FP032	Mar-1989	Catherine Island	Pine/palmetto	Unknown	den not visited	Unknown
FP032	May-1992	FPNWR	Palmetto	1	FP208♀	FP12
FP032	Mar-1996	FPNWR	Pine/palmetto	1	UCFP24 (Dead ♀)	Unknown
FP036	Mar-1990	BCSIR	Pine/palmetto	Unknown	den not visited	Unknown
FP036	May-1991	BCNP - Addition Lands	Palmetto	2	FP207♂, FP50♂ den not visited	FP26

Panther ID	Den date	Location[a]	Habitat	Minimum number of kittens at den	Kittens handled	Purported field sire
FP036	Oct-1993	N of BCSIR	Pine/palmetto	1	den not visited	FP26, FP34
FP036	Jun-1995	Canoe Lake Strand	Mixed swamp	Unknown	den not visited	FP45
FP036	Jan-1996	Wilson Cypress	Hardwood hammock	4	K24♀,K25♂,K26♂,UCFP44	FP45
FP040	Nov-1990	BCNP-Baker's Grade	Hardwood/Schinus	2	FP206♀, FP44♂ den not visited	FP26
FP040	Mar-1992	BCNP-Baker's Grade	Pine/palmetto	2	FP54♂, K02♂	FP28
FP040	May-1993	BCNP-Baker's Grade	Cypress, cabbage	3	K03♂,K04♀,K05♀	FP26
FP040	Apr-1997	BCNP - Addition Lands	Pine/palmetto	2	FP69♀, K37♂	FP45
FP040	Sep-1995[b]	Unknown	Unknown	1	FP60♂, ♀ tracks, den not visited	Unknown
FP048	Oct-1993	BCNP - Bear Island	Palmetto	3	K06♂,K07♀,K08♀	FP12
FP048	Jun-1995	Dozier Hammock	Palmetto	2	FP59♂,K17♀	Unknown
FP048	Sep-1996	NE Doctor's Hammock	Pine/palmetto	3	FP62♂,FP64♂,UCFP50♂	Unknown
FP048	Jun-1998	BCNP - Bear Island	Pine/palmetto	2	K51♂, FP75♀	FP68 or FP45
FP048	Oct-1999	BCNP - Bear Island	Pine/palmetto	2	K74♀, K75♀(abandoned)	FP63 or FP68
FP049	Jan-1999	BCNP - Addition Lands	Unknown	1	K55♂	Unknown
FP049	Aug-2001	BCNP - Addition Lands	Unknown	1	K107♂	Unknown
FP052	Jul-1993	Sadie Cypress	Palmetto	2	UCFP23♂ (roadkill) den not visited	FP46
FP052	Jul-1994	Sadie Cypress	Hardwood hammock	Unknown	den not visited	Unknown
FP055	Apr-1995	BCNP	Pine/palmetto	2	K14♀,K15♀	FP42
FP055	Sep-1997	SBCNP - N Burns Lake	Palmetto	1	K44♂	Unknown
FP055	Feb-1998	SBCNP - N Monument Lake	Palmetto	3	FP102♀,K49♀,K50♂	Unknown
FP055	Apr-1999	BCNP	Palmetto	2	FP87♀, K61♂	Unknown
FP055	Jun-2001	SBCNP - NE Airplane Prairie	Palmetto	1	K104♂	FP79
FP055	May-2002	BCNP	Pine/palmetto	1	K127♀	FP79
FP055	Sep-2003	BCNP	Pine/cabbage	Unknown	den not visited	Unknown
FP056	Apr-1994	BCNP-Baker's Grade	Pine/palmetto	3	K09♂,K10♀,K11♂	Unknown
FP056	Oct-1995	North BCSIR	Sawgrass marsh	3	K20♂,K21♂,K22♂	FP45
FP056	Jul-1996	North BCSIR	Fern bed	2	K29♀?,K30♀	FP45
FP056	May-1997	BCNP-Baker's Grade	Unknown	4	K40♂,K41♀,K43♂, FP67♀	FP45
FP057	Jun-1998	FSPSP	Palmetto	Unknown	den not visited	FP54
FP061	Mar-1999	Long Pine Key	Pine/palm	1	FP85♂	FP16
FP061	Sep-2002	EVER - East	Sawgrass marsh	4	K139♀, K140♂, K141♂, K142♀	Unknown
FP066	Sep-1998	Belle Meade	Palmetto	3	K52♂,K53♀,K54♂	FP72
FP066	Dec-1999	Private lands	Hardwood hammock	3	K76♂,K77♀,K78♀	FP60
FP067	Aug-2000	Private lands	Pine/palmetto	2	K84♂, K85♀	Unknown
FP067	May-2001	Private lands	Hardwood hammock	4	K98♀,K99♂,K100♂, K101♂	Unknown

Panther ID	Den date	Location[a]	Habitat	Minimum number of kittens at den	Kittens handled	Purported field sire
FP067	Jun-2002	Private lands	Brazilian pepper	3	FP116♀, K133♂, K134♂	Unknown
FP069	Jul-1999	BCNP - NE of Baker's Camp	Hardwood hammock	3	K71♂,K72♀,K73♀	Unknown
FP070	Jun-1999	SBCNP–NE of Monument Lk	Pine/palmetto	3	FP88♀, FP92♂, FP91♀	FP79
FP070	May-2004	SBCNP - Turner River Unit	Palmetto/vines	3	K167♀ , K168♂, FP161♀	Unknown
FP071	Jun-1999	BCNP	Mixed swamp	4	FP90♂, FP86♀, K69♂, K70♀	FP79
FP073	Aug-1997[c]	BCSIR	Unknown	1	FP74♂ den not visited	Unknown
FP073	Feb-1999	BCSIR	Pine/palmetto	1	FP84♂ den not visited	Unknown
FP073	Feb-2002	BCNP - Addition Lands	Pine/palmetto	3	K109♂, K110♂, K111♀	Unknown
FP075	Apr-2000	Private lands	Hardwood hammock	Unknown	den not visited	Unknown
FP075	Jun-2001	NBCNP - Bear Island	Pine/palmetto	2	K102♂,K103♂	FP59
FP075	May-2002	NBCNP - Bear Island	Pine/palmetto	2	K128♂, K129♂	FP98, FP100
FP075	Mar-2004	NBCNP - Bear Island	Pine/palmetto	3	K157♂, K158♂, K159♀	Unknown
FP075	Aug-2005	NBCNP - Bear Island	Hardwood hammock	4	K192♂, K193♀, K194♀, K195♂	FP135
FP077	May-2000	BCNP - Addition Lands	Palmetto/vines	3	K81♂,K82♀,K83♂	Unknown
FP077	Aug-2001	BCNP - Addition Lands	Pine/palmetto	1	K108♂	Unknown
FP078	Apr-2000	FPNWR	Palmetto/oak	2	FP107♀, FP96♂	FP59
FP078	Apr-2002	FPNWR	Palmetto	4	K117♀, K118♀, K119♀, K120♂	FP59
FP082	Dec-2000	OSSF	Unknown	3	K86♀,K87♀,K88♂	FP65
FP083	Apr-2002	FSPSP	Pine/palmetto	1	K123♂	Unknown
FP083	Jun-2004	FSPSP	Pine/palmetto	Unknown	den not visited	Unknown
FP087	Jan-2001	SBCNP	Pine/palmetto	3	K89♀,FP108♂,K91♂	FP79
FP087	Mar-2003	SBCNP - N of Oasis	Pine/palmetto	3	K143♀, K144♂, K145♀	FP79
FP088	May-2001	SBCNP - Loop Unit	Cypress/ferns	4	K94♂,K95♀,K96♂, K97♀	Unknown
FP093	Apr-2002	SBCNP - Turner River Unit	Pine/palmetto	4	FP151♀, K114♀, FP119♂, K116♀	FP79
FP093	Jul-2003	SBCNP - Turner River Unit	Hardwood hammock	3	FP150♀, K153♂, K154♂	FP60
FP093	Jun-2006	SBCNP - Turner River Unit	Tropical hardwood	3	K211♀, K212♀, K213♀	FP133
FP093	Feb-2007	SBCNP - Turner River Unit	Pine/palmetto	3	K226♂, FP163♂ , FP220♀	Unknown
FP094	Jun-2006	EVER - CIA hammock	Hardwood hammock	3	K205♀, K206♂, K207♀	Unknown
FP095	Mar-2002	EVER - Long Pine Key	Pine/palmetto	1	K112♀	FP85
FP095	Jun-2006	EVER - Long Pine Key	Hardwood/palmetto	3	K214♀, K215♀, K216♂	Unknown
FP101	Apr-2002	BCSIR	Pine/palmetto	2	K121♂, K122♀	Unknown
FP101	Apr-2003	Private lands	Pine/palmetto	3	K146♀, K147♂, K148♀	FP65/FP100
FP102	Jun-2001	SBCNP - Monument Lake	Pine/palmetto	2	K105♂,K106♂	FP79
FP102	Jul-2002	SBCNP - Monument Lake	Hardwood hammock	2	K137♀, K138♂	FP79
FP102	Jul-2004	SBCNP - Burns Lake	Hardwood hammock	3	K170♀,K171♂,K172♀	FP79

Panther ID	Den date	Location[a]	Habitat	Minimum number of kittens at den	Kittens handled	Purported field sire
FP102	Jun-2006	SBCNP - Turner River Unit	Hardwood hammock	2	K217♂, K218♂	FP138
FP102	Jun-2010	SBCNP	Pine/palmetto	2	K303♂ , K304♂	Unknown
FP103	Apr-2007	SBCNP - Corn Dance	Hardwood hammock	3	K236♀, K237♀, K238♂	FP127
FP106	May-2002	FPNWR	Hardwood hammock	3	K124♀, K125♂, K126♂	Unknown
FP107	Jun-2002	FPNWR	Hardwood hammock	2	K135♂, K136♀	Unknown
FP107	May-2004	FPNWR	Hardwood hammock	4	K163♂ ,K164♂ ,K165♀ ,K166♀	Unknown
FP107	Mar-2005	FPNWR	Hardwood hammock	2	K180♀ , K181♀	FP119, FP131
FP107	Feb-2006	FPNWR	Pine/palmetto	2	K200♀, K201♂	FP131
FP107	Apr-2007	FPNWR - Rock Island	Pine/palmetto	3	K247♀, K248♂, K249♀	Unknown
FP107	Sep-2007	FPNWR	Pine/palmetto	3	K261♂, K262♂, K263♂	Unknown
FP110	May-2003	OSSF	Pine/palmetto	3	K149♀,K150♂,K151♀	Unknown
FP110	Feb-2005	OSSF	Pine/palmetto	2	K178♂ ,K179♀	Unknown
FP110	Nov-2005	OSSF	Hardwood hammock	4	K196♂ ,K197♂ ,K198♂ ,K199♀	Unknown
FP110	Mar-2007	OSSF	Pine/palmetto	4	K229♀, K230♂, K231♀,K232♂	FP137
FP110	Aug-2007	OSSF	Hardwood hammock	2	K257♂, K258♂	Unknown
FP110	Nov-2007	OSSF-Dog Island	Palmetto	Unknown	den not visited	Unknown
FP110	Aug-2010	OSSF	Palmetto	3	K312♀, K313♀, K314♂	Unknown
FP110	Dec-2011	OSSF	Pine/palmetto	2	K343♀, K344♀	Unknown
FP112	Jun-2002	NBCNP - Bear Island	Pine/palmetto	2	K130♂, K131♂	FP98, FP100
FP113	Aug-2004	FPNWR	Pine/palmetto	Unknown	UCFP67	Unknown
FP113	Apr-2005	FPNWR	Pine/palmetto	2	K185♀ , K186♀	FP131, FP133
FP113	Mar-2007	FPNWR	Hardwood hammock	3	K233♀, K234♂, K235♂	FP119
FP113	Apr-2009[d]	FPNWR	Unknown	1	1 kitten via remote camera	Unknown
FP113	Jul-2010	Barron Collier, N. of FPNWR	Pine Palmetto	3	K307♀, K308♂, K309♀	Unknown
FP113	Mar-2011	Barron Collier, N. of FPNWR	Pine Palmetto	1	K321♂	Unknown
FP113	Aug-2011	Barron Collier, N. of FPNWR	Pine Palmetto	1	K342♀	Unknown
FP116	Apr-2004	Hendry Co. Gum Swamp	Hardwood hammock	3	K160♀,K161♀,K162♂	FP65
FP116	May-2005	NBCNP- Addition Lands	Pine/palmetto	3	K187♂, K188♀, K189♂	Unknown
FP120	Jan-2004	SBCNP - Turner River Unit	Pine/palmetto	2	K155♀, K156♂	Unknown
FP121	Aug-2004	BCSIR	Pine/palmetto	1	K173♀	Unknown
FP121	Feb-2006	BCSIR	Pine/palmetto	3	K202♀, K203♂, K204♂	Unknown
FP124	Sep-2004	SBCNP - Stairsteps	Pine/palmetto	1	K174♂	Unknown
FP124	Jan-2005	SBCNP - Pinecrest	Pine/palmetto	3	K175♂, K176♂, K177♀	Unknown
FP124	Feb-2007	SBCNP - Stairsteps	Cypress/hardwood	2	K224♂, K225♂	Unknown
FP128	Jun-2005	BCSIR	Pine/palmetto	2	K190♂, K191♂	Unknown

Panther ID	Den date	Location[a]	Habitat	Minimum number of kittens at den	Kittens handled	Purported field sire
FP128	May-2007	Stirelli property - Add Lands	Palmetto/fern	3	K250♂, K252♂, K252♀	Unknown
FP129	Apr-2005	SBCNP- Corn Dance	Unknown	3	K182♀, K183♂, K184♂	Unknown
FP140	Nov-2006	FPNWR	Hardwood hammock	2	K219♀, K220♂	FP119
FP140	May-2008	FPNWR	Cypress/ferns	2	K266♂, K267♂	FP154
FP145	Jun-2006	SBCNP -Deep Lake	Pine/palmetto	3	K208♀, K209♀, K210♀	FP138
FP145	Apr-2007	SBCNP - Deep Lake	Hardwood hammock	3	K244♂, K245♂, K246♀	FP133
FP145	Feb-2010	SBCNP	Palmetto	3	K291♀, K292♂, K293♀	Unknown
FP145	Jun-2011	SBCNP	Palmetto	3	K337♂ , K338♀ , K339♀	Unknown
FP145	Feb-2012	SBCNP- Deep Lake	Hardwood hammock	3	K345♂, K346♀, K347♂	Unknown
FP148	Jan-2007	Belle Meade-PSSF	Palmetto	3	K221♀, K222♂, K223♀	FP146
FP148	Apr-2010	Belle Meade-PSSF	Pine/palmetto	3	K297♀, K298♀, K299♂	Unknown
FP148	Jan-2011	Belle Meade-PSSF	Cypress swamp/ferns	2	K315♂ , K316♂	Unknown
FP148	Mar-2013	Belle Meade-PSSF	Cypress swamp/ferns	3	K389♂ , K390♀ , K391♀	Unknown
FP149	Apr-2007	PSSF	Bracken fern	2	K239♀, K240♀	Unknown
FP150	Jul-2007	SBCNP	Palmetto	4	K253♂, K254♀, K255♀, K256♀	Unknown
FP151	Apr-2007	SBCNP- Turner River	Palmetto	3	K241♂, K242♀, K243♀	Unknown
FP151	Aug-2007	SBCNP	Palmetto	2	K259♂, K260 unknown sex	Unknown
FP151	Mar-2008	SBCNP-Turner River	Palmetto	2	K264♀, K265♂	Unknown
FP151	Jun-2011	SBCNP-Turner River	Palmetto	2	K340♀ , K341♂	FP187
FP151	Jan-2013	SBCNP-Turner River	Palmetto	2	K385♀, K386♀	Unknown
FP153	Jul-2008	SBCNP-Turner River	Palmetto	3	K274♀, K275♂, K276♂	Unknown
FP153	Jul-2009	SBCNP	Hardwood hammock	2	K281♂, K282♂	Unknown
FP153	Feb-2012	SBCNP- Turner River	Saw Palmetto	4	K348♂, K349♂, K350♂, K351♂	Unknown
FP158	Jun-2008	CSSP	Pepper/climbing fern	4	K270♀, K271♂, K272♂, K273♂	FP146
FP158	Apr-2010[e]	PSSF	Pine/palmetto	2	kittens not handled	Unknown
FP160	Oct-2008	Jack-In-The-Box Ranch CREW	Hardwood hammock	Unknown	Den not visited	Unknown
FP161	Feb-2009	SBCNP	Palmetto	3	K277♂, K278♂, K279♀	Unknown
FP161	May-2010	SBCNP	Pine/palmetto	3	K300♂, K301♀, K302♀	Unknown
FP161	Apr-2012	SBCNP-Turner River	Pine/Palmetto	4	K357♀ , K358♂ , K359♂ , K360♀	Unknown
FP161	Dec-2012	SBCNP-Turner River	Pine/palmetto	2	K383♂, K384♀	Unknown
FP162	May-2008	SBCNP-Turner River	Hardwood hammock	2	K268♀, K269♂ (both dead)	FP138
FP162	Apr-2009	SBCNP	Hardwood hammock	1	K280♀	Unknown
FP162	Mar-2010	SBCNP	Hardwood hammock	3	K294♂, K295♀, K296♀	FP133
FP162	Apr-2011	SBCNP	Palmetto	4	K322♀, K323♂, K324♂, K325♂	Unknown
FP162	Jun-2012	SBCNP	Palmetto	2	K367♂ , K368♀	FP187

Panther ID	Den date	Location[a]	Habitat	Minimum number of kittens at den	Kittens handled	Purported field sire
FP162	Apr-2014	SBCNP	Hardwood hammock	3	K413♂ ,K414♀ , K415♂	Unknown
FP162	Aug-2014	BCNP-Turner River	Palmetto	3	K429♂, K430♂, K431♀	Unknown
FP168	Jul-2009	CREW-Flint Pen	Pine/palmetto/fern	2	K283♂, K284♂	Unknown
FP170	Jul-2009	PSSF	Cabbage Palm/shrub	3	K285♂. K286♂, K287♀	Unknown
FP172	Feb-2010	NBCNP- Addition Lands	Palmetto	3	K288♂. K289♂, K290♂	Unknown
FP175	Aug-2010	NBCNP, Bear Island	Pine/palmetto	2	K310♀, K311♀	Unknown
FP175	Jan-2011	NBCNP, Bear Island	Palmetto/pine scrub	2	K319♂ , K320♀	Unknown
FP175	Jul-2012	NBCNP, Bear Island	Hardwood hammock	3	K373♀ , K374♂, K375♂	Unknown
FP178	Jun-2010	NBCNP, Bear Island	Pine/palmetto	2	K305♂, K306♂	Unknown
FP178	Jan-2011	NBCNP, Bear Island	Palmetto/oak scrub	2	K317♂, K318♂	Unknown
FP178	Jul-2012	NBCNP, Bear Island	Pine/palmetto	3	K369♀ , K370♀ , K371♀	Unknown
FP178	Mar-2014	Bear Island, south of E Hinson	Pine/palmetto	2	K409♀ , K410♂	Unknown
FP180	Mar-2011[f]	SBCNP	Unknown	2	den not visited	Unknown
FP180	Aug-2012	SBCNP-Deep Lake Unit	Hardwood/fern	3	K376♂ , K377♂ , K378♂	Unknown
FP180	Sep-2015	SBCNP-Deep Lake Unit	Saw Palmetto	2	K448♀,K449♂	Unknown
FP180	May-2016	SBCNP-Deep Lake Unit	Palmetto	3	K459♀, K460♀, K461♀	Unknown
FP182	Apr-2011	SBCNP	Hardwood scrub	4	K330♂, K331♂, K332♀, K333♂	Unknown
FP184	Apr-2011	NBCNP, Addition Lands	Saw Palmetto	4	K326♂, K327♂, K328♀, K329♂	Unknown
FP185	Mar-2016	Immokalee Ranch	Palmetto	3	K454♀, K455♀, K456♀	Unknown
FP188	May-2011	Troyer Bros., Lee County	Cypress/ferns	3	K334♀, K335♂, K336♂	Unknown
FP190	May-2012	SBCNP-Raccoon Point	Oak Palmetto	3	K361♀ , K362♂ , K363♀	Unknown
FP191	Mar-2012	SBCNP- Turner River	Pine Island	1	K353♂	Unknown
FP191	Jul-2012	SBCNP- Turner River	Pine Island	1	K372♀	FP187
FP192	Apr-2012	SBCNP-Corn Dance Unit	Hardwood/Fern	3	K354♂, K355♂, K356♂	Unknown
FP192	Feb-2013	SBCNP-Corn Dance Unit	Pine-Hardwood	2	K387♂ , K388♂	Unknown
FP192	Mar-2015	SBCNP-Corn Dance Unit	Pine/palmetto	2	K441♂ , K442♂	Unknown
FP195	Mar-2012	PSSF	Pine/palmetto	1	K352♂	Unknown
FP195	Jan-2014	FPNWR	Sawgrass	1	UCFP205♂	Unknown
FP195	Sep-2014[g]	SE Golden Gate Estates	Hardwood hammock	2	den not visited	Unknown
FP195	Apr-2016	PSSF	Pine cabbage/fern	1	K462♂	Unknown
FP198	Oct-2012	Corkscrew Water Treat Plant	Cogan grass	4	K379♂, K380♂, K381♂, K382♀	FP197
FP198	Dec-2013	LCPA Mitigation Land	Palmetto	3	K403♀ , K404♂ , K405♂	FP159
FP198	Oct-2015	FL Rock, N of LCPA	Palmetto, Grapevine	2	K450♀ , K451♂	Unknown
FP199	Sep-2013	NBCNP - Addlands	Hardwood/fern	2	K401♀ , K402♂	Unknown
FP199	Jun-2015	NBCNP- Addlands	Hardwood/fern	2	K446♂ , K447♂	Unknown

Panther ID	Den date	Location[a]	Habitat	Minimum number of kittens at den	Kittens handled	Purported field sire
FP199	Apr-2017	NBCNP-Addlands	Hardwood/fern	3	K471♀, K472♀, K473♂	Unknown
FP213	Jun-2012	OSSF- 4 Sections	Palmetto	3	K364♂, K365♀ , K366♂	Unknown
FP213	Sep-2013	OSSF- 4 Section	Hardwood hammock	2	K399♀,K400♂	Unknown
FP213	Apr-2014	Alico Ranch south of Keri Rd.	Sawgrass	3	K418♀, K419♂, K420♀	Unknown
FP214	Mar-2016	SBCNP-Turner River	Palmetto	2	K452♂, K453♂	Unknown
FP214	Dec-2016	SBCNP-Turner River	Palmetto	2	K466♂, K467♂	Unknown
FP215	Mar-2013	Barron Collier	Pine/palmetto	2	K392♀ , K393♀	Unknown
FP215	Mar-2014	Barron Collier	Shrub/brush	2	K411♂ ,K412♀	Unknown
FP217	Apr-2014	OSSF- 4 Section	Pine/palmetto	2	K416♀,K417♂	Unknown
FP218	May-2013	Alico North of Keri Rd	Palmetto	4	K394♂ , K395♂ , K396♀ , K397♀	Unknown
FP219	Jun-2013	FSPSP	Maple Fern	1	K398♀	Unknown
FP219	Sep-2014	Naples National Golf Course	Pine/palmetto	3	K432♀, K433♀, K434♀	Unknown
FP220	Mar-2014	SBCNP-Turner River	Palmetto	3	K406♀ , K407♂, K408♀	Unknown
FP220	Jun-2017	SBCNP-Turner River	Palmetto	4	K477♂, K478♀, K479♂, K480♀	Unknown
FP220	Feb-2018	SBCNP-Turner River	Pine/palmetto	3	K485♀, K486♂, K487♀	Unknown
FP221	May-2014	SBCNP-Turner River	Palmetto	2	K424♂ , K425♀	Unknown
FP221	Mar-2016	SBCNP-Turner River	Palmetto	2	K457♂, K458♂	Unknown
FP222	Jun-2014	Barron Collier	Palmetto	3	K426♂, K427♀, K428♀	Unknown
FP224	Feb-2015	North Belle Meade	Pine/palmetto	4	K437♂, K438♂, K439♀, K440♂	Unknown
FP224	Oct-2016	North Belle Meade	Pine/palmetto	3	K463♂, K464♀, K465♀	Unknown
FP224	Jun-2017	North Belle Meade	Pine/palmetto	3	K474♂, K475♀, K476♂	Unknown
FP226	Oct-2014	NBCNP- Addlands	Fern/palmetto	2	K435♀, K436♀	FP177
FP229	May-2014	NBCNP- Addlands	Sawgrass	3	K421♂ , K422♂ , K423♀	Unknown
FP239	Jul-2017	SBCNP-Turner River	Pine/palmetto	2	K481♀, K482♂	Unknown
FP240	Jun-2015	SBCNP-Turner River	Palmetto	3	K443♀ , K444♂, K445♂	FP187
FP246	Jun-2018	Immokalee Ranch	Palmetto	3	K488♀, K489♂, K490♂	Unknown
FP247	Apr-2017	Immokalee Ranch	Agr./exotic grass	3	K468♀, K469♂, K470♂	Unknown
FP247	Oct-2017	Immokalee Ranch	Palmetto	2	K483♀, K484♂	Unknown
TX101	Sep-1995	BCSIR	Pine/palmetto	2	FP73♀ , FP79♂	Unknown
TX101	Dec-1996	BCSIR	Palmetto/oak	2	FP65♂, FP66♀	FP45
TX105	Aug-1996	EVER - Long Pine Key	Tropical hardwood	1	K34♀	FP16
TX105	Jul-1999	EVER - Long Pine Key	Brazilian pepper	1	FP94F1♀ den not visited	FP16
TX106	Nov-1995	S Golden Gate Estates	Cypress/mixed	1	K23♀	FP51
TX106	Feb-1998	N Golden Gate Estates	Vines/cabbage	1	K47♂	FP54, FP59
TX106	Jun-1999	PSSF	Cabbage	2	K62♀, FP83♀	FP54

Panther ID	Den date	Location[a]	Habitat	Minimum number of kittens at den	Kittens handled	Purported field sire
TX106	Mar-2001	FPNWR	Pine/palmetto	2	K92♀, FP181♂	FP60
TX107	Apr-1997	SBCNP - N of Oasis	Pine/palmetto	2	FP70♀, FP71♀	Unknown
TX107	Feb-1999	SBCNP - N of Buckskin Prairie	Pine/palmetto	3	FP191♀, K57♂, FP93♀	FP79
TX108	Jun-1996	EVER - Long Pine Key	Tropical hardwood	1	FP61♀ den not visited	FP16
TX108	Jan-1998	EVER - Long Pine Key	Tropical hardwood	2	FP95♀, K46♂	FP16

[a]BCNP = Big Cypress National Preserve; BCSIR = Big Cypress Seminole Indian Reservation; CREW = Corkscrew Regional Ecosystem Watershed; CSSP = Collier-Seminole State Park; EVER = Everglades National Park; FPNWR = Florida Panther National Wildlife Refuge; FSPSP = Fakahatchee Strand Preserve State Park; LCPA = Lee County Port Authority Mitigation Area; NBCNP = Big Cypress National Preserve north of Interstate 75; OSSF = Okaloacoochee Slough State Forest; PSSF = Picayune Strand State Forest/Wildlife Management Area; SBCNP = Big Cypress National Preserve south of Interstate 75.

[b]FP40 had lost her collar when her kitten FP60 was captured at 6 months of age on 3/6/96. Den is assumed to have dated to September 1995.

[c]FP73 was marked as a kitten then captured with her 15month old kitten FP74 on 11/12/98. Den is assumed to have dated to August 1997.

[d]FP113 den in April 2009 was not documented by FWC during routine monitoring. A 4 month old kitten was photographed with FP113 on 28 July 2009 via trail camera on FPNWR.

[e]FP158 den in April 2010 was visited by FWC, but kittens were not sampled or marked. This litter subsequently failed with the death of FP158 on 22 May 2010.

[f]FP180 den in March 2011 was not documented by BCNP staff. A visual was obtained of FP180 with two 4 month old kittens on 8 July 2011 during routine aerial telemetry monitoring.

[g]FP195 den in September 2014 was not documented by FWC after repeated attempts at locating the site. Video of FP195 with two kittens crossing under I75 from FPNWR verified litter in June 2015.

Appendix IV. Florida panther and Texas puma mortalities, injuries, and removal to captivity sorted by year through 30 June 2018. Data collected by FWC and BCNP. Ages are estimated unless panthers were handled as kittens at natal dens. Age values are in years unless noted otherwise.

Date	Panther ID	Sex	Age	Location[a]	Cause
Circa 1940s	UCFP01	U	Unknown	Immokalee, Collier Co.	Preserved skin, skull and bones
Circa 1954	UCFP47	U	Unknown	Rocky Lake, Hendry Co.	Taxidermy pelt from hunted specimen
2/13/1972	UCFP28	M	2 to 3	SR 25 S of Moore Haven	Vehicle
3/8/1978	UCFP02	M	2 to 3	L-28, Dade Co.	Illegally shot
2/1/1979	UCFP03	M	unknown	US 41, Gannet Strand	Unknown
12/23/1979	UCFP04-(G80-4)	F	1.5 to 2.5	SR 29 just N SR 84 (now I-75)	Vehicle
2/7/1980	UCFP05-(G80-15)	M	1.5 to 2.5	SR 29 near Sunniland	Vehicle
4/19/1981	UCFP06-(G81-19)	F	2 to 3	SR 29 near Copeland	Vehicle
4/16/1982	FP06	M	6 to 7	SBCNP	Unknown
1/17/1983	FP03	F	9+	FSSP	Capture
3/18/1983	UCFP09-(G83-22)	M	2 to 3	US 27 Palmdale	Vehicle
5/22/1983	UCFP10	F	adult	L-8 canal near Canal Point, Palm Beach Co.	Illegally shot
11/18/1983	FP05	F	8 to 9	Fakahatchee Conservation Club (now FPNWR)	Unknown
12/1/1983	UCFP08	M	3 to 6	BCSIR	Illegally shot
12/14/1983	FP01	M	12 to 14	SR 84 (now I-75)	Vehicle
11/28/1984	FP02	M	14+	FSSP	Intraspecific aggression
10/30/1984	UCFP11	F	2 to 3	Corbett WMA, Palm Bch. Co. (Elmer Brooker)	Illegally shot
11/2/1984	BIG GUY (FP200)	M	2 to 4	US 41 near Turner River	Vehicle - **injured**
11/12/1984	UCFP12-(G84-26)	F	8 to 10	SR 84 (now I-75)	Vehicle
1/8/1985	UCFP13-(G85-BNZ)	F	1.5 to 2	SR 84 (now I-75)	Vehicle
3/23/1985	UCFP14	F	2 to 3	Collier Seminole State Park, Collier Co.	Illegally shot (skeleton)
4/18/1985	FP04	M	12+	SR 84 (now I-75)	Vehicle
5/12/1985	NONE	F	UNK	CR 951, 2 miles N of US 41	Vehicle - **injured**
10/26/1985	FP07	M	10	SR 29, 4 miles S of SR 84 (now I-75)	Vehicle
1/1/1986	FP09	F	not fatal	Golden Gate Estates, S of SR 84 (now I-75)	Illegally shot (**not fatal**)
11/15/1986	UCFP15	F	4 to 5	SR 84 (now I-75)	Vehicle
1/27/1987	FP10	M	16 to 20 mo.	Mud Lake Strand, now FPNWR	Intraspecific aggression - by adult male panther
6/17/1987	FP20	M	3 to 4	CR 858 .8 miles E of SR 29	Vehicle - **injured**
12/14/1987	FP13	M	6 to 8	SR 29 Sunniland	Vehicle
12/19/1987	UCFP17	M	10	Crane Swamp, Farmton WMA, Volusia Co.	Unknown (skeletal remains)
6/10/1988	FP15	F	7 to 8	EVER	Unknown

Date	Panther ID	Sex	Age	Location[a]	Cause
7/23/1988	FP21	F	2.5	1 mile E of US1 on Palm Drive	Vehicle - **injured**
8/20/1988	FP08	F	13 to 15	Gainesville	Liver failure (old age)
8/22/1988	FP24	M	3 to 5	Glades Co. near Palmdale	Unknown
8/24/1988	FP20	M	4 to 5	Bear Island	Congenital heart defect
8/26/1988	FP25	M	4 to 5	FPNWR	Intraspecific aggression - bacterial infection
11/29/1988	FP28	M	1.5 to 2	Near Daniels Road, RSW Airport	Vehicle - **injured**
1/25/1989	UCFP18	M	3	CR 850, 1.5 miles S of SR 82	Vehicle
7/23/1989	FP27	M	3 to 4	EVER	Unknown
11/25/1989	FP33	M	3	2 mi. NW of Hendry Prison	Rabies
1/24/1990	FP35	M	10 mo.	Gainesville	Capture-related abandonment (infection)
1/29/1990	FP30	M	22 mo.	FSSP	Intraspecific aggression- killed by FP37
6/18/1990	UCFP19	M	10 mo.	CR 835, 1 mile E of CR 833	Vehicle
6/18/1990	FP39	M	3 to 4	EVER	Pyothorax
7/23/1990	FP17	M	9	NBCNP, near Tangerine Camp	Unknown
9/26/1990	FP41	F	2	W of BCSIR, Hendry Co.	Intraspecific aggression- killed by FP28
10/3/1990	FP18	F	9	S of CR 846 near Rocky Lake, Hendry Co.	Intraspecific aggression- killed by FP28
11/26/1990	FP37	M	4 to 5	SR 29, 0.5 miles N of I-75	Vehicle
2/4/1991	UCFP20	F	9 mo.	SR 29, at Pistol Pond	Vehicle
6/20/1991	FP14	F	10 to 11	EVER	Unknown
7/20/1991	FP22	F	5	EVER	Infection
11/1/1991	FP43	M	2	BCSIR, Hendry Co.	Intraspecific aggression - killed by FP26
4/7/1992	NONE	M	Unknown	Alico Road, Lee Co.	Vehicle - **injured**
5/27/1992	FP29	M	4	Hendry Co., Gum Swamp	Pseudorabies
9/25/1992	FP28	M	5.5	BCSIR, Hendry Co.	Intraspecific aggression - possibly killed by FP26
11/9/1992	UCFP21	F	7 mo.	SR 29, Sunniland	Vehicle
2/19/1993	FP47	M	18 mo.	FSSP	Intraspecific aggression - killed by FP51
2/26/1993	FP53	M	11 mo.	Private lands N of FPNWR	Intraspecific aggression-killed, eaten by uncollared male
7/6/1993	FP44	M	2.5	SBCNP, Raccoon Pt.	Intraspecific aggression-killed by FP42
8/9/1993	UCFP22	M	2 to 3	Daniels Rd, 1 mile E of I-75	Vehicle
11/15/1993	FP34	M	5	SE Hendry Co. near L28 W feeder canal	Bacterial infection from lacerated esophagus
12/6/1993	FP50	M	2.5	CR 846, 5 miles E of Immokalee	Vehicle
2/28/1994	UCFP23	M	8 mo.	County Line Road, 3 miles N of CR 858	Vehicle
3/3/1994	FP31	F	12 to 14	SR 29 Sunniland	Vehicle
7/8/1994	FP26	M	11 to 12	4 mi. E. Hendry Prison	Intraspecific aggression- killed by FP46, punctured skull
8/4/1994	FP38	F	9	Conservation Area 3A	Pleuritis related to chest puncture

Date	Panther ID	Sex	Age	Location[a]	Cause
11/8/1994	FP12	M	13 to 14	Private lands, Hendry County	Intraspecific aggression - infected bite wounds by FP46
1/14/1995	FP52	F	3.3	CR 846 near Dupree Road	Vehicle
6/22/1995	FP42	M	6	SBCNP	Unknown
9/21/1995	TX102	F	4	CR 833, just N of CR 835	Vehicle
3/18/1996	UCFP24	F	1.5 to 2 wks.	FPNWR	Unknown (dehydrated)
4/24/1996	UCFP29	M	3 to 5	CR 832, 5.5 miles E of SR 29	Vehicle
5/2/1996	UCFP30	F	1	US 41, Turner River	Vehicle
3/30/1997	FP58	M	3	Sadie Cypress - Collier Co.	Intraspecific aggression-septicemia from bite wounds
7/13/1997	UCFP31	U	UNK	CR 846, 1.5 miles W of CR 858	Vehicle
12/2/1997	FP19	F	11.5	FPNWR	Ruptured aorta
12/26/1997	FP21	F	11 to 12	White Oak	Euthanasia
2/2/1998	FP40	F	10	NBCNP	Intraspecific aggression, infected bite wounds
2/14/1998	FP64	M	1.5	SR 29, at clearcut, FPNWR	Vehicle - **injured**
4/18/1998	TX104	F	6 to 7	S of Sabal Palm Road in citrus grove	Illegally shot
6/13/1998	UCFP25	F	2	CR 846, 3 miles E of CR 858	Vehicle
7/17/1998	FP51	M	9	SR 29, Bear Island Grade	Vehicle
8/2/1998	FP45	M	7.5	BCSIR, Hendry Co.	Intraspecific aggression
9/17/1998	UCFP26	M	3 to 5	US 41	Vehicle
10/10/1998	FP36	F	14+	NBCNP, E of L28 interceptor canal	Unknown (likely natural)
12/23/1998	FP72	M	3 to 4	BCSIR, Hendry Co.	Intraspecific aggression- killed by uncollared male
2/3/1999	FP46	M	9 to 9.5	Private land S. CR 846, Hendry Co.	Intraspecific aggression
3/26/1999	FP64	M	2.5	Audubon's Corkscrew Sanctuary	Intraspecific aggression- killed by uncollared male
7/8/1999	UCFP27	F	2	Farm Road E of Hendry Prison	Vehicle
8/19/1999	TX103	F	UNK	SBCNP, Lostman's Pines 1 mile N of EVER boundary	Metabolic complications associated with pregnancy
9/8/1999	FP74	M	2.5	US 27, near Venus	Vehicle
10/29/1999	UCFP33	M	11 mo.	CR 833, 2 miles N of BCSIR	Vehicle
11/13/1999	FP76	M	2.5 to 3	FSSP, 1.9 miles W of SR 29 off of Lancaster Grade	Intraspecific aggression-killed by FP54
1/3/2000	FP16	M	14	EVER, NE boundary	Unknown
1/15/2000	FP63	M	5	SR 29, N of Pistol Pond	Vehicle-drowning
2/10/2000	FP80	F	4 to 5	W Boundary Road, BCSIR	Vehicle
2/28/2000	K76	M	3 mo.	CR 858, 1 mile W of SR 29	Vehicle
3/1/2000	FP68	M	5 to 7	NBCNP, W of Tangerine tram	Unknown
3/23/2000	UCFP34	M	1.5 to 2	CR 846, 2 miles E of Collier/Hendry line	Vehicle
3/29/2000	TX101	F	UNK	BCSIR, near game pen	Unknown
4/20/2000	FP84	M	14 mo.	Fisheating Creek WMA, 5 miles W of US 27	Unknown

Date	Panther ID	Sex	Age	Location[a]	Cause
6/23/2000	UCFP35	M	1.5 to 2	CR 846, 2 miles E of Immokalee	Vehicle
8/13/2000	UCFP36	F	1.7	CR 846, near big powerline	Vehicle
11/10/2000	FP89	M	3.5	BCNP, 2 miles NW of Mud Lake	Intraspecific aggression - killed by FP79
12/1/2000	FP23	F	14	BCNP, 2 miles E of Turkey Foot	Unknown
12/29/2000	UCFP37	F	5	CR 846, 4.5 miles E of SR 29	Vehicle
1/18/2001	TX107	F	8 to 9	SBCNP, near Eleven Mile Rd.	Unknown
2/27/2001	FP11	F	19 to 20	Private land, 200yds. S of CR846, 1 mile E of Dupree Rd.	Intraspecific aggression
4/14/2001	UCFP38	F	2	CR 833, 1 mile N of BCSIR, Hendry Co.	Vehicle
4/26/2001	FP90	M	1.9	US 27, 2.5 miles N of Terrytown	Vehicle
5/7/2001	UCFP39	F	10 mo.	SR 29, 1/2 mile N of Jerome	Vehicle
5/7/2001	UCFP40	M	10 mo.	SR 29, 1/2 mile N of Jerome	Vehicle
5/22/2001	UCFP41	M	2 to 3	SR 29, Sunniland, near mine entrance	Vehicle
6/14/2001	UCFP42	F	3 to 4	CR 846, 1 mile E of big powerline	Vehicle
8/17/2001	UCFP43	M	2 to 3	CR 846, 1 mile E of big powerline	Vehicle
9/1/2001	FP92	M	2.2	CREW, N Flint Pen Strand	Unknown
12/2/2001	FP97	M	2	Private land, E of Gopher Ridge Grove, N of Immokalee	Intraspecific aggression
1/3/2002	FP49	F	12	BCNP Addition Lands	Intraspecific aggression- killed by uncollared male
1/15/2002	FP96	M	1.75	Private land, Hogan Island, Collier Co.	Intraspecific aggression
1/16/2002	FP105	F	7	FPNWR, SW corner of clearcut	Unknown
4/5/2002	UCFP45	M	3	US 27, 3.4 miles N of Palmdale, Glades Co.	Vehicle
4/10/2002	UCFP46	M	6 mo.	SR 29, 1/2 mile N of Deep Lake, Collier Co.	Vehicle
7/1/2002	FP98	M	4 to 5	SR 29, 1 km N of Pistol Pond	Vehicle
9/5/2002	FP111	M	9 to 10	OSSF, N of CR 832	Intraspecific aggression
9/11/2002	FP112	F	4	BCNP - Bear Island	Intraspecific aggression
9/12/2002	FP32	F	15	FPNWR - Rock Island	Malnutrition (old-age)
10/16/2002	FP78	F	6	FPNWR - Fire Tower	Intraspecific aggression
11/10/2002	UCFP48	F	8 to 9 mo.	CR 846, 5 miles E of Immokalee	Vehicle
11/16/2002	FP108	M	22 mo.	SBCNP, Raccoon Point	Traumatic Neck Injury
11/25/2002	UCFP49 (K98)	F	19 mo.	CR 846, 3 miles E of Immokalee	Vehicle
11/28/2002	FP99	M	33 mo.	CR 846, 1/4 mile N of Collier fairgrounds	Vehicle
1/15/2003	FP67	F	5.5	Private land, Gum Slough, Hendry Co.	Intraspecific aggression-killed by FP65
1/26/2003	UCFP50 (K33)	M	3 to 4	CR 846, 3.4 miles E of Everglades Blvd.	Vehicle
2/20/2003	FP106	F	3	SR 29, entrance to Sunniland Mine	Vehicle
2/22/2003	FP109	M	10+	OSSF, N of CR 832	Intraspecific aggression
3/10/2003	UCFP51	M	1.5 to 2.0	I-4, 0.25 miles E of I-75, near Tampa	Vehicle

Date	Panther ID	Sex	Age	Location[a]	Cause
3/20/2003	UCFP52	M	2 to 3	CR 833, 2 miles S of CR 832, Hendry Co.	Vehicle
4/4/2003	FP118	F	1	BCSIR - Game Pen	Pseudorabies
5/10/2003	FP82	F	6	OSSF	Intraspecific aggression
5/17/2003	FP115	F	4 to 5	OSSF, Sick Island	FeLV
5/25/2003	UCFP53	F	2 to 3	SR 29, 1.4 miles N of CR 858, Collier Co.	Vehicle
6/3/2003	UCFP54	M	8 to 10 mo.	SR 29, 1.7 miles N of CR 858, Collier Co.	Vehicle
6/13/2003	UCFP55	M	1 to 1.5	BCSIR Safari Pen	Unknown
6/14/2003	UCFP56	M	1 to 1.5	BCSIR Safari Pen	Unknown
6/16/2003	UCFP57	F	4 to 6	BCSIR Safari Pen	Pseudorabies
6/19/2003	FP87	F	4	SBCNP - 7 miles NNE of Oasis	Intraspecific aggression
6/28/2003	FP73	F	7.8	BCSIR - Game Pen	Unknown
6/30/2003	UCFP58	F	1	CR 846, 3/4 miles E of Everglades Blvd.	Vehicle
7/12/2003	FP77	F	6	BCSIR- Game Pen	Unknown
10/17/2003	FP114	M	1.5	FPNWR, S of Oil Pad Rd.	Intraspecific aggression
11/2/2003	UCFP59	M	3 to 4 mo.	CR 858, 1.2 miles W of SR 29	Vehicle
11/7/2003	FP86	F	4.5	University of Florida, Vet School, Gainesville	Euthanasia
12/9/2003	UCFP60	M	2 to 3	US 41, 1 mile E of CR 92	Vehicle
12/12/2003	FP91	F	4.5	BCNP, Turner River Unit	Intraspecific aggression
12/25/2003	UCFP61	F	2 to 3	CR 833, 1.7 miles N of CR 846 intersection	Vehicle
1/11/2004	UCFP62	F	7 to 8 mo.	US 41, near 40 Mile Bend	Vehicle
2/13/2004	FP122	F	2 to 3	OSSF, NW Wild Cow Island	FeLV
2/26/2004	UCFP63	M	3.5	I-75, 99 mm, Eastbound lane	Vehicle
3/1/2004	FP85	M	5	EVER	Unknown
3/3/2004	UCFP64	U	unknown	SR66, 0.75 miles W OF SR 635	Vehicle - i**njured**
3/15/2004	FP123	M	3.5	OSSF	Intraspecific aggression
4/6/2004	UCFP65	M	2	SR 29, 200 yds. N of Bear Island Grade	Vehicle
6/27/2004	UCFP66	M	3	I-75, 93 mm, 0.5 miles W of Everglades Blvd.	Vehicle
7/7/2004	FP55	F	11.5	BCNP	Intraspecific aggression
7/11/2004	FP120	F	4	US 41, 750 m W of Turner River Road	Vehicle - i**njured**
7/22/2004	FP132	M	3 to 3.5	OSSF	FeLV
7/28/2004	FP117	M	27 mo.	OSSF	Pseudorabies
8/2/2004	K156	M	6 mo.	US 41, Turner River	Vehicle
8/17/2004	K94	M	3.3	I-75, near 98 mm, Eastbound lane	Vehicle
9/2/2004	UCFP67	F	< 7 days	FPNWR - Ridge Road	Unknown
9/30/2004	UCFP68	F	3 to 6	SBCNP - N of Oasis Ranger Station	Unknown

Date	Panther ID	Sex	Age	Location[a]	Cause
10/25/2004	UCFP69	F	2	SR 29 2.5 miles N of CR 858	Vehicle
11/22/2004	FP59	M	9.4	Private property, just E of Ford Test Track, Collier Co.	Intraspecific aggression
12/1/2004	UCFP70	F	1	SR 29, Owl Hammock Curve	Vehicle
12/6/2004	K128	M	2.5	CR 832, 1 mile E of RR grade	Vehicle
1/1/2005	FP126	M	1.6	Private property, 1/2 mile S of CR 846, Sadie Cypress	Intraspecific aggression
2/4/2005	UCFP71	M	2 to 3	US 41, just E of 11 Mile Road	Vehicle
2/25/2005	UCFP72	M	2	SR 29, near Jerome	Vehicle
4/7/2005	UCFP73	M	7 mo.	CR 951, S of Rattlesnake Hammock Road	Vehicle
5/7/2005	FP120	F	5	US 41, near Turner River	Vehicle
6/4/2005	UCFP74	M	3	I-95, St. John's/Flagler Co. line	Vehicle
6/14/2005	FP136	F	4	SBCNP, 2 miles NE of Burns Lake	Spinal trauma
6/19/2005	UCFP75	M	2	SR 29, Owl Hammock Curve	Vehicle
8/29/2005	K153	M	2.1	CR951, 1.2 miles S of Davis Blvd.	Vehicle
9/12/2005	FP69	F	8.3	NBCNP - Addition Lands	Unknown
9/18/2005	UCFP76	M	1	US 41, 1.4 miles E of CR 951	Vehicle
12/2/2005	K49	F	7.8	SR 29,1 mile N of Wagon Wheel Road	Vehicle
1/14/2006	FP70	F	8.6	US 41, near Turner River	Vehicle
1/15/2006	UCFP77	F	2 to 3	BCSIR, W of Swamp Safari	Intraspecific aggression
1/25/2006	UCFP78	M	9 mo.	CR 846, 1 miles W of CR 858	Vehicle
1/26/2006	UCFP79	F	2	CR 846, 2 miles N of CR 858 - near Collier fairgrounds	Vehicle
2/2/2006	UCFP80	F	2	Card Sound Road, Dade Co.	Vehicle
2/27/2006	UCFP81	M	2	I-75, between exits 137-138, Lee Co.	Vehicle
2/27/2006	UCFP82	U	unknown	Private property, 0.2 miles W of SR 29 Hendry Co.	Unknown (skeletal remains)
3/9/2006	FP104	M	5.5	SBCNP	Unknown
3/11/2006	UCFP83	M	3	CREW, 1 mile S of Corkscrew Rd., Flint Pen Strand	Intraspecific aggression
3/22/2006	FP129	F	5	SBCNP	Unknown
4/6/2006	K203	M	1 mo.	BCSIR	Unknown
4/14/2006	UCFP84	M	3 to 4	I-4, SW of Orlando	Vehicle
6/5/2006	UCFP85	M	3 to 4	CR 832, 3 miles E of OSSF SF	Vehicle
7/6/2006	UCFP86	U	unknown	SR 29, 0.6 miles S of Sunniland	Vehicle - carcass not found (gator?)
8/24/2006	UCFP87	M	3	Corkscrew Rd. near Alico, Lee Co.	Vehicle
10/27/2006	FP135	M	3.5	Private property, N of FPNWR	Intraspecific aggression/euthanized at UF Vet School
10/23/2006	FP48	F	15	Sunniland, Collier Co.	Unknown
11/26/2006	UCFP88	F	2	US 41, between Manatee Rd and CR951	Vehicle
12/12/2006	UCFP89	M	3 to 5	County Line Road, Collier/Hendry	Vehicle

Date	Panther ID	Sex	Age	Location[a]	Cause
1/10/2007	FP116	F	4.5	Williams Ranch, Hendry Co.	Intraspecific aggression
1/24/2007	UCFP90	F	4 to 6 mo.	CR 832, 1mile W of Forestry tower	Vehicle
1/25/2007	FP100	M	10	Miccosukee Reservation, N of I-75	Unknown
1/29/2007	FP134	M	5.5	NBCNP, W of L-28, S of pipeline	Intraspecific aggression
3/9/2007	UCFP91	M	5 mo.	CR 832, W of Keri tower, OSSF	Vehicle
3/21/2007	FP130	M	4	I-4, near Osceola/Orange County line	Vehicle
3/29/2007	UCFP92	M	1.5	US 41, 1.2 miles W of SR 29	Vehicle
3/30/2007	UCFP93	M	2	I-75, 0.5 miles N Corkscrew Road, Lee Co.	Vehicle
4/3/2007	UCFP94	M	2 to 3	I-75, 2 miles E of toll booth 98mm, Collier Co.	Vehicle
4/18/2007	UCFP95	M	2 to 3	Walk-in-Water road, Polk Co.	Vehicle
4/27/2007	K249	F	10 to 12 days	FPNWR, Unit12	Septicemia
5/3/2007	K247	F	16 to 18 days	FPNWR, Unit12	Complications related to dermatophytosis
5/3/2007	K248	M	16 to 18 days	FPNWR, Unit12	Unknown
5/9/2007	UCFP96	F	3	US1, 1/2 mile S of Card Sound Rd., Dade Co.	Vehicle
5/14/2007	UCFP97	F	4 to 5	Corkscrew Road, near Alico, Lee Co.	Vehicle
6/11/2007	UCFP98	M	20 to 24 mo.	SR 29, at Jerome wildlife crossing	Vehicle
6/14/2007	UCFP99	M	12 to 15 mo.	SR 82, 0.7 miles W of Sunshine Blvd	Vehicle
6/23/2007	UCFP100	M	2 to 3	SR 29, 3 miles S of Immokalee	Vehicle
6/23/2007	K199	F	20 mo.	CR 832, 0.6 miles W of Forestry tower	Vehicle
6/26/2007	UCFP101	M	4	US 41, 1 mile E of Krome Ave	Vehicle
8/2/2007	FP103	F	7	SBCNP	Intraspecific aggression
8/27/2007	K259	M	3 wks.	SBCNP	Suspected black bear predation at den
8/27/2007	K260	U	3 wks.	SBCNP	Suspected black bear predation at den
9/12/2007	UCFP102	M	2	I-75, 1.5 miles E of SR 29	Vehicle
9/27/2007	FP128	F	7.5	BCSIR, game pen	Unknown
3/9/2008	UCFP103	M	2 to 3	Pine Ridge Road, half way between CR951, Logan	Vehicle
3/14/2008	FP127	M	5	NBCNP	Intraspecific aggression
4/12/2008	UCFP104	F	1 to 2	SR 29, 2.6 km N of US 41	Vehicle
4/9/2008	FP157	M	3	CREW	Intraspecific aggression
4/16/2008	FP131	M	9	Horse Trial grounds, N of CR 858, W of SR 29	Pneumonia
4/23/2008	UCFP105	F	5 to 6	FSSP, 0.24 miles W of Janes Scenic, N side of Mud Tram	Unknown or Accidental
5/4/2008	UCFP106	M	2	Leonard Boulevard, Lehigh Acres, Lee Co.	Vehicle
5/12/2008	FP138	M	7	SBCNP, 5.5 km N of Monument Lake Campground	Unknown
5/22/2008	UCFP107	F	2 to 3	CR 951, 2.4 km S of US 41 on CR951, crossed E to W	Vehicle
5/23/2008	K268	F	2 wks.	SBCNP	Consumed (possible intraspecific aggression)

Date	Panther ID	Sex	Age	Location[a]	Cause
5/23/2008	K269	M	2 wks.	SBCNP	Consumed (possible intraspecific aggression)
6/30/2008	FP164	M	2.5	NBCNP	Unknown
7/28/2008	UCFP108	F	3 to 4	CR 846, 1.7 mile E of Oil Grade Rd	Vehicle
8/6/2008	FP107	F	8	FPNWR	Unknown
9/15/2008	FP155	M	3	Lee-Hendry Landfill, Hendry Co.	Unknown
9/15/2008	UCFP109	M	8	Private Property (J. Ivey), 2 miles E of Corkscrew Sanctuary	Unknown
9/29/2008	UCFP110	F	2 to 3 mo.	EVER	Vehicle
10/22/2008	FP152	M	5 to 6	SBCNP	Intraspecific aggression
10/24/2008	UCFP111	F	6 to 8 mo.	SR 29, 2.4km N of Oil Well Road	Vehicle
11/4/2008	UCFP112	M	3	SR 80, E of CR 833	Vehicle
11/16/2008	UCFP123	M	3 to 4	Troup Co., GA	Shot
11/26/2008	UCFP113	M	4 to 5	Alico Road, Lee Co.	Vehicle
11/28/2008	UCFP114	F	4	CR 858, 1 miles E of Camp Keais Rd	Vehicle
1/11/2009	UCFP115	M	4	CR 832, E of OSSF	Vehicle
1/17/2009	K253	M	18 mo.	I-75, eastbound exit ramp for SR 29	Vehicle
1/20/2009	UCFP116	F	4 to 5	SR 29, 3 miles S of Immokalee	Vehicle
2/2/2009	UCFP117	M	3	BCSIR	Intraspecific aggression
3/25/2009	UCFP118	M	1.5	Treeline Ave, Lee Co.	Vehicle
4/9/2009	UCFP119	F	2 to 3	US 41, Turner River	Vehicle
4/21/2009	UCFP120	F	2	Big Cypress Mitigation Bank	Illegally Shot
5/14/2009	UCFP121	M	2	SR 29, ~4 miles S of I-75	Vehicle
5/25/2009	UCFP122	M	2	CR 846, near Camp Keais Rd	Vehicle
6/12/2009	FP140	F	7	FPNWR, SE of Hog Pond	Intraspecific aggression
7/28/2009	FP204	F	19	White Oak (captive)	Euthanasia
8/5/2009	UCFP124	M	1.5	I-75, 90mm	Vehicle
9/6/2009	UCFP125	F	2	I-75, 96.5mm	Vehicle
9/15/2009	UCFP126	M	2	E of Ave Maria, Ranch 1 Orange Gr.	Vehicle
10/5/2009	FP166	M	5 to 6	BCSIR, N. of Safari Pen	Intraspecific aggression
10/9/2009	UCFP127	F	3 to 4	Turner River, 600m S of US 41	Unknown
10/10/2009	UCFP128	F	3	North Belle Meade	Illegally shot
10/19/2009	UCFP129	M	3 to 4 mo.	CR 846, 2 miles E of Immokalee	Vehicle
10/21/2009	UCFP130	F	3 to 4	CR 846, 2 miles E of Immokalee	Vehicle
11/1/2009	UCFP131	F	3 to 4 mo.	CR 833, N boundary of BCSIR	Vehicle
11/19/2009	UCFP132	M	3 to 4	FL Turnpike, S of Yeehaw Junction	Vehicle (decapitated posthumously)
12/17/2009	UCFP133	M	3 to 4	I-75, 1/2 miles W Snake Road	Vehicle
12/23/2009	UCFP134	M	3	Corkscrew Road, near CREW Gate 5	Vehicle

Date	Panther ID	Sex	Age	Location[a]	Cause
12/29/2009	UCFP135	F	4	SR 29, 2 miles N of Jerome	Vehicle
12/31/2009	UCFP136	F	3 to 4 mo.	County Barn Rd, 0.3 miles S of Davis Blvd	Vehicle
1/16/2010	UCFP137	M	2.5	I mile S Corkscrew Rd, near Bella Terra	Intraspecific aggression
1/29/2010	UCFP138	M	6 to 8	N of Shell Island Rd, Rookery Bay	Unknown (skeletal remains)
3/12/2010	UCFP139	F	3	Corkscrew Rd, CREW Marsh Trailhead 1	Vehicle
3/16/2010	FP174	M	4 to 5	I-75, 95mm, eastbound	Vehicle
3/22/2010	FP172	F	5	NBCNP	Intraspecific aggression
4/15/2010	UCFP140	M	1.5 to 2	I-75, mm 117, Lee Co.	Vehicle
4/29/2010	UCFP141	F	6 mo.	Church Road, near Hendry Co landfill	Vehicle
5/4/2010	UCFP142	F	8 mo.	Golden Gate Blvd., between 5th and 7th St NW	Vehicle
5/21/2010	FP169	M	5 to 6	US 41, 4km W of Monroe Station	Vehicle
5/22/2010	FP158	F	5	US 41, 1km E of SR92	Vehicle
5/23/2010	UCFP143	M	7 to 8 mo.	US 41, 2.2km E of CR951	Vehicle
5/31/2010	UCFP144	M	12 to 14 mo.	CR 833, 0.66km N of intersect with CR 832	Vehicle
6/21/2010	FP144	M	6	NBCNP	Intraspecific aggression
6/24/2010	UCFP145	M	16 to 18 mo.	SR 29, 3.7km S of Farm Workers Village	Vehicle
8/3/2010	UCFP146	F	3 to 4	SR 29, 1 miles S of Owl Hammock, Collier Co.	Vehicle
10/1/2010	UCFP147	F	3	US 41, 1.7 miles E of Monroe Station	Vehicle
10/15/2010	FP168	F	8	CREW, Flint Pen Strand	Intraspecific aggression
10/25/2010	FP102	F	12 8mo.	SBCNP	Intraspecific aggression
11/17/2010	FP176	M	4 to 5	CR 832, OSSF	Vehicle
12/12/2010	UCFP148	M	2 to 3	US 27, 0.5 miles E of SR 80, Hendry Co.	Vehicle
12/13/2010	UCFP149	M	1.5	Golden Gate Blvd., 7th ST NW, Collier Co.	Vehicle
12/19/2010	UCFP150	M	8 to 9 mo.	CR 846, 1.5 miles S of CR 833	Vehicle
12/22/2010	FP173	M	5	Lee County Port Authority Mitigation Land	Pseudorabies
12/23/2010	UCFP151	F	10 to 18 mo.	Private property, Collier Co.	Intraspecific aggression
1/5/2011	FP141	M	8.5	Private property, Hendry Co.	Unknown
1/7/2011	K284	M	1.5	SR 29, S of Sears Rd., Hendry Co.	Vehicle
1/13/2011	UCFP152	F	3	I-75, 98mm, eastbound, Collier Co.	Vehicle
1/21/2011	UCFP153	M	8 mo.	I-75, 98mm, westbound, Collier Co.	Vehicle
1/21/2011	UCFP154	M	8 mo.	Orange grove N of Sears Rd, Hendry Co.	Intraspecific aggression
2/23/2011	UCFP155	F	4	Golden Gate Estates	Illegally Shot
2/26/2011	UCFP156	M	3 to 4	I-75, near 114mm, Collier Co.	Vehicle
3/2/2011	FP170	F	4.5	PSSF, Swan Lake Prairie, Collier Co.	Intraspecific aggression
3/15/2011	UCFP157	F	>3	SBCNP	Unknown (skeletal remains)
3/17/2011	UCFP158	M		Seminole Co.	Under Investigation
3/25/2011	UCFP159	F	4 to 5	SR 29, near Farmworkers Village	Vehicle (survived gunshot to head)

Date	Panther ID	Sex	Age	Location[a]	Cause
3/25/2011	FP83	F	11 10 mo.	US 41, W of Port of the Islands, Collier Co.	Vehicle
4/30/2011	UCFP160	M	12 to 14 mo.	US 41, between 40 and 50 mile bend, Miami-Dade Co.	Vehicle
5/3/2011	K322	F	5 wks.	SBCNP, Collier Co.	Wildfire
5/3/2011	K323	M	5 wks.	SBCNP, Collier Co.	Wildfire
5/3/2011	K324	M	5 wks.	SBCNP, Collier Co.	Wildfire
5/3/2011	K325	M	5 wks.	SBCNP, Collier Co.	Wildfire
6/1/2011	FP186	M	11.5 mo.	CREW, Bird Rookery Swamp, Collier Co.	Intraspecific aggression
7/6/2011	UCFP161	M	7 to 9	Silver Strand Grove, N of Immokalee, Collier Co.	Intraspecific aggression
7/11/2011	UCFP162	M	1 to 1.5	SR 29, Owl Hammock Curve, Collier Co.	Vehicle
7/29/2011	FP156	M	6	PSSF, Belle Meade, Collier Co.	Pseudorabies
9/3/2011	UCFP163	M	3 to 4	Palmer Ranch, Hendry Co.	Unknown
9/14/2011	FP188	F	3.5	Private Land, Collier Co.	Unknown
9/19/2011	UCFP164	F	3 to 4	SR 29, Owl Hammock Curve, Collier Co.	Vehicle
10/30/2011	UCFP165	F	3 to 4	SR 29, Collier-Hendry line	Vehicle
1/2/2012	UCFP166	M	4 to 5	SR 82, 3.8km W of SR 29, Collier Co.	Vehicle
1/5/2012	FP189	M	3.5	Tomato field S of Oil Well Rd, Collier Co.	Intraspecific aggression
1/7/2012	UCFP167	F	4	US 41, 0.5km W of Manatee Rd, Collier Co.	Vehicle
1/13/2012	FP194	M	20 mo.	SBCNP, Collier Co.	Intraspecific aggression
2/6/2012	UCFP168	M	5	US 41, 0.4km E of Bass Rd, Collier Co.	Vehicle
2/23/2012	K351	M	12 days	SBCNP, Collier Co.	Malnutrition
2/27/2012	FP133	M	12	FSSP, Collier Co.	Intraspecific aggression
3/13/2012	TX106	F	21	White Oak Conservation Center, (in captivity)	Age related- cancer
3/31/2012	UCFP190	U	U	US 41, W of Trail Lakes Campground; Ducati panther	Vehicle- **injured**
4/7/2012	UCFP169	M	9 wks.	Orange grove N of Church Rd., Hendry Co.	Vehicle
4/16/2012	UCFP170	M	3 to 4	Alico Rd, 0.1 km W of Airport Haul Rd, Lee Co.	Vehicle
5/18/2012	FP212	M	3	2 km NW of CR 846 and County Line Rd intersection	Intraspecific aggression
5/21/2012	FP211	M	2	Orange grove 8.7km SE of prison, Hendry Co.	Intraspecific aggression
5/23/2012	UCFP171	M	1.5 to 2	SR80, 23km E of I-75, Lee Co.	Vehicle
5/26/2012	UCFP172	M	4 mo.	Found injured on SR82, E of Church Rd., Lee Co.	Vehicle - **rescued but died in captivity**
6/19/2012	UCFP173	F	7 mo.	CR 846, 2.4 km E of Oil Well Grade Rd, Collier Co.	Vehicle
7/18/2012	FP197	M	4.5	Port Authority Mitigation Land, Lee Co.	Unknown
8/28/2012	UCFP174	M	10 mo.	Private property, N of CR 832, E of OSSF, Hendry Co.	Intraspecific aggression
8/31/2012	FP79	M	17	Captivity, F1 panther originally radiocollared in BCNP	Euthanasia- cancer
10/6/2012	FP196	F	2.5	US 41, 1.4km E of San Marco Rd, Collier Co.	Vehicle
10/8/2012	UCFP175	M	12 to 14 mo.	SR 29, 2.7km N of US 41, Collier Co.	Vehicle
10/9/2012	UCFP176	F	3 mo.	Immokalee Rd, 2 miles N of fairgrounds, Collier Co.	Vehicle
11/4/2012	UCFP177	F	4 mo.	18th Ave NE, Golden Gate Estates, Collier Co.	Vehicle

Date	Panther ID	Sex	Age	Location[a]	Cause
11/14/2012	UCFP178	F	1	SR 29, 1.5 miles S of I-75, Collier Co.	Vehicle
11/19/2012	UCFP179	M	3	SR 29, Owl Hammock Curve, Collier Co.	Vehicle
11/19/2012	UCFP180	M	4 to 5	US 41, 0.5 miles W of Manatee Road, Collier Co.	Vehicle
11/26/2012	UCFP181	F	2 to 3 mo.	Immokalee Rd, 3.6 miles N of Oil Well Rd, Collier Co.	Vehicle
12/9/2012	UCFP182	M	3	SR 528, Orange Co.	Vehicle
12/11/2012	FP182	F	3.8	US 41, near Turner River canoe launch, Collier Co.	Vehicle
12/28/2012	UCFP183	U	unknown	CR 835, 0.21km S of Dooley Grade Rd, Hendry Co.	Vehicle
1/1/2013	UCFP184	F	7 mo.	CR 833, 2 miles E CR 846, Hendry Co.	Vehicle
1/3/2013	UCFP185	M	10 mo.	SR 29, 600 ft. S Oil Well Rd, Collier Co.	Vehicle
1/26/2013	UCFP186	M	2 to 4	Sadie Cypress, 2 miles S 846, Collier Co.	Intraspecific aggression
1/31/2013	UCFP187	F	4 mo.	CR835, Hendry Co.	Vehicle
2/1/2013	UCFP188	M	2 to 3	OSSF, S of Dove Field Rd, Hendry Co.	Unknown
2/20/2013	UCFP189	F	5 to 6 mo.	Everglades Blvd S, Golden Gate Estates, Collier Co.	Vehicle
3/16/2013	UCFP191	M	2 to 3	SR 80, just E of Labelle, Hendry Co.	Vehicle
4/26/2013	FP184	F	5 to 6	NBCNP, Collier Co.	Intraspecific aggression
4/28/2013	UCFP192	F	10	CR 846, 2.3 miles W of County Line Road, Collier Co.	Vehicle
5/13/2013	FP224	F	9 mo.	12 Street NE, Golden Gate Estates, Collier Co.	Vehicle-**injured**
5/31/2013	UCFP193	M	2	US 192, E of Triple N WMA, Osceola Co.	Vehicle
6/29/2013	UCFP194	M	2-3	Orange River Rd, 1.2km E of Staley Rd, Lee Co.	Vehicle
7/8/2013	UCFP195	M	2 to 3	CR 846, 7.9km E of County Line Rd, Hendry Co.	Vehicle
7/15/2013	UCFP196	M	2 to 3	I-75, 96.5mm, Collier Co.	Vehicle
8/7/2013	UCFP197	F	16 mo.	US41, 2.4km W of Oasis, Collier Co.	Vehicle
8/19/2013	UCFP198	F	3	I-75, 93 MM on Miller Canal Bridge, Collier Co.	Vehicle
9/20/2013	UCFP199	M	4	CR951, Collier Co.	Vehicle
11/12/2013	UCFP200	M	2-3	Treeline Ave. N of Daniels Pkwy., Lee Co.	Vehicle
12/2/2013	UCFP201	M	1	Northbound I75 W of Faka Union MM92, Collier Co.	Vehicle
12/7/2013	K368	F	1.5	Big Cypress National Preserve, Collier Co.	Illegally Shot
12/11/2013	UCFP202	U	9 mo.	FL Panther National Wildlife Refuge, Collier Co.	Intraspecific Aggression
1/2/2014	UCFP203	M	2-3	I-75 near MM 111, Collier Co.	Vehicle
1/4/2014	FP223	M	2.7	Private Land, Hendry Co.	Pneumonia
1/22/2014	UCFP204	M	1.5	SR 29, Owl Hammock Curve, Collier Co.	Vehicle
1/23/2014	UCFP205	M	7 days	**Yuma**- FPNWR, Collier Co.	Hypothermic – **CAPTIVITY HOMOSASSA SPRGS.**
1/24/2014	FP175	F	6.5	BCNP Addition Lands, Collier Co.	Peritonitis
3/1/2014	UCFP206	M	3	SR80, Lee/Hendry Co line	Vehicle
3/8/2014	UCFP207	M	1.5	CR 833, Hendry Co.	Vehicle
3/17/2014	FP228	M	4	Everglades/Francis Taylor WMA, Broward Co.	Vehicle
3/29/2014	UCFP208	U	2	Concho Billy Trail, SBCNP	Intraspecific Aggression

Date	Panther ID	Sex	Age	Location[a]	Cause
4/3/2014	UCFP209	M	3 to 5	CR 833, just S of CR 832, Hendry Co.	Vehicle
4/8/2014	UCFP210	M	2 to 3	CR 846, 6 miles E of Immokalee, Collier Co.	Vehicle
4/11/2014	UCFP211	U	8 to 10 mo.	Belle Meade, PSSF, Collier Co.	Intraspecific Aggression
4/14/2014	UCFP212	M	4 to 5	US27, N of Lake Placid, Highlands Co.	Vehicle
4/14/2014	FP232	M	3	East Broadway Street, Ft. Meade, Polk Co.	Vehicle - **injured**
4/25/2014	FP163	M	7.2	Co Line Rd, Collier/Hendry Co. Line	Vehicle
4/25/2014	FP231	M	2	Golden Gate Blvd, just W of Everglades, Collier Co	Vehicle **- injured**
5/1/2014	UCFP213	F	3	I-75 near MM 134, Lee Co.	Vehicle
5/16/2014	UCFP214	M	14 mo.	Oil Well Rd, E of Pacific Grade, Collier Co.	Vehicle
6/12/2014	K390/UCFP215	F	1-2	US41, SE of Collier Seminole SP, Collier Co.	Vehicle
6/25/2014	UCFP216	F	1	Corkscrew Rd, near CREW gate 5, Lee/Collier Co. line	Vehicle
7/1/2014	TX105	F	22	White Oak Conservation Center, (died in captivity)	Age related- Renal failure
7/16/2014	FP177	M	7	BCNP - North Addition Lands, Collier Co.	Intraspecific Aggression
8/4/2014	FP231	M	2.5yrs	Golden Gate Estates, Collier Co.	Unknown
8/6/2014	UCFP217	F	2	CR833, between CR 832 and SR 80, Hendry Co.	Vehicle
8/24/2014	UCFP218	F	4 mo.	Immokalee Rd/Wildwood Blvd, Collier Co.	Vehicle
8/24/2014	UCFP219	M	4 mo.	Immokalee Rd/Krape Rd, Collier Co.	Vehicle
9/2/2014	UCFP220	F	3 to 4	CR833, N of BCSIR, Hendry Co.	Vehicle
9/3/2014	FP66	F	17	Homosassa Springs Wildlife Park (died in captivity)	Age related
10/11/2014	UCFP221	M	2	**Uno** - Found blinded by shotgun on CR 846, Collier Co.	**CAPTIVITY - NAPLES ZOO**
10/20/2014	UCFP222	M	3	Florida's Turnpike, MM 192, Yeehaw Junction, Osceola Co.	Vehicle
11/13/2014	UCFP223	F	3-4	County Line Road, just S of CR846, Collier Co.	Vehicle
11/14/2014	FP229	F	4-5	Northern Addition Lands, BCNP, Collier Co.	Unknown
11/21/2014	K434	F	11 wks.	Parker's Hammock Road, Collier Co.	Separated from dam, **CAPTIVITY – MIAMI ZOO**
11/28/2014	UCFP224	M	6 mo.	Golden Gate Blvd/6th St NE, Collier Co.	Vehicle
12/18/2014	UCFP225	M	4	Flaghole Road, 8km S of US27, Hendry Co.	Vehicle
12/18/2014	UCFP226	M	3	Collier Blvd, 2.4km S of US41, Collier Co.	Vehicle
12/19/2014	UCFP227	M	2	US41, MM 57, 3.8 km W of Oasis, Collier Co.	Vehicle
12/28/2014	UCFP228	M	2	Golden Gate Blvd/10th St NE, Collier Co.	Vehicle
12/30/2014	UCFP229	F	2.5	16th ST SE, Golden Gate Estates, Collier Co.	Vehicle
12/31/2014	FP213	F	5.5	Dinner Island Ranch WMA, Hendry Co.	Intraspecific Aggression
1/16/2015	UCFP230	F	1.5	I-75 1/2 mile E of toll booth, Collier Co.	Vehicle
1/20/2015	UCFP231	F	1.5	Immokalee Rd, 250m S of Bethune RD, Collier Co	Vehicle
1/24/2015	UCFP232	M	4	MM132, I75, Lee Co.	Vehicle
1/25/2015	UCFP233	M	5-6	MM95, I75, Collier Co.	Vehicle
1/29/2015	UCFP234	U	U	Corkscrew Swamp Sanctuary, Collier Co. (skeletal)	Unknown (skeletal remains)
2/6/2015	UCFP235	U	10 mo.	Golden Gate Estates, Collier Co.	Unknown

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2/13/2015	FP191	F	16	Big Cypress National Preserve, Collier Co.	Unknown
2/15/2015	UCFP236	M	1	CR846, 1/2 mi S of CR833 intersection, Hendry Co.	Vehicle
2/25/2015	FP183	M	9	SR29, 2.75 mi S of I-75, Collier Co.	Vehicle
3/7/2015	K402	M	1.5	I-75, 0.5 miles S of Exit 123, Corkscrew Road, Lee Co.	Vehicle
3/8/2015	UCFP237	M	2.5	CR951, 300 m N of Port au Prince Rd, Collier Co.	Vehicle
3/20/2015	FP148	F	11.5	Picayune Strand State Forest, Collier Co.	Intraspecific Aggression
3/22/2015	UCFP238	M	5	Immokalee Road, 3.4km W of Camp Keais Rd., Collier Co.	Illegally Shot
3/30/2015	FP237	M	1	Audubon's Corkscrew Swamp Sanctuary, Collier Co.	Intraspecific Aggression
4/3/2015	UCFP239	M	3 to 4	I-75, 1.1 miles E of toll booth, Collier Co.	Vehicle
4/13/2015	UCFP240	F	1	SR29, 1.3 mi N. of CR858, Collier Co.	Vehicle
4/27/2015	FP159	M	12 to 13	Private land, 2 miles N of Corkscrew Rd., Lee Co.	Unknown
4/30/2015	UCFP241	M	2 to 3	I-75, 0.5 miles S of Exit 123, Corkscrew Road, Lee Co.	Vehicle
5/19/2015	UCFP242	F	3	CR833, 1/4 mi south of CR832, Hendry Co.	Vehicle
6/11/2015	UCFP243	M	4	US 41, BCNP, Collier Co.	Vehicle
6/16/2015	FP153	F	14	BCNP, Collier Co.	Unknown
7/5/2015	UCFP244	M	1.5	Immokalee Rd., 0.4 mi south of Wild Turkey Dr., Collier Co.	Vehicle
7/8/2015	UCFP245	M	10 to 11 mo.	Daniels Pkwy, 1 mi SW of SR82, Lee Co.	Vehicle
7/1/2015	UCFP246	U	2 wks.	Lee County Port Authority Mitigation Land, Lee Co.	Unknown
7/13/2015	UCFP247	M	2 to 3	SR80, 5 mi west of LaBelle, Hendry Co.	Vehicle
7/30/2015	UCFP248	F	4 to 5 mo.	Golden Gate Blvd, Collier Co.	Vehicle
8/9/2015	FP240	F	2.7	Deep Lake Unit of Big Cypress NP, Collier Co.	Intraspecific Aggression
9/18/2015	FP219	F	4.3	I-75, just west of exit 101, Collier Co.	Vehicle
9/22/2015	UCFP249	M	4 mo.	CR858. 1/4 mi west of County Line Rd, Collier Co.	Vehicle
9/28/2015	UCFP250	M	3 to 4	US41, just west of Trail Lakes Campground, Collier Co.	Vehicle
9/30/2015	K432	F	13 mo.	I-75, MM102, Collier Co.	Vehicle
10/8/2015	UCFP251	F	3	US 41, west of CR 92, Collier Co.	Vehicle
10/23/2015	FP222	F	10.5	I75, MM90, Collier Co.	Vehicle
10/31/2015	UCFP252	M	4 mo.	CSSP near boat ramp, Collier. Co.	Emaciation due to orphaning
11/2/2015	UCFP253	F	4 mo.	CSSP campground, Collier Co.	Orphaned, **CAPTIVITY – PALM BEACH ZOO**
11/23/2015	UCFP254	M	8 to 10 mo.	CR846, just W Everglades Blvd., Collier Co.	Vehicle
11/25/2015	K387	M	2.8	SR29 between Pollywog Rd and SR78, Glades Co.	Vehicle
12/2/2015	FP93	F	16.8	Turner River Unit, BCNP, Collier Co.	Unknown (skeletal remains)
12/8/2015	UCFP255	F	1	CR832, Hendry Co.	Vehicle
12/15/2015	UCFP256	F	2.5	Corkscrew Road, Collier Co.	Vehicle
12/16/2015	UCFP257	M	6	CR835, 2.5 km S of Dooley Grade Rd, Hendry Co.	Vehicle
12/21/2015	UCFP258	M	1	SR29, Owl Hammock Curve, Collier Co.	Vehicle
12/30/2015	UCFP259	F	7 mo.	CR832, 3 mi west of CR833, Hendry Co.	Vehicle

Date	Panther ID	Sex	Age	Location[a]	Cause
1/3/2016	UCFP260	M	6 mo.	18th Ave SE, W of Desoto, Collier Co.	Unknown
1/18/2016	UCFP261	M	3 mo.	Sakata Farms off SR82, Lee Co.	Orphaned. **CAPTIVITY – HOMOSASSA SPRGS.**
1/20/2016	UCFP262	F	7 to 9 mo.	Daniel's Parkway, 1/2 mile east of Treeline Avenue, Lee Co.	Vehicle
1/21/2016	UCFP263	M	2 to 3	Florida Tnpk, S of Ft. Drum Service Plaza, Okeechobee Co.	Vehicle
1/30/2016	UCFP264	F	4	SR82, 1.4 km west of Church Rd, Hendry Co.	Vehicle
2/2/2016	UCFP265	M	2 to 3	I75, 2 km north of Daniel's Parkway, Lee Co.	Vehicle
2/12/2016	UCFP266	F	1.5 to 2	SR82, near Sparta Avenue, Lee Co.	Vehicle
2/15/2016	UCFP267	U	5 to 6 mo.	SR82, just E of Hendry Co line, Collier Co.	Vehicle
2/17/2016	UCFP268	M	4	SR 82, 1.25 miles E of Corkscrew Road, Collier Co.	Vehicle
2/18/2016	UCFP269	U	2	Private Property S of CR864, W of CR951, Collier Co.	Unknown
3/5/2016	UCFP270	U	2 to 4	NBCNP, Addition Lands Unit, west of L28I, Collier Co.	Under Investigation
3/10/2016	UCFP271	M	3	Polk Parkway (SR570) west of Lakeland, Polk Co.	Vehicle
3/25/2016	UCFP272	M	14 to 16 mo.	Golden Gate Blvd., 0.3 miles east of CR951, Collier Co.	Vehicle
4/1/2016	UCFP273	U	1	I-75, near MM96 bordering Belle Meade, Collier Co.	Vehicle
4/6/2016	UCFP274	M	3	I-75, near Luckett Rd Exit, MM138, Lee Co.	Vehicle
4/6/2016	UCFP275	M	3	Immokalee Rd, 4km east of CR951, Collier Co.	Vehicle
4/9/2016	UCFP276	M	4-5	I-75, 0.6 mi south of Bonita Beach Rd, Lee Co.	Vehicle
4/10/2016	UCFP277	M	5 to 6 mo.	Golden Gate Blvd, just east of 22nd St NE, Collier Co.	Vehicle
4/15/2016	UCFP278	M	16 to 18 mo.	Randall Blvd, 110 m east of 16th St. NE, Collier Co.	Vehicle
4/26/2016	UCFP279	F	3 to 4	I-75, southbound at 122 MM, Lee Co.	Vehicle
4/26/2016	UCFP280	M	1	CR833, 735m north of junction with CR835, Hendry Co.	Vehicle
4/28/2016	UCFP281	M	4	OSSF, 3.5 mi N of Keri Rd, Twin Mills Grade, Hendry Co.	Intraspecific Aggression
5/3/2016	UCFP282	M	2 to 3	SR 29, 1/4 mi N of US 41, Collier Co.	Vehicle
5/6/2016	FP162	F	11	SBCNP, Turner River Unit, Collier Co.	Intraspecific Aggression
5/26/2016	K403	F	4	Daniel's Parkway junc. with Commerce Lakes Drive, Lee Co.	Vehicle
5/26/2016	UCFP283	M	2	US 27 near Venus, Highlands Co.	Vehicle
6/16/2016	UCFP284	F	6 mo.	CR 858 at Camp Keais Road, Collier Co.	Vehicle
6/22/2016	FP215	F	11	Private Property NW of FPNWR, Collier Co.	Unknown
8/5/2016	UCFP285	F	4	SR 82, 1/2 mile W of Church Road, Collier County	Vehicle
8/5/2016	FP242	M	10	Immokalee Ranch, 670m south of CR846, Hendry County	Pseudorabies
8/14/2016	FP171	M	9-10	SR29, 4.3km north of I75, Collier County	Vehicle
8/29/2016	FP195	F	8.5	36th Avenue SE, Golden Gate Estates, Collier County	Intraspecific Aggression
10/2/2016	K421	M	2yr 5 mo.	2685 SR 29, Immokalee, Collier County	Vehicle
10/10/2016	UCFP286	M	2	SR 80 at the Lee/Hendry Co. line	Vehicle
10/18/2016	UCFP287	M	3-4	US27, near Venus, Highlands County	Vehicle
10/28/2016	UCFP288	M	6 mo.	Daniels Parkway southwest of SR82, Lee County	Vehicle
10/31/2016	UCFP289	F	3	Golden Gate Blvd 1km west of Everglades Blvd, Collier Co.	Vehicle

Date	Panther ID	Sex	Age	Location[a]	Cause
11/16/2016	UCFP290	F	adult	SR 29, 2.3 miles S of CR 858, Collier County	Vehicle
11/20/2016	UCFP291	M	9 mo.	CR 832 two miles E of SR29, Hendry County	Vehicle
12/6/2016	UCFP292	F	2	SR 29 2 miles N of CR 858, Collier County	Vehicle
12/8/2016	UCFP293	F	4 mo.	Paul J. Doherty Pkwy, just S of Daniels Pkwy, Lee County	Vehicle
12/9/2016	UCFP294	F	2	Corkscrew Rd 250m E of Ben Hill Griffin Pkwy, Lee Co.	Vehicle
12/10/2016	UCFP295	F	4-5 mo.	Ben Hill Griffin Pkwy & FGCU Blvd, Lee County	Vehicle
1/12/2017	UCFP296	M	3 mo.	CR832 5 miles W of CR833, Hendry County	Vehicle
†	UCFP297	†	†	†	**Injured- under investigation**
1/27/2017	K388	M	4	Private property east of CR835, Hendry County	Intraspecific Aggression
2/23/2017	UCFP299	U	U	2nd Ave NE, east of Desoto, GGE, Collier County	Unknown
2/27/2017	UCFP300	M	5-6	SR82 1/2 mile east of CR850, Collier County	Vehicle
2/28/2017	UCFP301	M	2.5-3	NE Four Mile Road, Desoto County	Vehicle
3/4/2017	UCFP302	F	2	SR82 1.7 miles west of CR850, Hendry County	Vehicle
3/9/2017	UCFP303	F	2 mo.	SR82 1.4 miles east of CR850, Collier County	Vehicle
3/14/2017	UCFP304	F	4	CR846, 2 miles east of Immokalee, Collier County	Vehicle
3/22/2017	FP198	F	9	Consolidated Citrus, near CREW, Lee County	Intraspecific Aggression
4/5/2017	UCFP305	F	1.5	CR835 south of Dooley Grade, Hendry County	Vehicle
4/13/2017	UCFP306	M	3	I-4, at CR532 exit, Polk County	Vehicle
4/20/2017	UCFP307	F	4-5	CR846, 2.6 miles west of County Line Rd, Collier County	Vehicle
5/8/2017	UCFP308	F	3-4	CR832, 5 mi. east of OSSF, Hendry County	Vehicle
5/11/2017	FP248	F	3	Corkscrew Rd, just south of CR832, Collier County	Vehicle-**injured**
6/7/2017	PC1095	M	1.5	Immokalee Road, 260 m east of Krape Rd., Collier Co.	Vehicle-**injured**
6/11/2017	UCFP309	U	U	Keri Island Rd. GGE, Collier County	Unknown
6/16/2017	UCFP310	M	2-3	CR846, 2 mi east of County Line Road, Hendry Co	Vehicle
6/28/2017	K480	F	18 days	SBCNP, Turner River Unit, Collier County	Abandoned- **CAPTIVITY**
7/3/2017	UCFP311	M	5	Immokalee Rd, 2 mi east of CR951, Collier County	Vehicle
7/18/2017	UCFP312	F	2.5	CR951, 400 ft N of City Gate, Collier County	Vehicle
8/2/2017	FP248	F	3	Struck by vehicle 5/11/2017.	Euthanized
8/13/2017	FP234	M	12	I75, MM54, Collier County	Vehicle
8/14/2017	UCFP313	M	2	CREW, Marsh Hiking Trails, Collier County	Intraspecific Aggression
8/18/2017	UCFP314	M	1.5	Ft. Denaud Rd., LaBelle, Hendry Co.	Vehicle
8/24/2017	UCFP315	F	1	CR846, Robert's Ranch Rd (Duck Curve), Hendry County	Vehicle
8/28/2017	FP244	M	7	Dinner Island Ranch WMA, Hendry County	Unknown
9/16/2017	UCFP316	M	3.5	SR98, north of Lake Istokpoga, Highlands County	Vehicle
10/15/2017	UCFP317	F	1.5	CR835, 1 mi south of Dooley Grade Rd, Hendry County	Vehicle
11/7/2017	K411	M	3.7	Immokalee Rd, Collier County	Vehicle
11/13/2017	UCFP318 (K364)	M	6	CR833. 1 mi south of Hill Grade, Hendry County	Vehicle

Date	Panther ID	Sex	Age	Location[a]	Cause
11/20/2017	FP249	M	2	CR833, 3.6 km south of junction with CR835, Hendry Co.	Vehicle
11/23/2017	UCFP319	M	2	Daniels Pkwy, east of 75, Lee Co.	Vehicle
12/9/2017	UCFP320	M	3 mo.	Desoto Blvd, near 24th Ave SE, Collier County	Vehicle (euthanized)
12/20/2017	UCFP321	M	2-3	North of SR78, 8.8km east of junction with SR29, Glades Co.	Intraspecific Aggression
12/29/2017	FP224	F	5.4	CR 951 at City Gate, Collier Co.	Vehicle-**injured**
1/7/2018	PC1144	F	4-5 mo.	I75 southbound lanes, just west of exit 101, Collier Co.	Vehicle
1/8/2018	UCFP322	F	3-4	Josie Billie Highway, 6 miles E of SIR, Hendry Co.	Vehicle
1/13/2018	UCFP323	M	1.5	Immokalee Road at Wildwood, Collier County	Vehicle
1/30/2018	UCFP324	M	2.5	SR80, west of LaBelle, Hendry County	Vehicle
2/2/2018	UCFP325	F	3	CR835, 1/2 mi south Dooley Gr Rd, Hendry County	Vehicle
2/3/2018	UCFP326	F	5 mo.	CR835, 1/2 mi south Dooley Gr Rd, Hendry County	Vehicle
2/5/2018	UCFP327	M	4 mo.	Immokalee Rd south of Stockade St, Collier County	Vehicle
2/19/2018	UCFP328	F	5-6	Immokalee Rd, 8.8km east of Everglades Blvd, Collier Co.	Vehicle
2/22/2018	UCFP329	M	2	US27, 6km west of Clewiston, Hendry Co.	Vehicle
2/28/2018	UCFP330	F	5-6	SR 29 in Jerome, Collier Co.	Vehicle
2/28/2018	UCFP331	F	3	CR846, 2.5 miles west of County Line Rd, Collier County	Vehicle
3/14/2018	FP245	M	7	Immokalee Ranch, 2mi ESE of the Bishop Pens; Hendry Co.	Unknown
3/21/2018	FP236	M	9-10	Rock Rd, Golden Gate Estates, Collier County	Unknown
4/3/2018	UCFP332	F	3	SR 82, 332m west of Corkscrew Rd., Collier Co.	Vehicle
5/18/2018	UCFP333	M	2.5	I-75, 2km east of SR29, Collier County	Vehicle
6/20/2018	UCFP334	M	9 mo.	CR833 0.2 km north of CR832, Hendry County	Vehicle
6/25/2018	UCFP335	M	2	SR29 3km south of CR858, Collier County	Vehicle

[a] BCSIR = Big Cypress Seminole Indian Reservation; CREW = Corkscrew Regional Ecosystem Watershed; EVER = Everglades National Park; FPNWR = Florida Panther National Wildlife Refuge; FSPSP = Fakahatchee Strand Preserve State Park; NBCNP = Big Cypress National Preserve north of Interstate 75; OSSF = Okaloacoochee Slough State Forest; PSSF = Picayune Strand State Forest/Wildlife Management Area.; SBCNP = Big Cypress National Preserve south of Interstate 75.
† Information withheld. Under investigation.

FPRMTF: FUNDING INFORMATION AS OF 30 JUNE 2018

Beginning Balance July 1, 2017	$2,043,515
Fiscal Year 2017-2018 Actual Revenue	
Panther License Plate Annual Use Fees	$ 1,167,145
Interest Earnings	29,613
Donations	4,100
Total Revenue	**$1,200,858**
Fiscal Year 2017-2018 Expenditures	
Law Enforcement	$352,688
Panther Management	480,699
Panther Research	332,319
Administration Overhead	150,000
Service Charge to General Revenue	99,583
Total Expenditures	**$1,415,289**
Projected Fund Balance June 30, 2018	**$2,050,413**
FWC Florida Panther Management Operating Program Appropriations	
Division of Law Enforcement	$348,938
Division of Habitat and Species Conservation	617,212
Fish and Wildlife Research Institute	383,500
Total Florida Panther Program Appropriations	**$ 1,349,650**

1 October 2018

From:	Cassler, Constance
To:	Dell, David; Tawes, Robert; Hinzman, Roxanna; Christian Spilker; Turner, Andrew; Clements, E. Carter Chandler; Ziewitz, Jerry; Tewis, Robert M SAJ; Johnson, Bruce
Cc:	Kelso, Charles; Mcdonald, Kenneth
Subject:	Fwd: [EXTERNAL] Data request
Date:	Friday, April 26, 2019 3:14:30 PM

Hi,

I'm forwarding the link to the information AECOM sent to respond to ECPO's questions about the traffic analysis. Please share with anyone else at ECPO that needs to see it.

Have a good weekend,

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
office: 772-469-4243
fax: 772-562-4288
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---------- Forwarded message ---------
From: **Purcell, Adam** <adam.purcell@aecom.com>
Date: Fri, Apr 26, 2019 at 3:00 PM
Subject: RE: [EXTERNAL] Data request
To: Cassler, Constance <constance_cassler@fws.gov>, Cherney, Laura <Laura.Cherney@aecom.com>
Cc: Kenneth Mcdonald <kenneth_mcdonald@fws.gov>, Charles Kelso <charles_kelso@fws.gov>, Samuels, Kelley <Kelley.Samuels@aecom.com>

All,

We have collected the data supporting our travel demand modeling efforts for Eastern Collier. That information can be downloaded through the link provided below. Please let me know if you have any additional questions.

Download link
https://we.tl/t-BVnKZ1qLab

1 file
Eastern Collier Modeling Files.zip

1 file, 51.7 MB in total · Will be deleted on 24 May, 2019

From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Thursday, April 18, 2019 8:05 AM
To: Cherney, Laura <Laura.Cherney@aecom.com>
Cc: Purcell, Adam <adam.purcell@aecom.com>; Kenneth Mcdonald <kenneth_mcdonald@fws.gov>; Charles Kelso <charles_kelso@fws.gov>; Samuels, Kelley <Kelley.Samuels@aecom.com>
Subject: Re: [EXTERNAL] Data request

Thank you Laura. I appreciate the great summary.

Connie

Constance L. Cassler, Ph.D.

Supervisory Fish and Wildlife Biologist

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On Wed, Apr 17, 2019 at 7:51 PM Cherney, Laura <Laura.Cherney@aecom.com> wrote:

> Hi Connie,
>
> In response to your request below, AECOM's modeling team will compile the data used to support the modeling effort presented in the EIS. We anticipate that we will have the files together by the end of next week.
>
> As a friendly reminder to the context of the traffic modeling prepared for the EIS, the modeling effort was completed on an extremely compressed timeline, and was based on a generalization of possible future condition. In an ideal situation, a detailed description of the timing and location of proposed development would have allowed AECOM to conduct a detailed analysis to identify allowable development based on a detailed review of the comprehensive plan and land development code.
>
> However, since that information was not available (and to accommodate the compressed project timeline and budget), AECOM proposed an alternative modeling process by which development estimates would be based on observed densities in Ave Maria. Therefore, the results provided a very generalized estimate of future traffic conditions. If moving forward, the traffic analysis methodology is revisited, a detailed plan for development would allow

future traffic conditions to be more accurately modeled.

Hope that helps. Please let me know if you have any questions.

Thanks,

Laura

From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Tuesday, April 16, 2019 5:09 PM
To: Cherney, Laura <Laura.Cherney@aecom.com>
Cc: Purcell, Adam <adam.purcell@aecom.com>; Kenneth Mcdonald <kenneth_mcdonald@fws.gov>; Charles Kelso <charles_kelso@fws.gov>
Subject: Fwd: [EXTERNAL] Data request

Hi Laura,

The traffic modeling you did for the EIS is also being used as the basis for the BO. We want to make sure that our analyses are on solid ground and have agreed to share them with the applicants. We already shared the table you produced and the summary of assumptions that was in the EIS. The applicants also have the EIS and appendices. See the message I'm forwarding from the applicant's consultant. It lists what they are asking for.

I would like to talk to you as early as possible tomorrow morning to discuss if this is information that would be part of our Admin Record and should be supplied to us as part of the Scope, or if this is above and beyond and will cost extra to provide. Please let me know if/when you are available tomorrow morning, or suggest an alternate time. Of course, we are on a short time frame as usual, and I'm sorry for the short notice.

Connie

Constance L. Cassler, Ph.D.

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---------- Forwarded message ---------
From: **Johnson, Bruce** <Bruce.Johnson@stantec.com>
Date: Tue, Apr 16, 2019 at 4:46 PM
Subject: [EXTERNAL] Data request
To: Dell, David (david_dell@fws.gov) <david_dell@fws.gov>
Cc: Constance L. Cassler, Ph.D. <constance_cassler@fws.gov>

David,

Per our conversation this morning, we are requesting the input data and assumptions that were used by AECOM to run the FDOT District One Regional Planning Model (D1RPM). In essence, we request everything that would be needed to reconstruct/deconstruct what was modeled, in order to achieve (validate) the model output results:

* All D1RPM model files for the baseline conditions and the two alternatives (No Action and Issuance of ITPs)
* Any spreadsheet files developed to interpolate/extrapolate TAZ socioeconomic (SE) land use data for the two alternatives
* Any GIS files used/developed that may have been used to quantify the SE data into the appropriate TAZs
* Any written documentation as to what modifications, if any were made to the TAZs, centroid connectors, network files, etc.
* Any supporting materials (input or output figures or tables) that clarify modeling approaches, inputs, and/or outputs

Given the timeline for the section 7 process, we request that the contractor deliver the necessary information to the Service ASAP. If they are unclear about any aspect of this request, we can promptly arrange a conference call between the Service, AECOM, and our transportation planner.

Thanks,

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

Stantec Consulting Services Inc.
300 Primera Blvd., Suite 300
Lake Mary, FL 32746-2145 US

[http://www.stantec.com/content/dam/stantec/images/esignature/stantec.png]
<http://www.stantec.com/>

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From:	Cassler, Constance
To:	Johnson, Bruce; Christian Spilker; Turner, Andrew
Cc:	Kelso, Charles; Dell, David; Hinzman, Roxanna; Williams, Larry O; Tawes, Robert; Ziewitz, Jerry; Mcdonald, Kenneth
Subject:	Fwd: [EXTERNAL] Traffic data files
Date:	Monday, May 6, 2019 3:26:06 PM

Hi Bruce,

AECOM sent the traffic model information you requested. Please let me know if you have any questions. We look forward to discussing the model with you when you are ready.

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
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---------- Forwarded message ---------
From: **Purcell, Adam** <adam.purcell@aecom.com>
Date: Mon, May 6, 2019 at 11:12 AM
Subject: RE: [EXTERNAL] Traffic data files
To: Cassler, Constance <constance_cassler@fws.gov>, Cherney, Laura <Laura.Cherney@aecom.com>, Samuels, Kelley <Kelley.Samuels@aecom.com>
Cc: Charles Kelso <charles_kelso@fws.gov>, Kenneth Mcdonald <kenneth_mcdonald@fws.gov>, David Dell <david_dell@fws.gov>

Connie,

Good morning. I was able to collect the additional base information requested by Stantec. I've provided a link through which the D1RPM files can be accessed.

Download link
https://we.tl/t-ol8IWSmc5K

1 file
D1RPM_v1.0.2.zip

1 file, 64.8 MB in total · Will be deleted on 3 June, 2019

Adam Purcell, AICP

Project Planner, Surface Transportation Planning

D 1-813-675-6812

adam.purcell@aecom.com

AECOM

7650 West Courtney Campbell Causeway, Tampa, Florida 33607

T 1-813-286-1711 F 1-813-286-6587

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From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Friday, May 03, 2019 8:20 AM
To: Cherney, Laura <Laura.Cherney@aecom.com>; Purcell, Adam

<adam.purcell@aecom.com>; Samuels, Kelley <Kelley.Samuels@aecom.com>
Cc: Charles Kelso <charles_kelso@fws.gov>; Kenneth Mcdonald <kenneth_mcdonald@fws.gov>; David Dell <david_dell@fws.gov>
Subject: Fwd: [EXTERNAL] Traffic data files

Hi Laura,

ECPO reviewed the traffic model information you sent and are asking for information they didn't find in what you sent us. Can you please let us know if what you sent is all the information you have, or if you have what ECPO is requesting and can send it to us. Of course, time is of the essence.

Thanks in advance,

Connie

Constance L. Cassler, Ph.D.

Supervisory Fish and Wildlife Biologist

U.S. Fish and Wildlife Service

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---------- Forwarded message ---------
From: **Johnson, Bruce** <Bruce.Johnson@stantec.com>
Date: Fri, May 3, 2019 at 7:58 AM
Subject: [EXTERNAL] Traffic data files
To: Constance L. Cassler Ph. D. (constance_cassler@fws.gov) <constance_cassler@fws.gov>
Cc: Dell, David (david_dell@fws.gov) <david_dell@fws.gov>

Hi Connie,

We have reviewed the traffic modeling data that you forwarded to us and note that the only model input files provided are the socio-economic data files (ZONEDATA) for the two land use alternatives. In order to complete our review, we need to see all of the files contained in the model input directories used to perform the model runs. Please send us those files as soon as possible.

We are mindful of the tight schedule for completing various analyses, and want to avoid any delay. If you have any questions, please call me on my mobile.

Thanks,

Bruce Johnson, Ph.D.

Senior Scientist, Environmental Services

Direct: (407) 710-3379

Mobile: (386) 527-8333

Stantec Consulting Services Inc.

300 Primera Blvd., Suite 300

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From:	Cassler, Constance
To:	Johnson, Bruce
Subject:	Fwd: Last call for species data the Applicants don"t have
Date:	Friday, February 22, 2019 10:19:18 AM
Attachments:	2004 Lake Trafford Pre-Construction Survey.pdf flahab1.sbn flahab1.sbx flahab1.prj flahab1.dbf flahab1.shp.xml flahab1.shx flahab1.shp

---

Hi Bruce,

There is some scrub-jay information we are not sure you have. See the email I'm forwarding. I'll follow-up by forwarding another email where Liz has Immokalee information attached.

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
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---------- Forwarded message ---------
From: **Landrum, Elizabeth** <elizabeth_landrum@fws.gov>
Date: Fri, Feb 22, 2019 at 10:03 AM
Subject: Re: Last call for species data the Applicants don't have
To: Cassler, Constance <constance_cassler@fws.gov>

Connie,

The HCP doesn't mention anything beyond the 1992-93 scrub-jay survey data, which Dr. Bowman apparently told them was the only data available in that area. Since I attached the Immokalee GIS files to my last email, I have attached the Lake Trafford Pre-construction Survey report to this email.

The only other info I found was a handmarked map of scrub-jays in Immokalee (attached: 20070326_email_Rousso to HatcherR.jpg). I have no coordinates for the scrub-jay

observations marked on the map, but they are in the same areas as the GIS locations I sent yesterday, and appear to correspond to some scrub habitat polygons (attached: seven "flahab1" GIS files).

Liz.

Elizabeth Landrum
Fish and Wildlife Biologist
US Fish and Wildlife Service
1339 20th Street
Vero Beach, FL 32960

Tel.: 772-469-4304
Fax: 772-562-4288
E-mail: elizabeth_landrum@fws.gov

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On Fri, Feb 22, 2019 at 8:11 AM Cassler, Constance <constance_cassler@fws.gov> wrote:

> Hi Liz,
>
> Can you please look at the HCP (\\IFW4FO-FLVEB620\Biologists\Trust Resources\HCP\County Collier\E Collier Multispecies HCP (2008FA0786)\HCP\Draft HCPs\20180822 Draft) on p 170 and 171 of the pdf and compare to what you have then send me anything different.
>
> Thank you,
>
> Connie
>
> Constance L. Cassler, Ph.D.
> Supervisory Fish and Wildlife Biologist
> U.S. Fish and Wildlife Service
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> On Thu, Feb 21, 2019 at 6:35 PM Landrum, Elizabeth <elizabeth_landrum@fws.gov> wrote:
>
> > Connie,

You said Heather found scrub-jay info in the Lake Trafford survey, so I won't include that. I assume they also have the 1992-93 survey data. Was the applicant supplied with the Immokalee Development scrub-jay info? If not, I have attached the 12 GIS files, and in case the attachments mess up, the path to the two files is - L:\Trust Resources\HCP\County Collier\Immokalee\GIS \Immokalee_FSJ_03262007.shp and \Immokalee_FSJ_05102007.shp
Liz.

Elizabeth Landrum
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On Thu, Feb 21, 2019 at 11:23 AM Cassler, Constance <constance_cassler@fws.gov> wrote:

> He Team,
>
> Last week, the Applicants requested any species data we have that they didn't present in their HCP. I have received info for some species and have passed it along to Bruce Johnson. If there is additional information please send it to me ASAP so I can send it to the applicants. If there is a reason we can't share it with them, please let me know that too.
>
> Thanks in advance,
>
> Connie
>
> Constance L. Cassler, Ph.D.
> Supervisory Fish and Wildlife Biologist
> U.S. Fish and Wildlife Service
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Pre-construction Threatened and Endangered Species Survey: Lake Trafford Spoil Disposal Site

Prepared for:
The South Florida Water Management District
P.O. Box 24682
West Palm Beach, Florida 33416-4682

Conducted by:
Environmental Science Division
Conservancy of Southwest Florida 1450 Merrihue Drive Naples, Florida

INTRODUCTION

The Lake Trafford Restoration Project, located within the Corkscrew Watershed in northern Collier County represents a critical restoration project to be funded under the Water Resources Development Act (WRDA) of 1996 (P.L. 104-303). The purpose of the Lake Trafford Restoration project is to improve water quality and ecosystem functions through the removal of organic bottom sediments (muck) via hydraulic dredging. The material is to be pumped to an upland disposal site for treatment. The restoration project is also designed to enhance the lake for public recreational uses (USFWS Coordination Act Report 1999).

The proposed disposal site is largely composed of abandoned farmlands and citrus groves that encompass approximately 450 acres. This disposal area is situated immediately to the east of Upper Corkscrew Swamp and Corkscrew Marsh Preserve and these areas are known habitat of Florida panther (*Puma concolor coryi*). Other listed species know or expected to occur in the area include the eastern indigo snake (*Drymacrchon corais couperi*), gopher tortoise (*Gopherus polyphemus*), Florida scrub jay (*Aphelocoma coerulescens*), wood stork (*Mycteria americana*), Everglade snail kite (*Rostrhamus sociabilis plumbeus*), Southern bald eagle (*Haliaetus leucocephalus*), Audubon's crested Caracara (*Caracara cheriway*), and Florida sandhill crane (*Grus canadensis pratensis*).

This listed species survey was conducted in accordance with the permit conditions for the Lake Trafford disposal site to identify if any threatened or endangered wildlife species occur onsite and to document their locations.

METHODS

The pre-construction wildlife survey at the Lake Trafford spoil disposal site was initiated on 1 September 2004 and completed on 5 October 2004. The timeline for completion of the survey was delayed by three major hurricanes that hit Florida during the month of September. This followed the devastation of hurricane "Charley", a category four storm that hit SW Florida on August 13th. Hurricane "Frances" crossed the central peninsula on 3,4,and 5 September and resulted in mass evacuations, and the closing of schools, businesses, and government offices. Hurricane "Ivan" was projected to hit Southwest Florida but instead veered north and hit the Panhandle region on the 13th of September. On the 25th and 26th of September hurricane Jeanne crossed peninsular Florida along a similar path of hurricane Frances causing similar emergency responses. The study site itself was

spared from damaging winds and flooding throughout these four hurricane events. Between these severe storms we conducted the wildlife and habitat surveys for this report.

A reconnaissance survey of the project site perimeter was conducted by a certified Senior Ecologist (ESA) on 30 August 2004. This was done to identify any potential suitable habitat for scrub jays (*Aphelocoma coerulescens*), gopher tortoise (*Gopherus polyphemus*) and eastern indigo snakes (*Drymarchon corais couperi*). Based on this reconnaissance it was determined that the entire parcel needed to be transect surveyed for gopher tortoise burrows and scrub jays. Vegetation communities/habitat types were assessed and mapped following the wildlife surveys in order to produce an GIS layer that will allow for burrow density/habitat type calculations and for identifying other wildlife and listed species habitat utilization.

Scrub Jays

Scrub jay call tapes were utilized at regular intervals of approximately 200-300 meters within remnant scrub and abandoned citrus groves and played for 2 minutes to attract and document presence/absence of jays in the area. Transect surveys for scrub jays using call tapes were conducted three times during a four-week period. Observation of scrub jays locations and activity were then GPS located and live birds were photo-documented. If scrub jays were observed in an area then meandering surveys of all low growing trees, especially oaks and old citrus trees, was conducted to look for recent evidence of nest construction.

Gopher Tortoise Burrows/Indigo Snakes

An intensive survey for gopher tortoise burrows was conducted with trained and experienced biologists over the entire parcel. In areas determined to be higher quality habitat with high probability or potential for gopher tortoise burrows, narrow-transect walking surveys were conducted to cover every patch of ground. In less suitable habitat such as low pasture and disturbed wetlands, transects were conducted with the assistance of ATVs due the vegetation change, lack of upland habitat for burrowing, and large acreage to cover. Active and inactive gopher tortoise burrows were identified by and GPS located. After the entire parcel was surveyed and the gopher tortoise burrows located, we began to scope the interior of each burrow within each of the burrow clusters in Figure 2 using a custom made fiber-optic video camera. This was done to determine if gopher tortoises were present and if any important commensal species might also be using burrows as refugia. Special attention was given to surveying the tortoise burrows for threatened eastern indigo snakes and the State listed gopher frog (*Rana capito*). Approximately 50% of all the burrows were scoped to check for tortoises and their commensal species including eastern indigo snakes. Eastern indigo snakes are difficult to survey for due to their wide-ranging activity patterns during warmer months and ability to avoid detection in the dense vegetation along ecotones between marshes and ditches and adjacent uplands. It is more likely for them to be detected in the cooler and drier months when vegetation has died back and they may be seen basking in the sun or found in the thermal refugia of gopher tortoise burrows on cold days. Not detecting indigo snakes does not mean that they are not present onsite.

Other Listed Species

As per the Coordination Act Report and Biological Opinion from the US Fish and Wildlife Service the following species were specifically surveyed for during the study period: Florida panther (*Puma concolor coryi*), wood stork (*Mycteria americana*), Everglade snail kite (*Rostrhamus sociabilis plumbeus*), Southern bald eagle (*Haliaetus leucocephalus*), and Audubon's crested Caracara (*Caracara cheriway*). The Florida sandhill crane (*Grus canadensis pratensis*) was not included as a species expected to occur onsite, but we included it as possibly occurring onsite and surveyed for both sandhill cranes and their nests.

Special attention was given to surveying trails and open sandy areas on the site for tracks, scat, and scrapes that would indicate use by large mammals. While our walking transect surveys were very thorough and covered the entire site, it was acknowledged that many nocturnal, or otherwise elusive, fauna such as the Florida panther and their prey base (deer, hogs, raccoons etc.) may go undetected during daytime surveys. Therefore, on 1 September we deployed four (4) infrared and motion-sensor, 35 mm cameras at strategic locations along game trails around the perimeter where the preserve abuts the remnant scrub and abandoned citrus for a period of two weeks (Figure 1). After two weeks these cameras were relocated to the eastern half of the parcel along the perimeter and reset for another 10 days. These same cameras (Camtracker ™) have provided reliable photographic records of large mammals including Florida panther, black bear and whitetail deer in the Western Everglades and detect movement up to 10 meters away. A total of eight (8) sites were sampled in this manner around the disposal site perimeter.

VEGETATION METHODS

Sampling consisted of qualitative methods only which are utilized to give a general portrayal of the plant species composition within surveyed areas. Qualitative plant survey methods consisted of meandering transects within pre-defined habitats. Abundance catagories were based on the literature for qualitative sampling conducted on barrier islands in SW Florida (Cooley 1955, Herwitz 1977, Morrill and Harvey 1980). All species observed in each habitat were recorded and assigned abundance categories. An effort was made to spend approximately the same amount of time in each of the sampled areas.

Abundance Categories

Qualitative observations of plant species within each habitat type were recorded utilizing abundance categories reflecting frequency and abundance. The categories are based on previous environmental assessments of Sanibel, N. Captiva, and Cayo Costa (Cooley 1955, Herwitz 1977, Morrill and Harvey 1980) and in part the Guide to Vascular Plants of Florida (Wunderlin 1998) which are listed below (Table 1). Six categories were chosen for use in characterizing sites. These categories were then utilized in field evaluations conducted in Lehigh Acres.

Table 1: Abundance/Frequency Categories (qualitative vegetation assessments) following literature for studies conducted in Southwest Florida

Cooley 1955		Herwitz 1977		Morrill and Harvey 1980		Wunderlin 1998	
D	**Dominant**: Prevailing, tending to drive out all other plants and to resist invasion by them	**D**	**Dominant**: Controlling habitat physiognomy	**V A**	**Very abundant**: Controlling habitat physiognomy		
A	**Abundant**: Teeming, in copious supply	**A**	**Abundant**: Teeming, in copious supply	**A**	**Abundant**: Teeming, in copious supply		

C	**Common**: General, not local, so frequent as to be found easily	**C**	**Common**: So frequent as to be easily found	**C**	**Common**: So frequent as to be found easily	**C**	**Common**: ?
F	**Frequent**: Often to be met with, but not general.		*-see L*			**F**	**Frequent**: ?
I	**Infrequent**: Isolated, sparse, occurring at considerable distances	**I**	**Infrequent**: Sparse, occasionally found	**I**	**Infrequent**: Sparse, occasionally encountered	**O**	**Occasional**: ?
R	**Rare**: Seldom met with, so infrequent as to be unexpected	**R**	**Rare**: So infrequent as to be unexpected	**R**	**Rare**: So infrequent as to be unexpected	**R**	**Rare**: ?
		L	**Localized**: Common in widely separated areas		*-follows Daubenmire (1968) for separate rating of "sociability"*		

In order to roughly define these qualitative abundance categories using quantitative terms, unpublished data were utilized from other sites where both quantitative and qualitative data were collected. These data, specifically the qualitative and quantitative assessments of Panther Island Mitigation Bank and the Florida Panther National Wildlife Refuge, were linked in an attempt to derive some guidelines in terms of actual measured percent cover and frequency of species and the qualitative abundance categories (Table 2).

Table 2: Qualitative abundance/frequency categories with associated ranges of values derived from quantitative data (ground cover quadrat and shrub line intercept sampling)

Abundance Category		**Aerial Coverage (%)**	**Frequency (%) within 0.5 meter quadrat**
D	**Dominant**: Controlling habitat physiognomy	>=10	
A	**Abundant**: Teeming, in copious	>=2 and <10	>=20

	supply		
C	**Common**: So frequent as to be found easily with general distribution	>=0.2 and <2	>=10 and <20
F	**Frequent**: Frequent as to be found easily with localized distribution	"	>=5 and <10
I	**Infrequent**: Sparse, occasionally encountered	<0.2	<5
R	**Rare**: So infrequent as to be unexpected		

Plant Taxonomy

All plant nomenclature follows Wunderlin and Hanson (http://www.plantatlas.usf.edu).

SURVEY RESULTS

Scrub Jays

During our first reconnaissance of the site, conducted 30 August 2004 at approximately 08:30 hours, two scrub jays were observed within the west-southwest corner of the disposal site in old citrus groves, later identified as "Abandoned Citrus – NW (34.3 acres) " in the vegetation results section. These two adult scrub jays came immediately to the call tape being played at the border between preserve and disposal area. The birds flew in from the NE and stayed in the area after the tape was stopped. These same two scrub jays were later observed approximately .25 miles away near the northern property boundary and again near a gate that separates the old citrus grove from the abandoned farm fields to the east. Two scrub jays were also observed on 1 September during the first day gopher tortoise transects in the same general area as two days earlier and were photographed (Appendix B). These birds were seen again during the week as wildlife surveys progressed but then they seemed to leave the area during the middle of September and were not seen again during the remainder of the fieldwork. On 5 October 2004, the cameras were retrieved from the field and a final effort was made to call the scrub jays at the same location between the preserve and the edge of the "abandoned citrus NW" '(Figures 1 and 2). Two adult scrub jays responded to the call tape after one minute and flew from the preserve area to the SW to my location on the inside edge of the disposal site.

Our survey for scrub jay nests was conducted during the non-breeding season but we located two (2) vacant nests in the general area where jays were observed on three separate occasions within the disposal site. The nests were constructed of thin sticks and twigs with fine threaded plant material lining. They were both located approximately 1.7 meters off the ground in "hardy orange" (*Poncirus trifoliata*) trees and many small oak trees in the immediate area. The locations of these two possible scrub jay nests were flagged, GPS located (Figure 1), and photographed (Appendix). The age and condition of these nests make it difficult to determine if they were scrub jay nests due to their similarity to nests constructed by northern mocking birds, which are common on the site. However, it is possible that one or both of these nests were constructed by scrub jays.

Based on these observations, it is clear that these two scrub jays are using the most of the 34 acres described as "abandoned citrus NW" as well as the designated preserve as foraging habitat and possibly for nesting. While the abandoned citrus is considered as sub-optimal habitat, it is possible that nesting has occurred in this area in the recent past (2003 or 2004).

Gopher Tortoise Survey

Active and inactive gopher tortoise burrows were identified by and GPS located. Our transect survey of the disposal area and adjacent perimeter produced a total of 104 active and inactive burrows. Of the104 active and inactive burrows, a total of 62 (or 59.6%) were located within five (5) distinct clusters totaling 15.8 acres (3.2% of the site) of roughly 493 acres surveyed. Figure 2 shows an overlay of the active and inactive burrows and general habitat mapping. Latitude and longitude coordinates for the gopher tortoise burrows are included in Appendix C.

A total of 53 burrow scopings were attempted of which 22 burrows we were unable to reach the end at the tortoise chamber with the camera attachment (Appendix). However, of the 31 burrows that we successfully scoped, a total of ten live gopher tortoises were observed. Commensal species observations included several unidentified species of spiders and a single southern toad (*Bufo terrestris*).

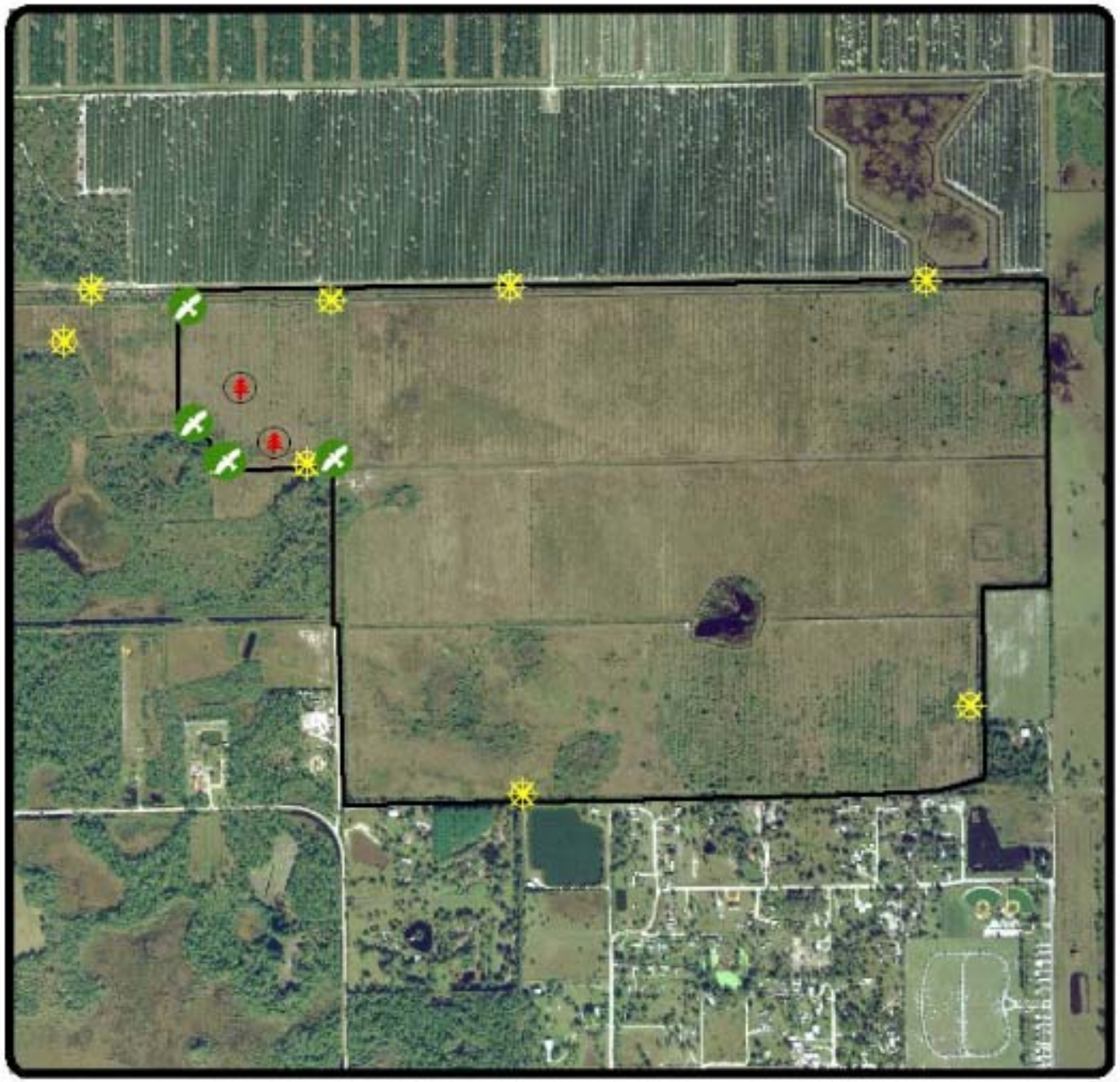

Figure 1:
Florida Scrub Jay Sightings and IR Motion Sensor Camera Locations

Camera Locations
Bird Nest Locations
Scrub Jay Sightings

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W E
S

Prepared By:
The Conservancy of Southwest Florida
October 2004
Source Base Map: Collier County 2003 Aerial Photography

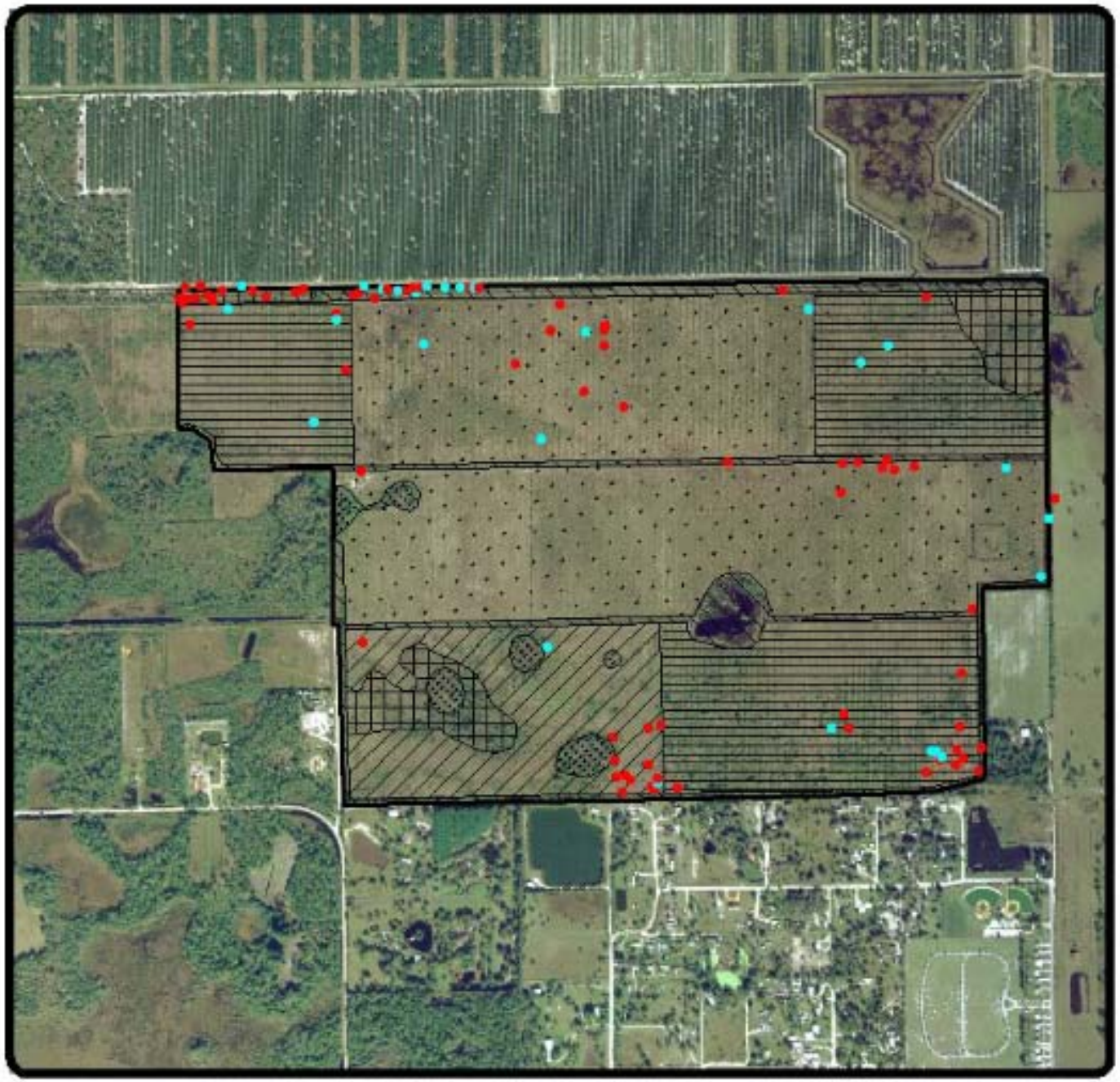


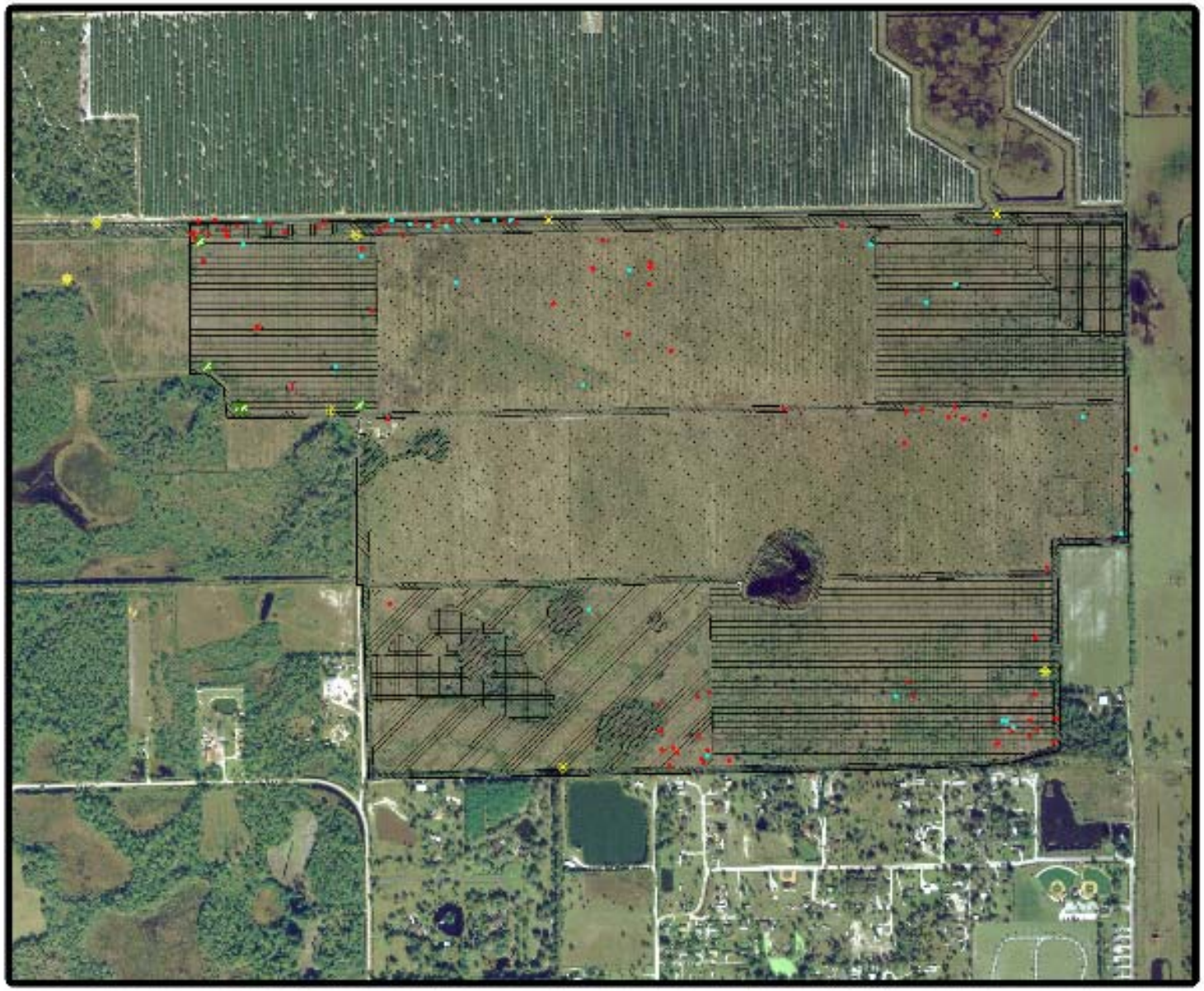
Figure 2:
Gopher Tortoise Burrow Locations and Habitat Descriptions

Tortoise Burrows
- *Active*
- *Inactive*

Habitat Description
- *Abandoned Agriculture*
- *Abandoned Citrus*
- *Ditches/Berms*
- *Freshwater Marsh*
- *Remnant Flatwood*
- *Remnant Scrub*
- *Wet Prairie -Disturbed*

N
W E
S

Prepared By:
The Conservancy of Southwest Florida
October 2004
Source Base Map: Collier County 2003 Aerial Photography



Composite Overlay Map of Florida Scrub Jay, Gopher Tortoise Burrows and Habitat Descriptions

Tortoise Burrows
- *Active*
- *Inactive*

- *Camera Locations*
- *Bird Nest Locations*
- *Scrub Jay Sightings*

Vegetation Types
- *Abandoned Agriculture*
- *Abandoned Citrus*
- *Ditches/Berms*
- *Freshwater Marsh*
- *Remnant Flatwood*
- *Remnant Scrub*
- *Wet Prairie -Disturbed*

N

W *E*

S

Habitat Descriptions where tortoises burrow densities were highest, defined as five burrow "clusters" as follows:

Disturbed scrub in NW: 2 inactive and 14 active 2.1 acres = **7.6** active and inactive burrows/acre
N berm cluster: 3 acre portion of the berm with 10 active and 9 inactive = **6.3** burrows/acre
Berm between abandoned fields: 4 active burrows over approximately 1.2 acres = **3.3** burrows/acre.
S central area: 13 active and 1 inactive burrows in 5 acres = **2.8** burrows/acre
SE corner in hardy orange: 6 active and 3 inactive burrows in 4 acres = **2.3** burrows/acre

The following is a detailed description of the major vegetation communities (habitats) that currently exist onsite, the total acreage, number of active/inactive burrows and overall density of burrows/acre (Figures 2 and 3).

Disturbed Scrub (2.1 acres)
This small area in the northwestern most portion of the site represents a thin strip of remnant scrub or scrubby flatwoods habitat that remained between two ditches and associated berms after agricultural development. Myrtle oak (*Quercus myrtifolia*) and Brazilian pepper dominate the shrub strata. The ground cover is predominantly native scrubby species but with abundant exotic and weedy species indicative of the severe disturbance. The most abundant groundcover species include natives such as wiregrass (*Aristida stricta* var. *beyrichiana*) and gopher apple (*Licania michauxii*) and exotic grasses such as natalgrass (*Rhynchelytrum repens*). One group of Adam's needles (*Yucca filamentosa*) was observed towards the eastern portion of the area. Prickly-pear cactus (*Opuntia humifusa*) also is present.

With 2 inactive and 14 active gopher tortoise burrows, this area had the highest concentration 7.6 active and inactive burrows/acre tied with an area of the berm just to the east of this area dominated by exotic grasses (see ditches and berms below). It was also the only area dominated by native scrubby flatwoods species, though exotic and weedy species still abound. The Florida scrub jay was observed near this area and likely utilizes it ocaisionaly due to the abundant myrtle oak, however the oaks are large and the area is generally a bit overgrown for the scrub jay.

Abandoned Citrus – NW (34.3 acres)
This area of former citrus production likely sits on former scrub or scrubby flatwoods habitat, especially in the northwestern portion of the area. Dominant vegetation includes planted grapefruit (*Citrus x paradisi*) and hardy orange (*Poncirus trifoliata*), scattered Brazilian pepper (*Schinus terebinthefolius*), and groundcover dominated by bahiagrass (*Paspalum notatum*), natalgrass (*Rhynchelytrum repens*), sourgrass (*Digitaria insularis*), and a variety of weedy species. Scattered myrtle oak (*Quercus myrtifolia*) occurs in the northwestern portion of the site with scattered live oak (*Q. virginiana*) in the southern half. Prickly-pear cactus (*Opuntia humifusa*) also is present.

This area contained few tortoise burrows with 3 inactive and 4 active gopher tortoise burrows at 0.2 burrows/acre. Also, the Florida Scrub jay was observed most frequently within this zone, likely due to the scattered small oaks and citrus giving it a scrubby vegetation structure desirable to the jays. It would not be surprising that this area would be utilized for nesting by the jays, and in fact 2 stick nests were found in hardy orange (*Poncirus trifoliata*) shrubs although these nests may be Northern mockingbird nests. A nesting season survey would be necessary to determine this.

Abandoned Citrus – NE (38.7 acres)

Planted grapefruit and hardy orange dominate the woody strata along with scattered Brazilian pepper trees. This area is not as high and dry as the citrus to the W, and in fact has a wetland cut out in the NE corner of the site. Dominant groundcover includes bahiagrass, natalgrass, smutgrass (*Sporobolus indicus var. pyramidale*) and scattered remnant maidencane (*Panicum hemitomon*) in the formerly wetter areas.

Gopher tortoise density was fairly low in these areas at 0.08 tortoises/acre with 2 inactive and 1 active burrow located. Scrub jays were not observed at any time is this habitat. A fair number of burrows were located along the perimeter of this zone including a high-density area just outside this zone in the perimeter berms forming the Northern property line.

Disturbed Flatwoods (51.7 acres)

This large area in the southern portion of the site probably was a mosaic of mesic pine flatwoods with some scrubby and hydric patches. The area was cleared in the past for agricultural purposes although it appears it was never completed. Dominant vegetation includes a variety of native and exotic plants such as grasses including bahaigrass, natalgrass, and little blue maidencane (*Amphicarpum muhlenbergianum*). Shrubs include live oak, Brazilian pepper, winged sumac (*Rhus copalinum*), and wax myrtle (*Myrica cerifera*). Several native herbaceous species typical of flatwoods were also observed such as choclateweed (*Melochia spicata*), St. John's worts (*Hypericum cistifolium*, *H. hypericoides*, and *H. tetrapetalum*), and lechea (*Lechea torreyii*). One large patch of cogongrass (*Imperata cylindrica*) occurs in this area.

Although this area consisted of a generally low gopher tortoise density of 0.3 burrows/acre with 2 inactive and 13 active burrows, one area of high density was found along the southern property boundary. This cluster consists of 13 active and 1 inactive burrows in an area of approximately 5 acres resulting in a density of 2.8 burrows/acre. This area, with comparable density to the remnant scrub in the NW of the property, may have been higher than the surrounding mesic flatwoods mosaic as is indicated by scrubby flatwoods species such as myrtle oak and lechea (*Lechea torreyi*). No scrub jays were observed in this area.

Abandoned Citrus – SE (66.3 acres)

The citrus area in the SE corner probably at one time consisted of mesic pine flatwoods with perhaps some scrubby components. Now the site is primarily dominated by weedy species but with wetland species such as maidencane (*Panicum hemitomon*) persisting in the northeastern portions closer to a historical wetland that had been excavated, ditched and bermed. Dominants include planted grapefruit, hardy orange, Brazilian pepper, muscadine (*Vitis rotundifolia*), caesarweed (*Urena lobata*), beggar's ticks (*Bidens alba var. radiata*) and bahiagrass.

Gopher tortoise density overall was low at 0.2 active and inactive burrows per acre with a total of 4 inactive and 10 active. However, all were located in the southern half of the zone, arguably doubling the density if the areas were to be split by higher and lower areas. Furthermore, the southeastern corner exhibits a high concentration in a more open part of the old grove dominated by hardy orange (*Poncirus trifoliata*) and grasses. This area sits next to some existing mesic flatwoods with a few myrtle oaks indicating that the entire area may have been on the dry side of mesic. A total of 6 active and 3 inactive burrows were located in this SE cluster covering roughly 4 acres resulting in a density of 2.3 burrows/acre.

Disturbed Freshwater Marsh (7.5 acres)

These areas were historically marsh but have now become more dominated by willow (*Salix caroliniana*) in the centers and are being encroached by hardwoods such as red maple (*Acer rubrum*) along the edges due to ground disturbance and fire exclusion. Remnant marsh species dominating in the groundcover include sawgrass (*Cladium jamaicense*), fire-flag (*Thalia geniculata*), and pickerelweed (*Pontederia cordata*).

No tortoises were found in these areas. Protected plant species observed include cinnamon fern (*Osmunda cinnamomea*). Generally the habitat quality is highest in the deeper portions as less mechanical disturbance has occurred and the effects of fire exclusion are less noticeable as the natural fire frequency was lower.

Disturbed Wet Prairie (20.9 acres)

These areas include the small drained wetland in the Northeast corner of the site surrounded by abandoned citrus as well as the less disturbed areas around the marshes embedded within the disturbed mesic flatwoods mosaic of the southern portion of the site.

The Northeastern wet prairie (9 acres) is dominated by maidencane (*Panicum hemitomon*) and little blue maidencane (*Amphicarpum muhlenbergianum*). The hydrology of this area appears to have been severely modified by the citrus development around it. Plant diversity is low and no protected species were observed.

The wet praire habitat in the southern portion of the site (12 acres) is floristically fairly diverse with a primarily native species composition. Dominant species include native grasses such as little blue maidencane (*Amphicarpum muhlenbergianum*) as well as the typically more weedy native carpetgrasses (*Axonopus fissifolius, A. furcatus*). Numerous desirable wet prairie species were also observed, though not extremely abundant, including beaksedge (*Rhynchospora inundata*, *R. microcarpa*), flatsedge (*Cyperus haspan*), arrowhead (*Sagittaria graminea*), St. John's wort (*Hypericum brachyphyllum*), musky mint (*Hyptis alata*), coyote-thistle (*Eryngium baldwinii*), meadow beauty (*Rhexia mariana*), Everglades morning-glory (*Ipomoea sagitata*), Corymb false-fiddle-leaf (*Hydrolea corymbosa*), and a variety of wet prairie species indicative of the past conditions.

Abandoned Fields (225 acres)

These areas generally consisted of weedy native and exotic species and have suffered the most severe and recent ground disturbance through vegetable production. The shrub strata primarily consisted of scattered saltbush (*Baccharris halimifolia*) and less abundant Brazilian pepper (*Schinus terebinthefolius*). The most dominant groundcover species was smutgrass (*Sporobolus indicus var. pyramidale*). Also abundant were bahiagrass (*Paspalum notatum*), natalgrass (*Rhynchelytrum repens*), West Indian pennisetum (*Pennisetum polystachion*), caesarweed (*Urena lobata*), hairy indigo (*Indigofera hirsuta*), dog-fennel (*Eupatorium capilifolium*), beggar's ticks (*Bidens alba var. radiata*), common ragweed (*Ambrosia artemisifolia*), and horseweed (*Conyza canadensis var. pusila*).

Overall gopher tortoise density was low at 0.08 burrows/acre and 5 inactive and 14 active burrows located. Two notable clusters of burrows, however, were located. One is generally the northwestern quarter of this zone and was likely higher than the rest of the areas to the south and also located more closely to the best remnants with the highest density of tortoises. The other area is in the northeastern portion of the middle block (or southern abandoned field) with forms a small group of burrows located on a slightly higher ground as indicated by the higher abundance of natalgrass. The berms in this area also have remnant saw palmetto (*Serenoa repens*) and lyonia (*Lyonia fruticosa*) and several burrows as well.

Ditches and Berms (39.7 acres)

This habitat type attempts to include all of the perimeter ditches and berms of the site which generally includes highly disturbed habitat, however the berms have in some cases acted to preserve native vegetation in scattered areas on site, with each area originating from differing habitat types. This area also includes the disturbed wetland in the center of the site that has been excavated and surrounded by ditches acting as a retention pond. Vegetation on the berms is predominately native and exotic weeds, such as Brazilian pepper (*Schinus terebinthefolius*), bahiagrass (*Paspalum notatum*), West Indian pennisetum (*Pennisetum polystachion*), natalgrass (*Rhynchelytrum repens*), and muscadine (*Vitus rotundifolia*) while remnant areas of saw palmetto (*Serenoa repens*), fetterbush (*Lyonia fruticosa*), and oaks (*Quercus minima, Q. myrtifolia, and Q. virginiana*) also occur. The ditches consist of a variety of mostly weedy native wetland species with significant patchy infestation of highly invasive exotics such as torpedograss (*Panicum repens*) and Old World climbing fern (*Lygodium microphyllum*).

The overall density of tortoises on the berms is moderate at 1.5 burrows per acre with 11 inactive and 19 active burrows (acreage calculated at 20 by eliminating the ditches). However, very high densities, were observed where the berms were located near the scrub remnant in the northwest portion of the site as well as a few areas around the site with remnant flatwoods species like saw palmetto such as the cluster in the central eastern berm within the agricultural fields. The Northern cluster occurs on an approximately 3 acre portion of the berm with 10 active and 9 inactive burrows giving a density of 6.3 burrows/acre. This cluster is comparable to the scrub remnant on the berm to the west, although that cluster has a higher active to inactive ratio. The central cluster consists of 4 active burrows over approximately 1.2 acres giving a density of 3.3 burrows/acre.

Interestingly, two protected plant species were observed in the ditches of the southern and southeastern perimeter ditches. Nodding club moss (*Lycopodiella cernua*) and royal fern (*Osmunda regalis var. spectabilis*) were both observed in these areas.

Eastern Indigo Snake (*Drymarchon corais couperi*)

No eastern indigo snakes were observed during our surveys of the disposal site or during the burrow scoping with fiber optic camera. However, due to the presence of suitable upland and wetland habitats, thermal refugia in the form of tortoise burrows, and proximity to larger conservation lands it is likely that eastern indigo snakes are present both on the spoil disposal site and on the adjacent preserve. Caution should be exercised at all times during construction to minimize the risk of injuring or killing eastern indigo snakes with vehicles and earthmoving operations.

Florida Panther (*Puma concolor coryi*)

No Florida panthers were observed and no sign of panther activity was detected during the period of this survey. However, there was an abundance of panther prey found during the survey period. This was thoroughly documented from tracks, direct visual observations, and photographs taken by remote cameras (Appendix B). The prey base consists of several wild hogs (*Sus scrofa*), wild turkey (*Meleagris gallopavo*), and many whitetailed deer (*Odeocoileus virginianus*), that were mainly concentrated along the western and northwestern portions of the abandoned citrus and remnant scrub habitats. The two cameras located within the preserve area recorded the largest number of hogs, deer and turkey that reflects the higher quality of habitat and distance from human activities to the south and southeast.

Wood Stork (*Mycteria americana*)

No wood storks or rookeries were observed onsite during the study but it is likely that the ditches and wetlands are occasionally used as foraging sites at certain times of the year.

Audubon's Crested Caracara (*Caracara cheriway*)
No caracara were observed onsite and it is highly unlikely that caracara would find suitable nesting sites due to the lack of large cabbage palms.

Everglades Snail Kite (*Rotrhamus sociabilis plumbeus*)
No snail kites were observed during the survey.

Florida Sandhill Crane (*Grus Canadensis pratensis*)
No sandhill cranes were observed on the property itself but on two occasions during the survey they were observed flying overhead toward Lake Trafford. In addition there is a large wet prairie and open shallow marsh immediately to the east of the disposal area approximately 100 meters from the eastern property line that may contain sandhill cranes nests. Three sandhill cranes were observed foraging in this marsh on two separate occasions and four cranes were observed in this same marsh another time.

American Alligator (Alligator mississipiensis)
No alligators were observed during the survey but it is likely that they utilize the property, especially the excavated retention pond in the South-central portion of the property at certain times of the year.

Other Wildlife Observed Onsite
Numerous non-listed, species of wildlife were observed during the period of 1 September through 5 October 2004. Observations include direct visual and audible observations in the field by qualified biologists and the project manager who is certified as a Senior Ecologist and indirect observations through the use of infrared motion-sensor cameras at strategic locations along major game trails (Figures 1 and 3). The combined results of these direct and indirect wildlife observations are included in Table 2.

THE CONSERVANCY
Of Southwest Florida

Table 2. Lake Trafford Disposal Site: Wildlife Observations

Genus / Species	Common Name	Designated Status USFWS	FWC
Reptiles / Amphibians:			
Acris gryllus dorsalis	Florida cricket frog		
Anolis carolinensis	Green anole		
Anolis sagrei sagrei	Cuban brown anole*		
Bufo quercicus	Oak toad		
Cnemidophorus sexlineatus	Six-lined racerunner		
Coluber constrictor priapus	Black racer		
Eumeces inexpectatus	Southeastern five-lined skink		
Gastrophryne carolinensis	Eastern narrowmouth toad		
Gopherus polyphemus	Gopher tortoise	**SSC**	
Hyla cinerea	Green treefrog		
Osteopilus septentrionalis	Cuban treefrog*		
Rana grylio	Pig frog		
Rana sphenocephala	Southern leopard frog		
Thamnophis sirtalis	Eastern garter snake		
BIRDS:			
Aphelocoma coerulescens	Florida scrub Jay	**T**	**T**
Ardea alba	Great egret		
Baeolophus bicolor	Tufted titmouse		
Buteo lineatus	Red-shouldered hawk		
Butorides virescens	Green heron		
Cardinalis cardinalis	Northern cardinal		
Cathartes aura	Turkey vulture		
Ceryle alcyon	Belted kingfisher		
Circus cyaneus	Northern harrier		
Colinus virginiacus	Northern bobwhite		
Columbina passerina	Common ground-dove		
Coragyps atratus	Black vulture		

Corvus brachyrhynchos	American crow
Cyanocitta cristata	Blue jay
Dendroica coronata	Yellow-rumped warbler
Dumetella carolinensis	Gray catbird
Lanius ludovicianus	Loggerhead shrike
Melanerpes carolinus	Red-bellied woodpecker
Meleagris gallopavo	Wild turkey
Mimus polyglottos	Northern mockingbird
Myiarchus crinitus	Great crested flycatcher
Pandion haliaetus	Osprey
Pipilo erythrophthalmus	Eastern towhee
Polioptila caerulea	Blue-gray gnatcatcher
Quiscalus quiscula	Common grackle
Seiurus aurocapillus	Ovenbird
Sturnella magna	Eastern meadowlark
Tachycineta bicolor	Tree swallow
Thryothorus ludovicianus	Carolina wren
Vireo griseus	White-eyed vireo
Zenaida macroura	Mourning dove

MAMMALS:

Dasypus novemcinctus	Armadillo
Didelphis virginiana	Opossum
Lynx rufus	Bobcat
Odocoileus virginianus	White-tailed deer
Procyon lotor	Raccoon
Sciurus carolinensis	Eastern gray squirrel
Spilogale putorius	Eastern spotted skunk
Sus scrofa	Feral pig*
Sylvilagus palustris	Marsh rabbit
Urocyon cinereoargenteus	Gray fox

*** exotic species**

FWC = Fish and Wildlife Conservation Commission
USFWS = U.S. Fish and Wildlife Service

T = Threatened
SSC = Species of Special Concern

SUMMARY

Our listed species survey covered approximately 493 acres, included the perimeter ditches and berms, and a small portion of the designated preserve that adjoins the western side of the spoil disposal area. Two scrub jays were observed on several occasions within the spoil disposal site footprint but were confined to an area of about 34 acres, identified as “abandoned citrus NW” (Figure 1 and 3). A total of one hundred and four (104) active and inactive gopher tortoise burrows were located within, and immediately adjacent to the spoil disposal area (Figure 2 and 3). Of these 104 burrows a total of 53 were checked with a fiber-optic video camera scope for both gopher tortoises and commensal species. Ten (10) live gopher tortoises were found in 31 burrows that were successfully scoped with the video camera to the chamber (end of burrow).

No indigo snakes were observed during our survey but it is likely that they are presently using the site but avoided detection in the dense groundcover. Large mammals survey techniques included the use of remote, infrared motion sensor cameras. No evidence was found of recent use by Florida panther (tracks, scrapes, fresh kills) of the spoil disposal site. No other State or Federally listed animal species were found during our survey.

Appendix A
Vegetation List

APPENDIX A

Vegetation List

Appendix A: Plant Species Observed by Vegetative Area

FAMILY	SCIENTIFIC NAME	COMMON NAME	FDA	FWS	Citrus NW	Dist. scrub	Citrus NE	Dist. Flat-woods	Citrus SE	Dist. Marsh	Dist. Wet Prarie	fields	ditch	berm
Shrubs and Trees														
PINACEAE	*Pinus elliottii*	Slash pine							I			I		
ARECACEAE	*Sabal palmetto*	Cabbage palm			I				I					
ARECACEAE	*Serenoa repens*	Saw palmetto				F	I					I		I
SALICACEAE	*Salix caroliniana*	Willow						I		C			I	
MYRICACEAE	*Myrica cerifera*	Wax-myrtle						I	I	C	C		I	
FAGACEAE	*Quercus elliottii*	Running oak				I								
FAGACEAE	Quercus laurifolia	Swamp laurel oak			I		I	I						I
FAGACEAE	*Quercus minima*	Dwarf live oak			I	I		I	I					I
FAGACEAE	*Quercus myrtifolia*	Myrtle oak			I	C		I	I					
FAGACEAE	*Quercus virginiana*	Live oak			I	F		I	I			I		I
MAGNOLIACEAE	*Magnolia virginiana*	Sweet bay											I	
E ANNONACEAE	*Asimina reticulata*	Pawpaw			I	F		I						
* FABACEAE	*Albizia lebbeck*	Woman's-tongue					I		I					I
* RUTACEAE	*Citrus x paradisi*	Grapefruit			C		C		C					
* RUTACEAE	*Poncirus trifoliata*	Hardy orange			I		I		F					
ANACARDIACEAE	*Rhus copallinum*	Winged sumac			F		F	F	F					F
* ANACARDIACEAE	*Schinus terebinthifolius*	Brazilian pepper			F	I	F	C	C	I		I	I	C
AQUIFOLIACEAE	*Ilex glabra*	Gallberry					I		I			I		I
SAPINDACEAE	*Acer rubrum*	Red maple								F	I			
* MYRTACEAE	*Melaleuca quinquenervia*	Melaleuca									I		I	I
* MYRTACEAE	*Psidium guajava*	Guava												I
* MYRTACEAE	*Rhodomyrtus tomentosa*	Rose myrtle							I					I
CORNACEAE	*Cornus foemina*	Swamp dogwood								F				
ERICACEAE	*Lyonia fruticosa*	Staggerbush					I		I			I		I
EBENACEAE	*Diospyros virginiana*	Persimmon									F			
* VERBENACEAE	*Lantana camara*	Shrub verbena			I				I			I		I
LAMIACEAE	*Callicarpa americana*	Beauty-bush			I	I			I					I
RUBIACEAE	*Cephalanthus occidentalis*	Buttonbush								F	I			
ADOXACEAE	*Sambucus nigra subsp. canadensis*	Elderberry								I				
ASTERACEAE	*Baccharis halimifolia*	Saltbush			I				F		I	C		

* = Exotic species; E=Endemic to Florida; Abundance Values listed above in Table __.

FDA = Florida Department of Agriculture and Consumer Services; FWS = United States Fish and Wildlife Service
C = Commercially Exploited

Appendix A: Plant Species Observed by Vegetative Area (Continued – Ground Cover)

	FAMILY	SCIENTIFIC NAME	COMMON NAME	FDA	FWS	Citrus NW	Dist. scrub	Citrus NE	Dist. Flat-woods	Citrus SE	Dist. Marsh	Dist. Wet Prarie	old fields	ditch	berm
	Ground Cover														
	LYCOPODIACEAE	*Lycopodiella cernua*	Nodding club-moss	C											I
	OSMUNDACEAE	*Osmunda cinnamomea*	Cinnamon fern	C							I				
	OSMUNDACEAE	*Osmunda regalis var. spectabilis*	Royal fern	C										I	
*	NEPHROLEPICACEAE A	*Nephrolepis multiflora*	Asian sword fern												I
	DENNSTAEDTIACEAE	*Pteridium aquilinum*	Eastern bracken fern						I	I	I				
	BLECHNACEAE	*Blechnum serrulatum*	Swamp fern								F	I		I	
	BLECHNACEAE	*Woodwardia virginica*	Chain fern								I			I	
	THELYPTERIDACEAE	*Thelypteris interrupta*	Willdenow's maiden fern								I				
	THELYPTERIDACEAE	*Thelypteris kunthii*	Maiden fern								I				
	SALVINIACEAE	*Salvinia minima*	Water spangles								F				
	TYPHACEAE	*Typha domingensis*	Cattail								I			I	
	ALISMATACEAE	*Sagittaria graminea*	Arrowhead									I			
	ALISMATACEAE	*Sagittaria lancifolia*	Arrowhead								I				
	POACEAE	*Amphicarpum muhlenbergianum*	Little blue maidencane					F		F		C			
	POACEAE	*Andropogon glomeratus*	Bushy bluestem			F			I			I	I	I	I
?	POACEAE	*Andropogon sp.*	Bluestem grass			I									
	POACEAE	*Andropogon ternarius*	Silver bluestem				F								
	POACEAE	*Andropogon virginicus*	Broomsedge			I		I	I				I		
	POACEAE	*Aristida spiciformis*	Bottlebrush threeawn						I						
	POACEAE	*Aristida stricta var. beyrichiana*	Wiregrass				F								
	POACEAE	*Axonopus fissifolius*	Southern carpet grass						I			C			
	POACEAE	*Axonopus furcatus*	Big carpet grass									F			
	POACEAE	*Cenchrus spinifex*	Coast sandspur										I		I
*	POACEAE	*Cynodon dactylon*	Bermudagrass							I			I		I
*	POACEAE	*Dactyloctenium aegyptium*	Crowfootgrass				F								I
	POACEAE	*Dichanthelium ensifolium*	Low panicum						I						
	POACEAE	*Dichanthelium portoricense*	Witchgrass				I		I						

* = Exotic species; E=Endemic to Florida; Abundance Values listed above in Table __.
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Appendix A: Plant Species Observed by Vegetative Area (Continued – Ground Cover)

	FAMILY	SCIENTIFIC NAME	COMMON NAME	FDA	FWS	Citrus NW	Dist. scrub	Citrus NE	Dist. Flat-woods	Citrus SE	Dist. Marsh	Dist. Wet Prarie	old fields	ditch	berm
	POACEAE	*Digitaria insularis*	Sourgrass			C							I		
	POACEAE	*Digitaria serotina*	Dwarf crabgrass			I									
*	POACEAE	*Eleusine indica*	Goosegrass			I									I
	POACEAE	*Eustachys glauca*	Saltmarsh fingergrass									I			
*	POACEAE	*Imperata cylindrica*	Cogongrass						F						
	POACEAE	*Leersia hexandra*	Cutgrass											F	
	POACEAE	*Panicum dichotomiflorum*	Fall panic grass									I			
	POACEAE	*Panicum hemitomon*	Maidencane					C	F	C		I	I	F	I
*	POACEAE	*Panicum maximum*	Guineagrass			I							I		I
*	POACEAE	*Panicum repens*	Torpedo grass				I						I		
	POACEAE	*Panicum rigidulum*	Redtop panicum									I			
*	POACEAE	*Paspalum notatum*	Bahiagrass			D	C	A	A	C		F	A		C
*	POACEAE	*Paspalum urvillei*	Vasey grass									I			
*	POACEAE	*Pennisetum polystachion*	West indian pennisetum			C			I	F			C		F
*	POACEAE	*Rhynchelytrum repens*	Natalgrass			F	C		I	C			F		F
	POACEAE	*Sacciolepis striata*	American cupscale									I		I	
	POACEAE	*Setaria parviflora*	Knotroot foxtail						I			I			
	POACEAE	*Spartina bakeri*	Sand cordgrass									I			
*	POACEAE	*Sporobolus indicus var. pyramidalis*	Smutgrass			C		A		A			D		I
	CYPERACEAE	*Bulbostylis ciliatifolia*	Capillary hairsedge				C								
	CYPERACEAE	*Cladium jamaicense*	Saw-grass								F	F			
	CYPERACEAE	*Cyperus haspan*	Flatsedge								I	I			
	CYPERACEAE	*Cyperus polystachyos*	Flatsedge						I			I			I
	CYPERACEAE	*Cyperus retrorsus*	Flatsedge				F		I				I		I
	CYPERACEAE	*Cyperus surinamensis*	Flatsedge										I		
	CYPERACEAE	*Eleocharis interstincta*	Spike-rush											I	
	CYPERACEAE	*Rhynchospora inundata*	Inundated beaksedge									I			
	CYPERACEAE	*Rhynchospora microcarpa*	Beaksedge									I			
?	LEMNACEAE	*Lemna sp.*	Duckweed								F				
?	XYRIDACEAE	*Xyris sp.*	Yellow-eyed-grass									I			

* = Exotic species; E=Endemic to Florida; Abundance Values listed above in Table __.
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Appendix A: Plant Species Observed by Vegetative Area (Continued – Ground Cover)

	FAMILY	SCIENTIFIC NAME	COMMON NAME	FDA	FWS	Citrus NW	Dist. scrub	Citrus NE	Dist. Flat-woods	Citrus SE	Dist. Marsh	Dist. Wet Prarie	old fields	ditch	berm
	ERIOCAULACEAE	*Lachnocaulon beyrichianum*	Southern bogbutton						I						
	PONTEDERIACEAE	*Pontederia cordata*	Pickerelweed								F	I		I	
	AGAVACEAE	*Yucca filimentosa*	Adam's needle				I								
	SMILACACEAE	*Smilax auriculata*	Greenbrier				F								
	HAEMODORACEAE	*Lachnanthes caroliana*	Red-root									I			
	IRIDACEAE	*Sisyrinchium angustifolium*	Pointed blue-eye-grass						I						
	MARANTACEAE	*Thalia geniculata*	Fireflag								F				
	URTICACEAE	*Boehmeria cylindrica*	Bog-hemp, false-nettle								F				
	POLYGONACEAE	*Polygonella polygama*	Jointweed				I								
*	CHENOPODIACEAE	*Chenopodium ambrosioides*	Mexican tea			I				I			I		
	AMARANTHACEAE	*Iresine diffusa*	Bloodleaf			I		F		F			I		I
	PHYTOLACCACEAE	*Phytolacca americana*	Pokeweed			I		I							
	NYMPHAEACEAE	*Nymphaea odorata*	White water-lily								I				
	ROSACEAE	*Rubus trivialis*	Southern dewberry									I			
	ROSACEAE	*Rubus argutus*	Sawtooth blackberry						I						
	CHRYSOBALANACEAE	*Licania michauxii*	Gopher apple				F								
	FABACEAE	*Chamaecrista nictitans*	Wild sesitive plant				I								
	FABACEAE	*Chamaecrista nictitans var. aspera*	Rough cassia			I							I		I
*	FABACEAE	*Indigofera hirsuta*	Hairy indigo			C		I	I				F		F
	EUPHORBIACEAE	*Stillingia sylvatica*	Queen's-delight						I						
	EUPHORBIACEAE	*Tragia urens*	Tragia					I	I						
*	MALVACEAE	*Urena lobata*	Caesar-weed, mozote			C				C			F	I	F
	STERCULIACEAE	*Melochia spicata*	Chocolate weed									I			
	CLUSIACEAE	*Hypericum brachyphyllum*	St. John's-wort									I			
	CLUSIACEAE	*Hypericum cistifolium*	St. John's-wort						I						
	CLUSIACEAE	*Hypericum hypericoides*	St. John's wort						I						

* = Exotic species; E=Endemic to Florida; Abundance Values listed above in Table __.
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Appendix A: Plant Species Observed by Vegetative Area (Continued – Ground Cover)

	FAMILY	SCIENTIFIC NAME	COMMON NAME	FDA	FWS	Citrus NW	Dist. scrub	Citrus NE	Dist. Flat-woods	Citrus SE	Dist. Marsh	Dist. Wet Prarie	old fields	ditch	berm
	CLUSIACEAE	*Hypericum tetrapetalum*	St. John's-wort						I						
	CISTACEAE	*Lechea torreyi*	Piedmont pinweed						I						
	TURNERACEAE	*Piriqueta cistoides subsp. Caroliniana*	Pitted stripeseed						I						
	CACTACEAE	*Opuntia humifusa*	Prickly-pear cactus			I	I								
	MELASTOMATACEAE	*Rhexia mariana*	Meadow beauty						I			F	I		
	ONAGRACEAE	*Gaura angustifolia*	Southern gaura					I							
*	ONAGRACEAE	*Ludwigia peruviana*	Primrose willow								I	I	I	C	
	ONAGRACEAE	*Ludwigia virgata*	Ludwigia						I						
	ARALIACEAE	*Centella asiatica*	Pennywort									I			
	APIACEAE	*Eryngium baldwinii*	Baldwin's coyote-thistle									I			
	ERICACEAE	*Lyonia fruticosa*	Staggerbush				I								
	ERICACEAE	*Vaccinium darrowii*	Blueberry						I						
	ERICACEAE	*Vaccinium myrsinites*	Shiny blueberry				C		I						
	BUDDLEJACEAE	*Polypremum procumbens*	Rustweed										I		
	GENTIANACEAE	*Sabatia grandiflora*	Marsh pink									I			
	HYDROLEACEAE	*Hydrolea corymbosa*	Corymb false-fiddle-leaf									I			
	LAMIACEAE	*Hyptis alata*	Musky mint									F			
	LAMIACEAE	*Piloblephis rigida*	Pennyroyal						I						
	VERONICACEAE	*Gratiola hispida*	Scrub hedge-hyssop									I			
	VERONICACEAE	*Scoparia dulcis*	Sweet broom						I				I		
	OROBANCHACEAE	*Buchnera americana*	Blueheart						I				I		
	RUBIACEAE	*Diodia teres*	Rough buttonweed			I									
*	RUBIACEAE	*Richardia scabra*	Richardia			I							I		
*	RUBIACEAE	*Spermacoce verticillata*	Spermacoce										I		
	ASTERACEAE	*Ambrosia artemisiifolia*	Common ragweed			F				I			F		

* = Exotic species; E=Endemic to Florida; Abundance Values listed above in Table __.
FDA = Florida Department of Agriculture and Consumer Services; FWS = United States Fish and Wildlife Service
C = Commercially Exploited

Appendix A: Plant Species Observed by Vegetative Area (Continued – Ground Cover)

FAMILY	SCIENTIFIC NAME	COMMON NAME	FDA	FWS	Citrus NW	Dist. scrub	Citrus NE	Dist. Flat-woods	Citrus SE	Dist. Marsh	Dist. Wet Prarie	old fields	ditch	berm
ASTERACEAE	*Arnoglossum ovatum*	Egg-leaf indian-plantain				I								
ASTERACEAE	*Bidens alba var. radiata*	Beggar-ticks; Romerillo			A			F	C			F		F
ASTERACEAE	*Bigelowia nudata subsp. australis*	Rayless goldenrod									I			
ASTERACEAE	*Carphephorus corymbosus*	Coastal-plain chaffhead				I								
ASTERACEAE	*Conyza canadensis var. pusilla*	Dwarf horseweed			I				I			F		
ASTERACEAE	*Eupatorium capillifolium*	Dog fennel			I		C	F	F			C		F
ASTERACEAE	*Eupatorium leptophyllum*	Fennel									I			
ASTERACEAE	*Eupatorium mohrii*	Thoroughwort									I			
ASTERACEAE	*Euthamia caroliniana*	Flat-topped goldenrod					F	F	F					
ASTERACEAE	*Heterotheca subaxillaris*	Camphorweed			I							I		
ASTERACEAE	*Liatris chapmanii*	Liatris						I						
ASTERACEAE	*Lygodesmia aphylla*	Roserush										I		
ASTERACEAE	*Pityopsis graminifolia*	Golden aster						I	I			I		
ASTERACEAE	*Pluchea rosea*	Rosy camphorweed									I			
ASTERACEAE	*Pseudognaphalium obtusifolium*	Rabbit tobacco										I		
ASTERACEAE	*Pterocaulon pycnostachyum*	Blackroot				I		I						
ASTERACEAE	*Solidago fistulosa*	Goldenrod						F						
ASTERACEAE	*Solidago odora var. chapmanii*	Goldenrod				I								
ASTERACEAE	*Symphyotrichum carolinianum*	Climbing aster								I				
ASTERACEAE	*Symphyotrichum elliottii*	Elliott's aster									I			

* = Exotic species; E=Endemic to Florida; Abundance Values listed above in Table __.
FDA = Florida Department of Agriculture and Consumer Services; FWS = United States Fish and Wildlife Service
C = Commercially Exploited

Appendix A: Plant Species Observed by Vegetative Area (Continued – Vines and Epiphytes)

	FAMILY	SCIENTIFIC NAME	COMMON NAME	FDA	FWS	Citrus NW	Dist. scrub	Citrus NE	Dist. Flat-woods	Citrus SE	Dist. Marsh	Dist. Wet Prarie	old fields	ditch	berm
	Vines														
*	SCHIZAEACEAE	*Lygodium microphyllum*	Old World climbing fern											F	I
	SMILACACEAE	*Smilax auriculata*	Greenbrier						F						I
	SMILACACEAE	Smilax bona-nox	Saw greenbrier												I
	AGAVACEAE	*Yucca filimentosa*	Adam's needle				I								
*	FABACEAE	*Abrus precatorius*	Rosary pea												C
	FABACEAE	*Galactia elliottii*	Elliott's milkpea			C	F		I						I
	ANACARDIACEAE	*Toxicodendron radicans*	Poison ivy												I
	VITACEAE	*Ampelopsis arborea*	Pepper-vine			I			I	I					I
	VITACEAE	*Cissus verticillata*	Possum grape								I				
	VITACEAE	*Parthenocissus quinquefolia*	Virginia creeper			I									F
	VITACEAE	*Vitis rotundifolia*	Muscadine grape			F	I	C	C	C			I	F	A
	APOCYNACEAE	*Sarcostemma clausum*	White vine									I			
	CONVOLVULACEAE	*Ipomoea sagittata*	Saltmarsh morning-glory									I			
*	CUCURBITACEAE	*Momordica charantia*	Wild balsam apple			I			F						I
	ASTERACEAE	*Mikania scandens*	Climbing hempvine								F	I		I	
	Epiphytes														
	POLYPODIACEAE	*Pleopeltis polypodioides var. michauxiana*	Resurrection fern								I				
	BROMELIACEAE	*Tillandsia recurvata*	Ball-moss								I				
	BROMELIACEAE	*Tillandsia usneoides*	Spanish moss								I				

* = Exotic species; E=Endemic to Florida; Abundance Values listed above in Table __.
FDA = Florida Department of Agriculture and Consumer Services; FWS = United States Fish and Wildlife Service
C = Commercially Exploited

APPENDIX B

Wildlife Photos

Scrub Jays in live oak (*Quercus virginiana*) tree located in abandoned citrus NW,
September 2004

Gopher tortoise in burrow along Northern berm (above) & Fiber-optic scope device used to check burrows for tortoises and commensal species such as indigo snakes (below).

Selected Infrared/Motion Camera Images, September 2004

Camera 3: White-tailed Deer

Camera 3: Wild Turkeys

Camera 3: Feral Hog

Camera 4A: White-tailed Deer

Camera 2A: Bobcat

Camera 3A:White-tailed Deer

Eastern Spotted Skunk in Abandoned Agricultural Field

APPENDIX C

Latitude and Longitude of Gopher Tortoise Burrows,
Remote Cameras, and Vacant Nests

TYPE	LATITUDE	LONGITUDE
BURROW	26.44091355	-81.47492629
BURROW	26.45091190	-81.48502339
BURROW	26.45070269	-81.48497804
BURROW	26.45069380	-81.48497536
BURROW	26.45092506	-81.48465659
BURROW	26.45066774	-81.48478760
BURROW	26.45075357	-81.48448359
BURROW	26.45072482	-81.48442333
BURROW	26.45085365	-81.48349704
BURROW	26.45071484	-81.48318482
BURROW	26.45080076	-81.48249683
BURROW	26.45063077	-81.48439650
BURROW	26.45089354	-81.48233355
BURROW	26.44936259	-81.47749208
BURROW	26.45004706	-81.47667090
BURROW	26.45058584	-81.47646513
BURROW	26.44083325	-81.47483904
BURROW	26.44091221	-81.47492671
BURROW	26.45038962	-81.48156141
BURROW	26.44879027	-81.47591393
BURROW	26.44974246	-81.47545561
BURROW	26.45005720	-81.47544765
BURROW	26.45014294	-81.47544354
BURROW	26.44848241	-81.47500257
BURROW	26.45075876	-81.46809580
BURROW	26.44195022	-81.46729449
BURROW	26.44146876	-81.46738342
BURROW	26.44921431	-81.48134859
BURROW	26.44129015	-81.46721997
BURROW	26.44116350	-81.46739432
BURROW	26.44127254	-81.46775189
BURROW	26.44132376	-81.46772968
BURROW	26.44101757	-81.46805556

BURROW	26.44145116	-81.46797527
BURROW	26.44067265	-81.47373623
BURROW	26.45014906	-81.48490470
BURROW	26.44304121	-81.46727756
BURROW	26.45057252	-81.48508172
BURROW	26.44736560	-81.47260987
BURROW	26.44737088	-81.46967394
BURROW	26.44740885	-81.46900716
BURROW	26.44438399	-81.46703314
BURROW	26.44727147	-81.46837248
BURROW	26.44724607	-81.46912015
BURROW	26.44720517	-81.46881044
BURROW	26.44734716	-81.47001701
BURROW	26.44716360	-81.48098976
BURROW	26.45067184	-81.48515825
BURROW	26.45074736	-81.48119017
BURROW	26.45082632	-81.48102991
BURROW	26.45087619	-81.48052021
BURROW	26.45090000	-81.48042340
BURROW	26.45085004	-81.48022609
BURROW	26.45084610	-81.48001310
BURROW	26.45082506	-81.47977028
BURROW	26.45091559	-81.47983633
BURROW	26.45091861	-81.47965821
BURROW	26.45092179	-81.47852037
BURROW	26.45069070	-81.48511659
BURROW	26.45093948	-81.47841660
BURROW	26.45095280	-81.47838852
BURROW	26.45091953	-81.47831560
BURROW	26.45087385	-81.47139508
BURROW	26.45046397	-81.48405863
BURROW	26.45092531	-81.48371866
BURROW	26.44814696	-81.48208863
BURROW	26.44976065	-81.47957222
BURROW	26.44781562	-81.47687215
BURROW	26.45026138	-81.48157029
BURROW	26.45001227	-81.47589248
BURROW	26.45050638	-81.47077960
BURROW	26.44941816	-81.46961485
BURROW	26.44976643	-81.46897917
BURROW	26.44503174	-81.46546053
BURROW	26.44725001	-81.46628195
BURROW	26.44673260	-81.47004258
BURROW	26.45093487	-81.48097325
BURROW	26.45083998	-81.48017311
BURROW	26.45094945	-81.47951807
BURROW	26.45093353	-81.47910870

BURROW	26.45093361	-81.47874685
BURROW	26.44123415	-81.47518605
BURROW	26.44171670	-81.47523425
BURROW	26.44190052	-81.47441936
BURROW	26.44196087	-81.47415575
BURROW	26.44362601	-81.48094215
BURROW	26.44069872	-81.47433193
BURROW	26.45068450	-81.48069958
BURROW	26.44064239	-81.47427921
BURROW	26.44087692	-81.47516325
BURROW	26.44192457	-81.47022254
BURROW	26.44192608	-81.46985097
BURROW	26.44219087	-81.46994661
BURROW	26.44076745	-81.47420998
BURROW	26.44058137	-81.47500953
BURROW	26.44114581	-81.47440025
BURROW	26.44087373	-81.47421450
BURROW	26.44354823	-81.47671717
BURROW	26.44144856	-81.46786924
BURROW	26.45088273	-81.48426189
BURROW	26.44623371	-81.46528711
BURROW	26.44665046	-81.46515979
BURROW	26.44149869	-81.46682368
BURROW	26.44104749	-81.46687808
CAMERA	26.44731062	-81.48220061
CAMERA	26.45100008	-81.47759291
CAMERA	26.44979409	-81.48777374
CAMERA	26.45117668	-81.46812086
CAMERA	26.45087703	-81.48715717
CAMERA	26.44239279	-81.46705778
CAMERA	26.45066321	-81.48166560
CAMERA	26.44053259	-81.47726267
NEST	26.44775393	-81.48301383
NEST	26.44888130	-81.48376996

Attachment _.sbn (48964 Bytes) cannot be converted to PDF format.

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Attachment _.prj (410 Bytes) cannot be converted to PDF format.

Attachment _.dbf (969358 Bytes) cannot be converted to PDF format.

Attachment _.xml (11896 Bytes) cannot be converted to PDF format.

Attachment _.shx (38276 Bytes) cannot be converted to PDF format.

Attachment _.shp (3999684 Bytes) cannot be converted to PDF format.

From: Cassler, Constance
To: Johnson, Bruce
Subject: Fwd: Last call for species data the Applicants don"t have
Date: Thursday, February 21, 2019 1:19:35 PM
Attachments: cara nest Passarella 2009 (determined predated - egg shells).kmz
2016 cara nest Passarella.kmz

Hi Bruce,

You may already know about these caracara locations, but sending just in case.

Connie

Constance L. Cassler, Ph.D.
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---------- Forwarded message ---------
From: **Schubert, Steve** <steve_schubert@fws.gov>
Date: Thu, Feb 21, 2019 at 1:15 PM
Subject: Re: Last call for species data the Applicants don't have
To: Cassler, Constance <constance_cassler@fws.gov>

Connie,
I found these 2 caracara nest locations in the RLWest BA this morning (they're not in our GIS data). They are very close to Bruce's locations, but don't seem exact, so feel free to pass them on.
Steve

On Thu, Feb 21, 2019 at 11:23 AM Cassler, Constance <constance_cassler@fws.gov> wrote:

> He Team,
>
> Last week, the Applicants requested any species data we have that they didn't present in their HCP. I have received info for some species and have passed it along to Bruce Johnson. If there is additional information please send it to me ASAP so I can send it to the applicants. If there is a reason we can't share it with them, please let me know that too.
>
> Thanks in advance,

Connie

Constance L. Cassler, Ph.D.
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--

Steve Schubert
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Attachment _ (1).kmz (713 Bytes) cannot be converted to PDF format.

From:	Cassler, Constance
To:	Johnson, Bruce
Subject:	Fwd: Last call for species data the Applicants don"t have
Date:	Friday, February 22, 2019 10:20:33 AM
Attachments:	Immokalee_FSJ_03262007.dbf Immokalee_FSJ_03262007.sbx Immokalee_FSJ_03262007.shp Immokalee_FSJ_03262007.prj Immokalee_FSJ_03262007.sbn Immokalee_FSJ_03262007.shx Immokalee_FSJ_05102007.dbf Immokalee_FSJ_05102007.sbn Immokalee_FSJ_05102007.sbx Immokalee_FSJ_05102007.prj Immokalee_FSJ_05102007.shp Immokalee_FSJ_05102007.shx

---

Hi Bruce,

Do you have this scrub-jay info?

Connie

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---------- Forwarded message ---------
From: **Landrum, Elizabeth** <elizabeth_landrum@fws.gov>
Date: Thu, Feb 21, 2019 at 6:35 PM
Subject: Re: Last call for species data the Applicants don't have
To: Cassler, Constance <constance_cassler@fws.gov>

Connie,

You said Heather found scrub-jay info in the Lake Trafford survey, so I won't include that. I assume they also have the 1992-93 survey data. Was the applicant supplied with the Immokalee Development scrub-jay info? If not, I have attached the 12 GIS files, and in case the attachments mess up, the path to the two files is -
L:\Trust Resources\HCP\County Collier\Immokalee\GIS

\Immokalee_FSJ_03262007.shp and \Immokalee_FSJ_05102007.shp

Liz.

Elizabeth Landrum
Fish and Wildlife Biologist
US Fish and Wildlife Service
1339 20th Street
Vero Beach, FL 32960

Tel.: 772-469-4304
Fax: 772-562-4288
E-mail: elizabeth_landrum@fws.gov

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On Thu, Feb 21, 2019 at 11:23 AM Cassler, Constance <constance_cassler@fws.gov> wrote:

> He Team,
>
> Last week, the Applicants requested any species data we have that they didn't present in their HCP. I have received info for some species and have passed it along to Bruce Johnson. If there is additional information please send it to me ASAP so I can send it to the applicants. If there is a reason we can't share it with them, please let me know that too.
>
> Thanks in advance,
>
> Connie
>
> Constance L. Cassler, Ph.D.
> Supervisory Fish and Wildlife Biologist
> U.S. Fish and Wildlife Service
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Attachment _.sbx (124 Bytes) cannot be converted to PDF format.

Attachment _.shp (408 Bytes) cannot be converted to PDF format.

Attachment _.prj (501 Bytes) cannot be converted to PDF format.

Attachment _.sbn (236 Bytes) cannot be converted to PDF format.

Attachment _.shx (188 Bytes) cannot be converted to PDF format.

Attachment _ (1).dbf (3515 Bytes) cannot be converted to PDF format.

Attachment _ (1).sbn (252 Bytes) cannot be converted to PDF format.

Attachment _ (1).sbx (124 Bytes) cannot be converted to PDF format.

Attachment _ (1).prj (501 Bytes) cannot be converted to PDF format.

Attachment _ (1).shp (464 Bytes) cannot be converted to PDF format.

Attachment _ (1).shx (204 Bytes) cannot be converted to PDF format.

From:	Cassler, Constance
To:	Johnson, Bruce
Subject:	Fwd: new cara data
Date:	Wednesday, February 20, 2019 11:12:24 AM
Attachments:	Converted_Graphics_4nests_1mort.dbf Converted_Graphics_4nests_1mort.shx Converted_Graphics_4nests_1mort.prj Converted_Graphics_4nests_1mort.shp Converted_Graphics_4nests_1mort.cpg

---

Hi Bruce,

A couple of the biologists have identified species data that aren't listed in the HCP. This one is for caracara. I will forward the others in separate emails.

Connie

Constance L. Cassler, Ph.D.
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---------- Forwarded message ---------
From: **Schubert, Steve** <steve_schubert@fws.gov>
Date: Fri, Feb 15, 2019 at 3:04 PM
Subject: new cara data
To: Constance Cassler <constance_cassler@fws.gov>

Connie,
Attached is a jpg showing 4 new caracara nests and one road mortality that were not in the HCP.
I also attached the relevant shapefile(s) (I did not have time to attribute the shapefile, so they will need to look at the jpg for descriptions). Also, I have been going through e-bird data to predict where other nests are likely, but have not finished that yet.

please forward to Bruce, as requested.
Steve

--
Steve Schubert

U.S. Fish and Wildlife Service
Fish and Wildlife Biologist
South Florida Ecological Services Field Office
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website: www.fws.gov/verobeach

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Attachment _.shx (140 Bytes) cannot be converted to PDF format.

Attachment _.prj (153 Bytes) cannot be converted to PDF format.

Attachment _.shp (240 Bytes) cannot be converted to PDF format.

Attachment _.cpg (5 Bytes) cannot be converted to PDF format.

From: Cassler, Constance
To: Johnson, Bruce
Subject: Fwd: request from Applicants for species data
Date: Wednesday, February 20, 2019 11:14:15 AM

Hi Bruce,

Here's the information for the red knot.

Connie

Constance L. Cassler, Ph.D.
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---------- Forwarded message ---------
From: **Howe, Jeffrey** <jeffrey_howe@fws.gov>
Date: Fri, Feb 15, 2019 at 11:59 AM
Subject: Re: request from Applicants for species data
To: Cassler, Constance <constance_cassler@fws.gov>

Connie:
The two red knot occurrences on eBird can be found at the following link:

https://ebird.org/map/redkno?neg=true&env.minX=&env.minY=&env.maxX=&env.maxY=&zh=false&gp=false&ev=Z&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2019

On Fri, Feb 15, 2019 at 11:03 AM Cassler, Constance <constance_cassler@fws.gov> wrote:

> Good morning,
>
> During a call with the ECMSHCP applicants this morning, Bruce Johnson (Stantec) requested that the Service send any species location information we have that is not in the HCP. It is probably easiest for each biologist to figure out what that information is for their species and then send it to me so I can forward it to Bruce. They would like it in the form of GIS. Some observations came from eBrid and other on-line sources. You can let me know if this is the case and we can point them to that source. Please do this as soon as possible because the applicants expect to get us an updated HCP by next Friday (Feb 22).

Bruce indicated during the call that he would be able to send us an updated map that subtracts the Ave Maria footprint and mitigation area from the HCP area and an updated habitat table. He though he could get us that by today or Monday at the latest.

Thank you,

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
office: 772-469-4243
fax: 772-562-4288
email: constance_cassler@fws.gov

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--

Jeff Howe
Coastal Fish & Wildlife Biologist
U.S. Fish & Wildlife Service
South Florida Ecological Services Office
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Vero Beach, Florida 32960
(772) 469-4283 (Office)
(772) 562-4288 (FAX)
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NOTE: This email correspondence and any attachments to and from this sender is subject to the Freedom of Information Act (FOIA) and may be disclosed to third parties.

From: Cassler, Constance
To: Johnson, Bruce
Subject: Fwd: request from Applicants for species data
Date: Wednesday, February 20, 2019 11:15:37 AM
Attachments: Lake Trafford Pre-Construction Survey.pdf

Hi Bruce,

This is the last on I think I have for now. It is for both gopher tortoises and sandhill cranes.

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
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Vero Beach, Florida 32960
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---------- Forwarded message ---------
From: **Hitt, Heather** <heather_hitt@fws.gov>
Date: Fri, Feb 15, 2019 at 1:19 PM
Subject: Re: request from Applicants for species data
To: Cassler, Constance <constance_cassler@fws.gov>

Hi Connie,

Attached is the report from the Lake Trafford dump site gopher tortoise survey. They had scrub jays too. It includes the GPS points for all the burrows, but I don't have it in GIS.

For sandhill crane I used E-bird and filtered it by the breeding season (April through September).

Heather Hitt
Fish and Wildlife Biologist
US Fish and Wildlife Service
1339 20th Street
Vero Beach, FL 32960
Phone: 772-469-4267

Fax: 772-562-4288
Email: heather_hitt@fws.gov

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On Fri, Feb 15, 2019 at 11:03 AM Cassler, Constance <constance_cassler@fws.gov> wrote:

> Good morning,
>
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> Constance L. Cassler, Ph.D.
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Pre-construction Threatened and Endangered Species Survey: Lake Trafford Spoil Disposal Site

Prepared for:
The South Florida Water Management District
P.O. Box 24682
West Palm Beach, Florida 33416-4682

Conducted by:
Environmental Science Division
Conservancy of Southwest Florida 1450 Merrihue Drive Naples, Florida

INTRODUCTION

The Lake Trafford Restoration Project, located within the Corkscrew Watershed in northern Collier County represents a critical restoration project to be funded under the Water Resources Development Act (WRDA) of 1996 (P.L. 104-303). The purpose of the Lake Trafford Restoration project is to improve water quality and ecosystem functions through the removal of organic bottom sediments (muck) via hydraulic dredging. The material is to be pumped to an upland disposal site for treatment. The restoration project is also designed to enhance the lake for public recreational uses (USFWS Coordination Act Report 1999).

The proposed disposal site is largely composed of abandoned farmlands and citrus groves that encompass approximately 450 acres. This disposal area is situated immediately to the east of Upper Corkscrew Swamp and Corkscrew Marsh Preserve and these areas are known habitat of Florida panther (*Puma concolor coryi*). Other listed species know or expected to occur in the area include the eastern indigo snake (*Drymacrchon corais couperi*), gopher tortoise (*Gopherus polyphemus*), Florida scrub jay (*Aphelocoma coerulescens*), wood stork (*Mycteria americana*), Everglade snail kite (*Rostrhamus sociabilis plumbeus*), Southern bald eagle (*Haliaetus leucocephalus*), Audubon's crested Caracara (*Caracara cheriway*), and Florida sandhill crane (*Grus canadensis pratensis*).

This listed species survey was conducted in accordance with the permit conditions for the Lake Trafford disposal site to identify if any threatened or endangered wildlife species occur onsite and to document their locations.

METHODS

The pre-construction wildlife survey at the Lake Trafford spoil disposal site was initiated on 1 September 2004 and completed on 5 October 2004. The timeline for completion of the survey was delayed by three major hurricanes that hit Florida during the month of September. This followed the devastation of hurricane "Charley", a category four storm that hit SW Florida on August 13th. Hurricane "Frances" crossed the central peninsula on 3,4,and 5 September and resulted in mass evacuations, and the closing of schools, businesses, and government offices. Hurricane "Ivan" was projected to hit Southwest Florida but instead veered north and hit the Panhandle region on the 13th of September. On the 25th and 26th of September hurricane Jeanne crossed peninsular Florida along a similar path of hurricane Frances causing similar emergency responses. The study site itself was

spared from damaging winds and flooding throughout these four hurricane events. Between these severe storms we conducted the wildlife and habitat surveys for this report.

A reconnaissance survey of the project site perimeter was conducted by a certified Senior Ecologist (ESA) on 30 August 2004. This was done to identify any potential suitable habitat for scrub jays (*Aphelocoma coerulescens*), gopher tortoise (*Gopherus polyphemus*) and eastern indigo snakes (*Drymarchon corais couperi*). Based on this reconnaissance it was determined that the entire parcel needed to be transect surveyed for gopher tortoise burrows and scrub jays. Vegetation communities/habitat types were assessed and mapped following the wildlife surveys in order to produce an GIS layer that will allow for burrow density/habitat type calculations and for identifying other wildlife and listed species habitat utilization.

Scrub Jays

Scrub jay call tapes were utilized at regular intervals of approximately 200-300 meters within remnant scrub and abandoned citrus groves and played for 2 minutes to attract and document presence/absence of jays in the area. Transect surveys for scrub jays using call tapes were conducted three times during a four-week period. Observation of scrub jays locations and activity were then GPS located and live birds were photo-documented. If scrub jays were observed in an area then meandering surveys of all low growing trees, especially oaks and old citrus trees, was conducted to look for recent evidence of nest construction.

Gopher Tortoise Burrows/Indigo Snakes

An intensive survey for gopher tortoise burrows was conducted with trained and experienced biologists over the entire parcel. In areas determined to be higher quality habitat with high probability or potential for gopher tortoise burrows, narrow-transect walking surveys were conducted to cover every patch of ground. In less suitable habitat such as low pasture and disturbed wetlands, transects were conducted with the assistance of ATVs due the vegetation change, lack of upland habitat for burrowing, and large acreage to cover. Active and inactive gopher tortoise burrows were identified by and GPS located. After the entire parcel was surveyed and the gopher tortoise burrows located, we began to scope the interior of each burrow within each of the burrow clusters in Figure 2 using a custom made fiber-optic video camera. This was done to determine if gopher tortoises were present and if any important commensal species might also be using burrows as refugia. Special attention was given to surveying the tortoise burrows for threatened eastern indigo snakes and the State listed gopher frog (*Rana capito*). Approximately 50% of all the burrows were scoped to check for tortoises and their commensal species including eastern indigo snakes. Eastern indigo snakes are difficult to survey for due to their wide-ranging activity patterns during warmer months and ability to avoid detection in the dense vegetation along ecotones between marshes and ditches and adjacent uplands. It is more likely for them to be detected in the cooler and drier months when vegetation has died back and they may be seen basking in the sun or found in the thermal refugia of gopher tortoise burrows on cold days. Not detecting indigo snakes does not mean that they are not present onsite.

Other Listed Species

As per the Coordination Act Report and Biological Opinion from the US Fish and Wildlife Service the following species were specifically surveyed for during the study period: Florida panther (*Puma concolor coryi*), wood stork (*Mycteria americana*), Everglade snail kite (*Rostrhamus sociabilis plumbeus*), Southern bald eagle (*Haliaetus leucocephalus*), and Audubon's crested Caracara (*Caracara cheriway*). The Florida sandhill crane (*Grus canadensis pratensis*) was not included as a species expected to occur onsite, but we included it as possibly occurring onsite and surveyed for both sandhill cranes and their nests.

Special attention was given to surveying trails and open sandy areas on the site for tracks, scat, and scrapes that would indicate use by large mammals. While our walking transect surveys were very thorough and covered the entire site, it was acknowledged that many nocturnal, or otherwise elusive, fauna such as the Florida panther and their prey base (deer, hogs, raccoons etc.) may go undetected during daytime surveys. Therefore, on 1 September we deployed four (4) infrared and motion-sensor, 35 mm cameras at strategic locations along game trails around the perimeter where the preserve abuts the remnant scrub and abandoned citrus for a period of two weeks (Figure 1). After two weeks these cameras were relocated to the eastern half of the parcel along the perimeter and reset for another 10 days. These same cameras (Camtracker ™) have provided reliable photographic records of large mammals including Florida panther, black bear and whitetail deer in the Western Everglades and detect movement up to 10 meters away. A total of eight (8) sites were sampled in this manner around the disposal site perimeter.

VEGETATION METHODS

Sampling consisted of qualitative methods only which are utilized to give a general portrayal of the plant species composition within surveyed areas. Qualitative plant survey methods consisted of meandering transects within pre-defined habitats. Abundance catagories were based on the literature for qualitative sampling conducted on barrier islands in SW Florida (Cooley 1955, Herwitz 1977, Morrill and Harvey 1980). All species observed in each habitat were recorded and assigned abundance categories. An effort was made to spend approximately the same amount of time in each of the sampled areas.

Abundance Categories

Qualitative observations of plant species within each habitat type were recorded utilizing abundance categories reflecting frequency and abundance. The categories are based on previous environmental assessments of Sanibel, N. Captiva, and Cayo Costa (Cooley 1955, Herwitz 1977, Morrill and Harvey 1980) and in part the Guide to Vascular Plants of Florida (Wunderlin 1998) which are listed below (Table 1). Six categories were chosen for use in characterizing sites. These categories were then utilized in field evaluations conducted in Lehigh Acres.

Table 1: Abundance/Frequency Categories (qualitative vegetation assessments) following literature for studies conducted in Southwest Florida

Cooley 1955		Herwitz 1977		Morrill and Harvey 1980		Wunderlin 1998	
D	**Dominant**: Prevailing, tending to drive out all other plants and to resist invasion by them	**D**	**Dominant**: Controlling habitat physiognomy	**V A**	**Very abundant**: Controlling habitat physiognomy		
A	**Abundant**: Teeming, in copious supply	**A**	**Abundant**: Teeming, in copious supply	**A**	**Abundant**: Teeming, in copious supply		

C	**Common**: General, not local, so frequent as to be found easily	**C**	**Common**: So frequent as to be easily found	**C**	**Common**: So frequent as to be found easily	**C**	**Common**: ?
F	**Frequent**: Often to be met with, but not general.		*-see L*			**F**	**Frequent**: ?
I	**Infrequent**: Isolated, sparse, occurring at considerable distances	**I**	**Infrequent**: Sparse, occasionally found	**I**	**Infrequent**: Sparse, occasionally encountered	**O**	**Occasional**: ?
R	**Rare**: Seldom met with, so infrequent as to be unexpected	**R**	**Rare**: So infrequent as to be unexpected	**R**	**Rare**: So infrequent as to be unexpected	**R**	**Rare**: ?
		L	**Localized**: Common in widely separated areas		*-follows Daubenmire (1968) for separate rating of "sociability"*		

In order to roughly define these qualitative abundance categories using quantitative terms, unpublished data were utilized from other sites where both quantitative and qualitative data were collected. These data, specifically the qualitative and quantitative assessments of Panther Island Mitigation Bank and the Florida Panther National Wildlife Refuge, were linked in an attempt to derive some guidelines in terms of actual measured percent cover and frequency of species and the qualitative abundance categories (Table 2).

Table 2: Qualitative abundance/frequency categories with associated ranges of values derived from quantitative data (ground cover quadrat and shrub line intercept sampling)

Abundance Category		**Aerial Coverage (%)**	**Frequency (%) within 0.5 meter quadrat**
D	**Dominant**: Controlling habitat physiognomy	>=10	
A	**Abundant**: Teeming, in copious	>=2 and <10	>=20

	supply		
C	**Common**: So frequent as to be found easily with general distribution	>=0.2 and <2	>=10 and <20
F	**Frequent**: Frequent as to be found easily with localized distribution	"	>=5 and <10
I	**Infrequent**: Sparse, occasionally encountered	<0.2	<5
R	**Rare**: So infrequent as to be unexpected		

Plant Taxonomy

All plant nomenclature follows Wunderlin and Hanson (http://www.plantatlas.usf.edu).

SURVEY RESULTS

Scrub Jays

During our first reconnaissance of the site, conducted 30 August 2004 at approximately 08:30 hours, two scrub jays were observed within the west-southwest corner of the disposal site in old citrus groves, later identified as "Abandoned Citrus – NW (34.3 acres) " in the vegetation results section. These two adult scrub jays came immediately to the call tape being played at the border between preserve and disposal area. The birds flew in from the NE and stayed in the area after the tape was stopped. These same two scrub jays were later observed approximately .25 miles away near the northern property boundary and again near a gate that separates the old citrus grove from the abandoned farm fields to the east. Two scrub jays were also observed on 1 September during the first day gopher tortoise transects in the same general area as two days earlier and were photographed (Appendix B). These birds were seen again during the week as wildlife surveys progressed but then they seemed to leave the area during the middle of September and were not seen again during the remainder of the fieldwork. On 5 October 2004, the cameras were retrieved from the field and a final effort was made to call the scrub jays at the same location between the preserve and the edge of the "abandoned citrus NW" '(Figures 1 and 2). Two adult scrub jays responded to the call tape after one minute and flew from the preserve area to the SW to my location on the inside edge of the disposal site.

Our survey for scrub jay nests was conducted during the non-breeding season but we located two (2) vacant nests in the general area where jays were observed on three separate occasions within the disposal site. The nests were constructed of thin sticks and twigs with fine threaded plant material lining. They were both located approximately 1.7 meters off the ground in "hardy orange" (*Poncirus trifoliata*) trees and many small oak trees in the immediate area. The locations of these two possible scrub jay nests were flagged, GPS located (Figure 1), and photographed (Appendix). The age and condition of these nests make it difficult to determine if they were scrub jay nests due to their similarity to nests constructed by northern mocking birds, which are common on the site. However, it is possible that one or both of these nests were constructed by scrub jays.

Based on these observations, it is clear that these two scrub jays are using the most of the 34 acres described as "abandoned citrus NW" as well as the designated preserve as foraging habitat and possibly for nesting. While the abandoned citrus is considered as sub-optimal habitat, it is possible that nesting has occurred in this area in the recent past (2003 or 2004).

Gopher Tortoise Survey

Active and inactive gopher tortoise burrows were identified by and GPS located. Our transect survey of the disposal area and adjacent perimeter produced a total of 104 active and inactive burrows. Of the104 active and inactive burrows, a total of 62 (or 59.6%) were located within five (5) distinct clusters totaling 15.8 acres (3.2% of the site) of roughly 493 acres surveyed. Figure 2 shows an overlay of the active and inactive burrows and general habitat mapping. Latitude and longitude coordinates for the gopher tortoise burrows are included in Appendix C.

A total of 53 burrow scopings were attempted of which 22 burrows we were unable to reach the end at the tortoise chamber with the camera attachment (Appendix). However, of the 31 burrows that we successfully scoped, a total of ten live gopher tortoises were observed. Commensal species observations included several unidentified species of spiders and a single southern toad (*Bufo terrestris*).

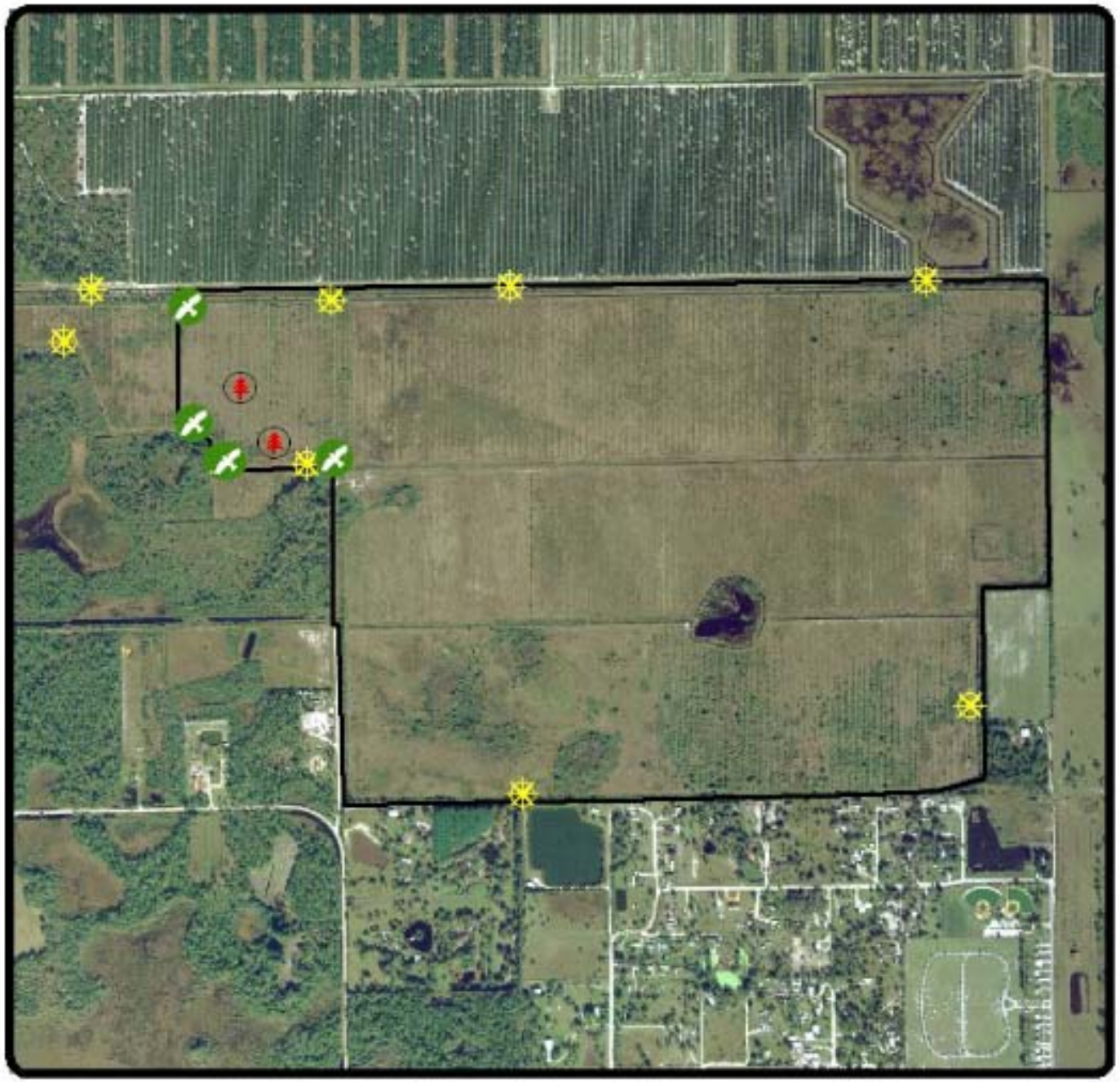

Figure 1:
Florida Scrub Jay Sightings and IR Motion Sensor Camera Locations

Camera Locations
Bird Nest Locations
Scrub Jay Sightings

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Prepared By:
The Conservancy of Southwest Florida
October 2004
Source Base Map: Collier County 2003 Aerial Photography

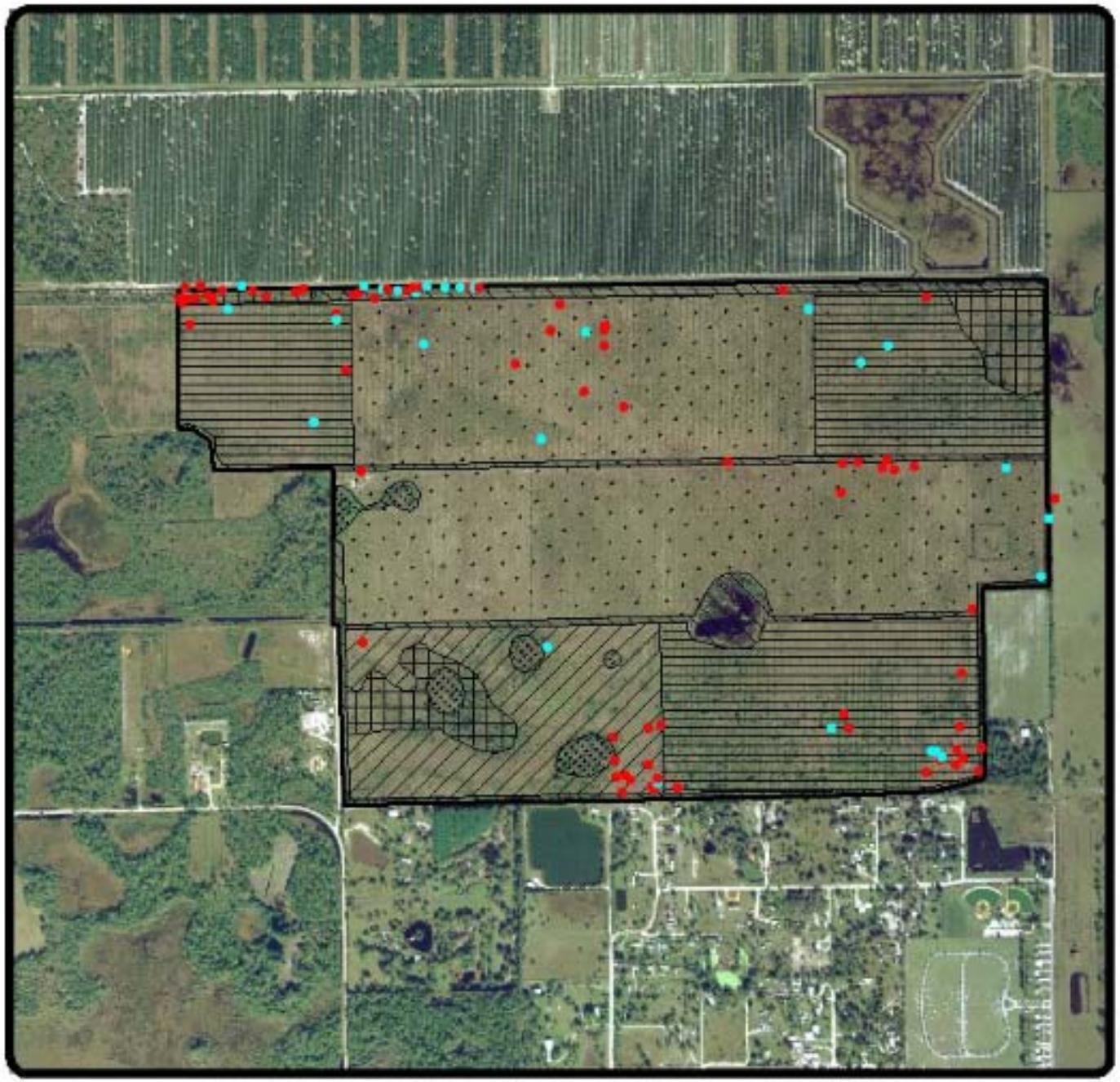

Figure 2:
Gopher Tortoise Burrow Locations and Habitat Descriptions

Tortoise Burrows
- *Active*
- *Inactive*

Habitat Description
- *Abandoned Agriculture*
- *Abandoned Citrus*
- *Ditches/Berms*
- *Freshwater Marsh*
- *Remnant Flatwood*
- *Remnant Scrub*
- *Wet Prairie -Disturbed*

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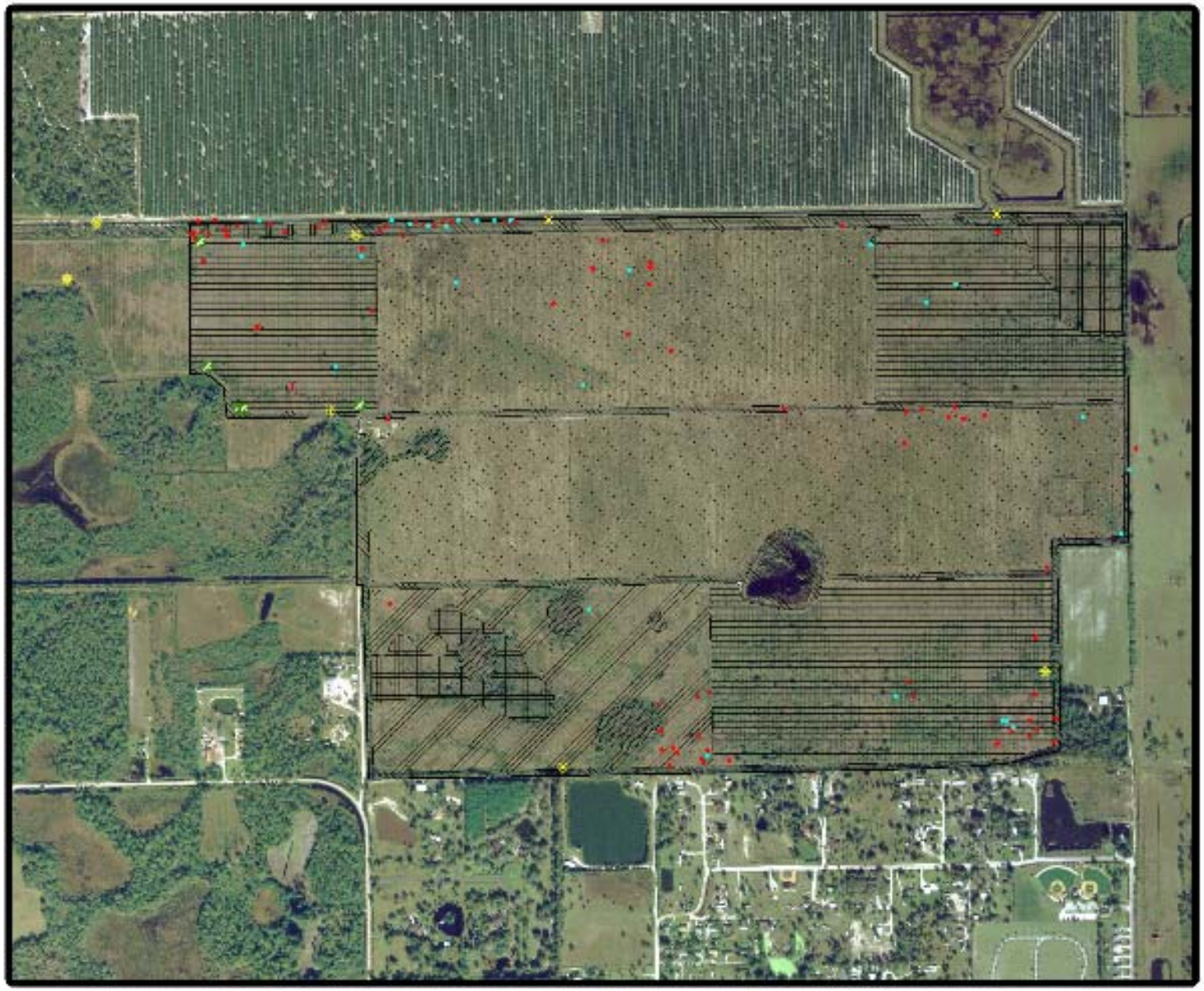
Prepared By:
The Conservancy of Southwest Florida
October 2004
Source Base Map: Collier County 2003 Aerial Photography



Composite Overlay Map of Florida Scrub Jay, Gopher Tortoise Burrows and Habitat Descriptions

Tortoise Burrows
- *Active*
- *Inactive*

- *Camera Locations*
- *Bird Nest Locations*
- *Scrub Jay Sightings*

Vegetation Types
- *Abandoned Agriculture*
- *Abandoned Citrus*
- *Ditches/Berms*
- *Freshwater Marsh*
- *Remnant Flatwood*
- *Remnant Scrub*
- *Wet Prairie -Disturbed*

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Habitat Descriptions where tortoises burrow densities were highest, defined as five burrow "clusters" as follows:

Disturbed scrub in NW: 2 inactive and 14 active 2.1 acres = **7.6** active and inactive burrows/acre
N berm cluster: 3 acre portion of the berm with 10 active and 9 inactive = **6.3** burrows/acre
Berm between abandoned fields: 4 active burrows over approximately 1.2 acres = **3.3** burrows/acre.
S central area: 13 active and 1 inactive burrows in 5 acres = **2.8** burrows/acre
SE corner in hardy orange: 6 active and 3 inactive burrows in 4 acres = **2.3** burrows/acre

The following is a detailed description of the major vegetation communities (habitats) that currently exist onsite, the total acreage, number of active/inactive burrows and overall density of burrows/acre (Figures 2 and 3).

Disturbed Scrub (2.1 acres)
This small area in the northwestern most portion of the site represents a thin strip of remnant scrub or scrubby flatwoods habitat that remained between two ditches and associated berms after agricultural development. Myrtle oak (*Quercus myrtifolia*) and Brazilian pepper dominate the shrub strata. The ground cover is predominantly native scrubby species but with abundant exotic and weedy species indicative of the severe disturbance. The most abundant groundcover species include natives such as wiregrass (*Aristida stricta* var. *beyrichiana*) and gopher apple (*Licania michauxii*) and exotic grasses such as natalgrass (*Rhynchelytrum repens*). One group of Adam's needles (*Yucca filamentosa*) was observed towards the eastern portion of the area. Prickly-pear cactus (*Opuntia humifusa*) also is present.

With 2 inactive and 14 active gopher tortoise burrows, this area had the highest concentration 7.6 active and inactive burrows/acre tied with an area of the berm just to the east of this area dominated by exotic grasses (see ditches and berms below). It was also the only area dominated by native scrubby flatwoods species, though exotic and weedy species still abound. The Florida scrub jay was observed near this area and likely utilizes it ocaisionaly due to the abundant myrtle oak, however the oaks are large and the area is generally a bit overgrown for the scrub jay.

Abandoned Citrus – NW (34.3 acres)
This area of former citrus production likely sits on former scrub or scrubby flatwoods habitat, especially in the northwestern portion of the area. Dominant vegetation includes planted grapefruit (*Citrus x paradisi*) and hardy orange (*Poncirus trifoliata*), scattered Brazilian pepper (*Schinus terebinthefolius*), and groundcover dominated by bahiagrass (*Paspalum notatum*), natalgrass (*Rhynchelytrum repens*), sourgrass (*Digitaria insularis*), and a variety of weedy species. Scattered myrtle oak (*Quercus myrtifolia*) occurs in the northwestern portion of the site with scattered live oak (*Q. virginiana*) in the southern half. Prickly-pear cactus (*Opuntia humifusa*) also is present.

This area contained few tortoise burrows with 3 inactive and 4 active gopher tortoise burrows at 0.2 burrows/acre. Also, the Florida Scrub jay was observed most frequently within this zone, likely due to the scattered small oaks and citrus giving it a scrubby vegetation structure desirable to the jays. It would not be surprising that this area would be utilized for nesting by the jays, and in fact 2 stick nests were found in hardy orange (*Poncirus trifoliata*) shrubs although these nests may be Northern mockingbird nests. A nesting season survey would be necessary to determine this.

Abandoned Citrus – NE (38.7 acres)

Planted grapefruit and hardy orange dominate the woody strata along with scattered Brazilian pepper trees. This area is not as high and dry as the citrus to the W, and in fact has a wetland cut out in the NE corner of the site. Dominant groundcover includes bahiagrass, natalgrass, smutgrass (*Sporobolus indicus var. pyramidale*) and scattered remnant maidencane (*Panicum hemitomon*) in the formerly wetter areas.

Gopher tortoise density was fairly low in these areas at 0.08 tortoises/acre with 2 inactive and 1 active burrow located. Scrub jays were not observed at any time is this habitat. A fair number of burrows were located along the perimeter of this zone including a high-density area just outside this zone in the perimeter berms forming the Northern property line.

Disturbed Flatwoods (51.7 acres)

This large area in the southern portion of the site probably was a mosaic of mesic pine flatwoods with some scrubby and hydric patches. The area was cleared in the past for agricultural purposes although it appears it was never completed. Dominant vegetation includes a variety of native and exotic plants such as grasses including bahaigrass, natalgrass, and little blue maidencane (*Amphicarpum muhlenbergianum*). Shrubs include live oak, Brazilian pepper, winged sumac (*Rhus copalinum*), and wax myrtle (*Myrica cerifera*). Several native herbaceous species typical of flatwoods were also observed such as choclateweed (*Melochia spicata*), St. John's worts (*Hypericum cistifolium*, *H. hypericoides*, and *H. tetrapetalum*), and lechea (*Lechea torreyii*). One large patch of cogongrass (*Imperata cylindrica*) occurs in this area.

Although this area consisted of a generally low gopher tortoise density of 0.3 burrows/acre with 2 inactive and 13 active burrows, one area of high density was found along the southern property boundary. This cluster consists of 13 active and 1 inactive burrows in an area of approximately 5 acres resulting in a density of 2.8 burrows/acre. This area, with comparable density to the remnant scrub in the NW of the property, may have been higher than the surrounding mesic flatwoods mosaic as is indicated by scrubby flatwoods species such as myrtle oak and lechea (*Lechea torreyi*). No scrub jays were observed in this area.

Abandoned Citrus – SE (66.3 acres)

The citrus area in the SE corner probably at one time consisted of mesic pine flatwoods with perhaps some scrubby components. Now the site is primarily dominated by weedy species but with wetland species such as maidencane (*Panicum hemitomon*) persisting in the northeastern portions closer to a historical wetland that had been excavated, ditched and bermed. Dominants include planted grapefruit, hardy orange, Brazilian pepper, muscadine (*Vitis rotundifolia*), caesarweed (*Urena lobata*), beggar's ticks (*Bidens alba var. radiata*) and bahiagrass.

Gopher tortoise density overall was low at 0.2 active and inactive burrows per acre with a total of 4 inactive and 10 active. However, all were located in the southern half of the zone, arguably doubling the density if the areas were to be split by higher and lower areas. Furthermore, the southeastern corner exhibits a high concentration in a more open part of the old grove dominated by hardy orange (*Poncirus trifoliata*) and grasses. This area sits next to some existing mesic flatwoods with a few myrtle oaks indicating that the entire area may have been on the dry side of mesic. A total of 6 active and 3 inactive burrows were located in this SE cluster covering roughly 4 acres resulting in a density of 2.3 burrows/acre.

Disturbed Freshwater Marsh (7.5 acres)

These areas were historically marsh but have now become more dominated by willow (*Salix caroliniana*) in the centers and are being encroached by hardwoods such as red maple (*Acer rubrum*) along the edges due to ground disturbance and fire exclusion. Remnant marsh species dominating in the groundcover include sawgrass (*Cladium jamaicense*), fire-flag (*Thalia geniculata*), and pickerelweed (*Pontederia cordata*).

No tortoises were found in these areas. Protected plant species observed include cinnamon fern (*Osmunda cinnamomea*). Generally the habitat quality is highest in the deeper portions as less mechanical disturbance has occurred and the effects of fire exclusion are less noticeable as the natural fire frequency was lower.

Disturbed Wet Prairie (20.9 acres)

These areas include the small drained wetland in the Northeast corner of the site surrounded by abandoned citrus as well as the less disturbed areas around the marshes embedded within the disturbed mesic flatwoods mosaic of the southern portion of the site.

The Northeastern wet prairie (9 acres) is dominated by maidencane (*Panicum hemitomon*) and little blue maidencane (*Amphicarpum muhlenbergianum*). The hydrology of this area appears to have been severely modified by the citrus development around it. Plant diversity is low and no protected species were observed.

The wet praire habitat in the southern portion of the site (12 acres) is floristically fairly diverse with a primarily native species composition. Dominant species include native grasses such as little blue maidencane (*Amphicarpum muhlenbergianum*) as well as the typically more weedy native carpetgrasses (*Axonopus fissifolius, A. furcatus*). Numerous desirable wet prairie species were also observed, though not extremely abundant, including beaksedge (*Rhynchospora inundata*, *R. microcarpa*), flatsedge (*Cyperus haspan*), arrowhead (*Sagittaria graminea*), St. John's wort (*Hypericum brachyphyllum*), musky mint (*Hyptis alata*), coyote-thistle (*Eryngium baldwinii*), meadow beauty (*Rhexia mariana*), Everglades morning-glory (*Ipomoea sagitata*), Corymb false-fiddle-leaf (*Hydrolea corymbosa*), and a variety of wet prairie species indicative of the past conditions.

Abandoned Fields (225 acres)

These areas generally consisted of weedy native and exotic species and have suffered the most severe and recent ground disturbance through vegetable production. The shrub strata primarily consisted of scattered saltbush (*Baccharris halimifolia*) and less abundant Brazilian pepper (*Schinus terebinthefolius*). The most dominant groundcover species was smutgrass (*Sporobolus indicus var. pyramidale*). Also abundant were bahiagrass (*Paspalum notatum*), natalgrass (*Rhynchelytrum repens*), West Indian pennisetum (*Pennisetum polystachion*), caesarweed (*Urena lobata*), hairy indigo (*Indigofera hirsuta*), dog-fennel (*Eupatorium capilifolium*), beggar's ticks (*Bidens alba var. radiata*), common ragweed (*Ambrosia artemisifolia*), and horseweed (*Conyza canadensis var. pusila*).

Overall gopher tortoise density was low at 0.08 burrows/acre and 5 inactive and 14 active burrows located. Two notable clusters of burrows, however, were located. One is generally the northwestern quarter of this zone and was likely higher than the rest of the areas to the south and also located more closely to the best remnants with the highest density of tortoises. The other area is in the northeastern portion of the middle block (or southern abandoned field) with forms a small group of burrows located on a slightly higher ground as indicated by the higher abundance of natalgrass. The berms in this area also have remnant saw palmetto (*Serenoa repens*) and lyonia (*Lyonia fruticosa*) and several burrows as well.

Ditches and Berms (39.7 acres)

This habitat type attempts to include all of the perimeter ditches and berms of the site which generally includes highly disturbed habitat, however the berms have in some cases acted to preserve native vegetation in scattered areas on site, with each area originating from differing habitat types. This area also includes the disturbed wetland in the center of the site that has been excavated and surrounded by ditches acting as a retention pond. Vegetation on the berms is predominately native and exotic weeds, such as Brazilian pepper (*Schinus terebinthefolius*), bahiagrass (*Paspalum notatum*), West Indian pennisetum (*Pennisetum polystachion*), natalgrass (*Rhynchelytrum repens*), and muscadine (*Vitus rotundifolia*) while remnant areas of saw palmetto (*Serenoa repens*), fetterbush (*Lyonia fruticosa*), and oaks (*Quercus minima, Q. myrtifolia, and Q. virginiana*) also occur. The ditches consist of a variety of mostly weedy native wetland species with significant patchy infestation of highly invasive exotics such as torpedograss (*Panicum repens*) and Old World climbing fern (*Lygodium microphyllum*).

The overall density of tortoises on the berms is moderate at 1.5 burrows per acre with 11 inactive and 19 active burrows (acreage calculated at 20 by eliminating the ditches). However, very high densities, were observed where the berms were located near the scrub remnant in the northwest portion of the site as well as a few areas around the site with remnant flatwoods species like saw palmetto such as the cluster in the central eastern berm within the agricultural fields. The Northern cluster occurs on an approximately 3 acre portion of the berm with 10 active and 9 inactive burrows giving a density of 6.3 burrows/acre. This cluster is comparable to the scrub remnant on the berm to the west, although that cluster has a higher active to inactive ratio. The central cluster consists of 4 active burrows over approximately 1.2 acres giving a density of 3.3 burrows/acre.

Interestingly, two protected plant species were observed in the ditches of the southern and southeastern perimeter ditches. Nodding club moss (*Lycopodiella cernua*) and royal fern (*Osmunda regalis var. spectabilis*) were both observed in these areas.

Eastern Indigo Snake (*Drymarchon corais couperi*)

No eastern indigo snakes were observed during our surveys of the disposal site or during the burrow scoping with fiber optic camera. However, due to the presence of suitable upland and wetland habitats, thermal refugia in the form of tortoise burrows, and proximity to larger conservation lands it is likely that eastern indigo snakes are present both on the spoil disposal site and on the adjacent preserve. Caution should be exercised at all times during construction to minimize the risk of injuring or killing eastern indigo snakes with vehicles and earthmoving operations.

Florida Panther (*Puma concolor coryi*)

No Florida panthers were observed and no sign of panther activity was detected during the period of this survey. However, there was an abundance of panther prey found during the survey period. This was thoroughly documented from tracks, direct visual observations, and photographs taken by remote cameras (Appendix B). The prey base consists of several wild hogs (*Sus scrofa*), wild turkey (*Meleagris gallopavo*), and many whitetailed deer (*Odeocoileus virginianus*), that were mainly concentrated along the western and northwestern portions of the abandoned citrus and remnant scrub habitats. The two cameras located within the preserve area recorded the largest number of hogs, deer and turkey that reflects the higher quality of habitat and distance from human activities to the south and southeast.

Wood Stork (*Mycteria americana*)

No wood storks or rookeries were observed onsite during the study but it is likely that the ditches and wetlands are occasionally used as foraging sites at certain times of the year.

Audubon's Crested Caracara (*Caracara cheriway*)
No caracara were observed onsite and it is highly unlikely that caracara would find suitable nesting sites due to the lack of large cabbage palms.

Everglades Snail Kite (*Rotrhamus sociabilis plumbeus*)
No snail kites were observed during the survey.

Florida Sandhill Crane (*Grus Canadensis pratensis*)
No sandhill cranes were observed on the property itself but on two occasions during the survey they were observed flying overhead toward Lake Trafford. In addition there is a large wet prairie and open shallow marsh immediately to the east of the disposal area approximately 100 meters from the eastern property line that may contain sandhill cranes nests. Three sandhill cranes were observed foraging in this marsh on two separate occasions and four cranes were observed in this same marsh another time.

American Alligator (Alligator mississipiensis)
No alligators were observed during the survey but it is likely that they utilize the property, especially the excavated retention pond in the South-central portion of the property at certain times of the year.

Other Wildlife Observed Onsite
Numerous non-listed, species of wildlife were observed during the period of 1 September through 5 October 2004. Observations include direct visual and audible observations in the field by qualified biologists and the project manager who is certified as a Senior Ecologist and indirect observations through the use of infrared motion-sensor cameras at strategic locations along major game trails (Figures 1 and 3). The combined results of these direct and indirect wildlife observations are included in Table 2.

THE CONSERVANCY
Of Southwest Florida

Table 2. Lake Trafford Disposal Site: Wildlife Observations

Genus / Species	Common Name	Designated Status USFWS	FWC
Reptiles / Amphibians:			
Acris gryllus dorsalis	Florida cricket frog		
Anolis carolinensis	Green anole		
Anolis sagrei sagrei	Cuban brown anole*		
Bufo quercicus	Oak toad		
Cnemidophorus sexlineatus	Six-lined racerunner		
Coluber constrictor priapus	Black racer		
Eumeces inexpectatus	Southeastern five-lined skink		
Gastrophryne carolinensis	Eastern narrowmouth toad		
Gopherus polyphemus	Gopher tortoise	**SSC**	
Hyla cinerea	Green treefrog		
Osteopilus septentrionalis	Cuban treefrog*		
Rana grylio	Pig frog		
Rana sphenocephala	Southern leopard frog		
Thamnophis sirtalis	Eastern garter snake		
BIRDS:			
Aphelocoma coerulescens	Florida scrub Jay	**T**	**T**
Ardea alba	Great egret		
Baeolophus bicolor	Tufted titmouse		
Buteo lineatus	Red-shouldered hawk		
Butorides virescens	Green heron		
Cardinalis cardinalis	Northern cardinal		
Cathartes aura	Turkey vulture		
Ceryle alcyon	Belted kingfisher		
Circus cyaneus	Northern harrier		
Colinus virginiacus	Northern bobwhite		
Columbina passerina	Common ground-dove		
Coragyps atratus	Black vulture		

Corvus brachyrhynchos	American crow
Cyanocitta cristata	Blue jay
Dendroica coronata	Yellow-rumped warbler
Dumetella carolinensis	Gray catbird
Lanius ludovicianus	Loggerhead shrike
Melanerpes carolinus	Red-bellied woodpecker
Meleagris gallopavo	Wild turkey
Mimus polyglottos	Northern mockingbird
Myiarchus crinitus	Great crested flycatcher
Pandion haliaetus	Osprey
Pipilo erythrophthalmus	Eastern towhee
Polioptila caerulea	Blue-gray gnatcatcher
Quiscalus quiscula	Common grackle
Seiurus aurocapillus	Ovenbird
Sturnella magna	Eastern meadowlark
Tachycineta bicolor	Tree swallow
Thryothorus ludovicianus	Carolina wren
Vireo griseus	White-eyed vireo
Zenaida macroura	Mourning dove

MAMMALS:

Dasypus novemcinctus	Armadillo
Didelphis virginiana	Opossum
Lynx rufus	Bobcat
Odocoileus virginianus	White-tailed deer
Procyon lotor	Raccoon
Sciurus carolinensis	Eastern gray squirrel
Spilogale putorius	Eastern spotted skunk
Sus scrofa	Feral pig*
Sylvilagus palustris	Marsh rabbit
Urocyon cinereoargenteus	Gray fox

*** exotic species**

FWC = Fish and Wildlife Conservation Commission
USFWS = U.S. Fish and Wildlife Service

T = Threatened
SSC = Species of Special Concern

SUMMARY

Our listed species survey covered approximately 493 acres, included the perimeter ditches and berms, and a small portion of the designated preserve that adjoins the western side of the spoil disposal area. Two scrub jays were observed on several occasions within the spoil disposal site footprint but were confined to an area of about 34 acres, identified as “abandoned citrus NW” (Figure 1 and 3). A total of one hundred and four (104) active and inactive gopher tortoise burrows were located within, and immediately adjacent to the spoil disposal area (Figure 2 and 3). Of these 104 burrows a total of 53 were checked with a fiber-optic video camera scope for both gopher tortoises and commensal species. Ten (10) live gopher tortoises were found in 31 burrows that were successfully scoped with the video camera to the chamber (end of burrow).

No indigo snakes were observed during our survey but it is likely that they are presently using the site but avoided detection in the dense groundcover. Large mammals survey techniques included the use of remote, infrared motion sensor cameras. No evidence was found of recent use by Florida panther (tracks, scrapes, fresh kills) of the spoil disposal site. No other State or Federally listed animal species were found during our survey.

Appendix A
Vegetation List

APPENDIX A

Vegetation List

Appendix A: Plant Species Observed by Vegetative Area

FAMILY	SCIENTIFIC NAME	COMMON NAME	FDA	FWS	Citrus NW	Dist. scrub	Citrus NE	Dist. Flat-woods	Citrus SE	Dist. Marsh	Dist. Wet Prarie	fields	ditch	berm
Shrubs and Trees														
PINACEAE	*Pinus elliottii*	Slash pine							I			I		
ARECACEAE	*Sabal palmetto*	Cabbage palm			I				I					
ARECACEAE	*Serenoa repens*	Saw palmetto				F	I					I		I
SALICACEAE	*Salix caroliniana*	Willow						I		C			I	
MYRICACEAE	*Myrica cerifera*	Wax-myrtle						I	I	C	C		I	
FAGACEAE	*Quercus elliottii*	Running oak				I								
FAGACEAE	Quercus laurifolia	Swamp laurel oak			I		I	I						I
FAGACEAE	*Quercus minima*	Dwarf live oak			I	I		I	I					I
FAGACEAE	*Quercus myrtifolia*	Myrtle oak			I	C		I	I					
FAGACEAE	*Quercus virginiana*	Live oak			I	F		I	I			I		I
MAGNOLIACEAE	*Magnolia virginiana*	Sweet bay											I	
E ANNONACEAE	*Asimina reticulata*	Pawpaw			I	F		I						
* FABACEAE	*Albizia lebbeck*	Woman's-tongue					I		I					I
* RUTACEAE	*Citrus x paradisi*	Grapefruit			C		C		C					
* RUTACEAE	*Poncirus trifoliata*	Hardy orange			I		I		F					
ANACARDIACEAE	*Rhus copallinum*	Winged sumac			F		F	F	F					F
* ANACARDIACEAE	*Schinus terebinthifolius*	Brazilian pepper			F	I	F	C	C	I		I	I	C
AQUIFOLIACEAE	*Ilex glabra*	Gallberry					I		I			I		I
SAPINDACEAE	*Acer rubrum*	Red maple								F	I			
* MYRTACEAE	*Melaleuca quinquenervia*	Melaleuca									I		I	I
* MYRTACEAE	*Psidium guajava*	Guava												I
* MYRTACEAE	*Rhodomyrtus tomentosa*	Rose myrtle							I					I
CORNACEAE	*Cornus foemina*	Swamp dogwood								F				
ERICACEAE	*Lyonia fruticosa*	Staggerbush					I		I			I		I
EBENACEAE	*Diospyros virginiana*	Persimmon									F			
* VERBENACEAE	*Lantana camara*	Shrub verbena			I				I			I		I
LAMIACEAE	*Callicarpa americana*	Beauty-bush			I	I			I					I
RUBIACEAE	*Cephalanthus occidentalis*	Buttonbush								F	I			
ADOXACEAE	*Sambucus nigra subsp. canadensis*	Elderberry								I				
ASTERACEAE	*Baccharis halimifolia*	Saltbush			I				F		I	C		

* = Exotic species; E=Endemic to Florida; Abundance Values listed above in Table __.

FDA = Florida Department of Agriculture and Consumer Services; FWS = United States Fish and Wildlife Service
C = Commercially Exploited

Appendix A: Plant Species Observed by Vegetative Area (Continued – Ground Cover)

	FAMILY	SCIENTIFIC NAME	COMMON NAME	FDA	FWS	Citrus NW	Dist. scrub	Citrus NE	Dist. Flat-woods	Citrus SE	Dist. Marsh	Dist. Wet Prarie	old fields	ditch	berm
	Ground Cover														
	LYCOPODIACEAE	*Lycopodiella cernua*	Nodding club-moss	C											I
	OSMUNDACEAE	*Osmunda cinnamomea*	Cinnamon fern	C							I				
	OSMUNDACEAE	*Osmunda regalis var. spectabilis*	Royal fern	C										I	
*	NEPHROLEPICACEAE A	*Nephrolepis multiflora*	Asian sword fern												I
	DENNSTAEDTIACEAE	*Pteridium aquilinum*	Eastern bracken fern						I	I	I				
	BLECHNACEAE	*Blechnum serrulatum*	Swamp fern								F	I		I	
	BLECHNACEAE	*Woodwardia virginica*	Chain fern								I			I	
	THELYPTERIDACEAE	*Thelypteris interrupta*	Willdenow's maiden fern								I				
	THELYPTERIDACEAE	*Thelypteris kunthii*	Maiden fern								I				
	SALVINIACEAE	*Salvinia minima*	Water spangles								F				
	TYPHACEAE	*Typha domingensis*	Cattail								I			I	
	ALISMATACEAE	*Sagittaria graminea*	Arrowhead									I			
	ALISMATACEAE	*Sagittaria lancifolia*	Arrowhead								I				
	POACEAE	*Amphicarpum muhlenbergianum*	Little blue maidencane					F		F		C			
	POACEAE	*Andropogon glomeratus*	Bushy bluestem			F			I			I	I	I	I
?	POACEAE	*Andropogon sp.*	Bluestem grass			I									
	POACEAE	*Andropogon ternarius*	Silver bluestem				F								
	POACEAE	*Andropogon virginicus*	Broomsedge			I		I	I				I		
	POACEAE	*Aristida spiciformis*	Bottlebrush threeawn						I						
	POACEAE	*Aristida stricta var. beyrichiana*	Wiregrass				F								
	POACEAE	*Axonopus fissifolius*	Southern carpet grass						I			C			
	POACEAE	*Axonopus furcatus*	Big carpet grass									F			
	POACEAE	*Cenchrus spinifex*	Coast sandspur										I		I
*	POACEAE	*Cynodon dactylon*	Bermudagrass							I			I		I
*	POACEAE	*Dactyloctenium aegyptium*	Crowfootgrass				F								I
	POACEAE	*Dichanthelium ensifolium*	Low panicum						I						
	POACEAE	*Dichanthelium portoricense*	Witchgrass				I		I						

* = Exotic species; E=Endemic to Florida; Abundance Values listed above in Table __.
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Appendix A: Plant Species Observed by Vegetative Area (Continued – Ground Cover)

	FAMILY	SCIENTIFIC NAME	COMMON NAME	FDA	FWS	Citrus NW	Dist. scrub	Citrus NE	Dist. Flat-woods	Citrus SE	Dist. Marsh	Dist. Wet Prarie	old fields	ditch	berm
	POACEAE	*Digitaria insularis*	Sourgrass			C							I		
	POACEAE	*Digitaria serotina*	Dwarf crabgrass			I									
*	POACEAE	*Eleusine indica*	Goosegrass			I									I
	POACEAE	*Eustachys glauca*	Saltmarsh fingergrass									I			
*	POACEAE	*Imperata cylindrica*	Cogongrass						F						
	POACEAE	*Leersia hexandra*	Cutgrass											F	
	POACEAE	*Panicum dichotomiflorum*	Fall panic grass									I			
	POACEAE	*Panicum hemitomon*	Maidencane					C	F	C		I	I	F	I
*	POACEAE	*Panicum maximum*	Guineagrass			I							I		I
*	POACEAE	*Panicum repens*	Torpedo grass				I						I		
	POACEAE	*Panicum rigidulum*	Redtop panicum									I			
*	POACEAE	*Paspalum notatum*	Bahiagrass			D	C	A	A	C		F	A		C
*	POACEAE	*Paspalum urvillei*	Vasey grass									I			
*	POACEAE	*Pennisetum polystachion*	West indian pennisetum			C			I	F			C		F
*	POACEAE	*Rhynchelytrum repens*	Natalgrass			F	C		I	C			F		F
	POACEAE	*Sacciolepis striata*	American cupscale									I		I	
	POACEAE	*Setaria parviflora*	Knotroot foxtail						I			I			
	POACEAE	*Spartina bakeri*	Sand cordgrass									I			
*	POACEAE	*Sporobolus indicus var. pyramidalis*	Smutgrass			C		A		A			D		I
	CYPERACEAE	*Bulbostylis ciliatifolia*	Capillary hairsedge				C								
	CYPERACEAE	*Cladium jamaicense*	Saw-grass								F	F			
	CYPERACEAE	*Cyperus haspan*	Flatsedge								I	I			
	CYPERACEAE	*Cyperus polystachyos*	Flatsedge						I			I			I
	CYPERACEAE	*Cyperus retrorsus*	Flatsedge				F		I				I		I
	CYPERACEAE	*Cyperus surinamensis*	Flatsedge										I		
	CYPERACEAE	*Eleocharis interstincta*	Spike-rush											I	
	CYPERACEAE	*Rhynchospora inundata*	Inundated beaksedge									I			
	CYPERACEAE	*Rhynchospora microcarpa*	Beaksedge									I			
?	LEMNACEAE	*Lemna sp.*	Duckweed								F				
?	XYRIDACEAE	*Xyris sp.*	Yellow-eyed-grass									I			

* = Exotic species; E=Endemic to Florida; Abundance Values listed above in Table __.
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Appendix A: Plant Species Observed by Vegetative Area (Continued – Ground Cover)

	FAMILY	SCIENTIFIC NAME	COMMON NAME	FDA	FWS	Citrus NW	Dist. scrub	Citrus NE	Dist. Flat-woods	Citrus SE	Dist. Marsh	Dist. Wet Prarie	old fields	ditch	berm
	ERIOCAULACEAE	*Lachnocaulon beyrichianum*	Southern bogbutton						I						
	PONTEDERIACEAE	*Pontederia cordata*	Pickerelweed								F	I		I	
	AGAVACEAE	*Yucca filimentosa*	Adam's needle				I								
	SMILACACEAE	*Smilax auriculata*	Greenbrier				F								
	HAEMODORACEAE	*Lachnanthes caroliana*	Red-root									I			
	IRIDACEAE	*Sisyrinchium angustifolium*	Pointed blue-eye-grass						I						
	MARANTACEAE	*Thalia geniculata*	Fireflag								F				
	URTICACEAE	*Boehmeria cylindrica*	Bog-hemp, false-nettle								F				
	POLYGONACEAE	*Polygonella polygama*	Jointweed				I								
*	CHENOPODIACEAE	*Chenopodium ambrosioides*	Mexican tea			I				I			I		
	AMARANTHACEAE	*Iresine diffusa*	Bloodleaf			I		F		F			I		I
	PHYTOLACCACEAE	*Phytolacca americana*	Pokeweed			I		I							
	NYMPHAEACEAE	*Nymphaea odorata*	White water-lily								I				
	ROSACEAE	*Rubus trivialis*	Southern dewberry									I			
	ROSACEAE	*Rubus argutus*	Sawtooth blackberry						I						
	CHRYSOBALANACEAE	*Licania michauxii*	Gopher apple				F								
	FABACEAE	*Chamaecrista nictitans*	Wild sesitive plant				I								
	FABACEAE	*Chamaecrista nictitans var. aspera*	Rough cassia			I							I		I
*	FABACEAE	*Indigofera hirsuta*	Hairy indigo			C		I	I				F		F
	EUPHORBIACEAE	*Stillingia sylvatica*	Queen's-delight						I						
	EUPHORBIACEAE	*Tragia urens*	Tragia					I	I						
*	MALVACEAE	*Urena lobata*	Caesar-weed, mozote			C				C			F	I	F
	STERCULIACEAE	*Melochia spicata*	Chocolate weed									I			
	CLUSIACEAE	*Hypericum brachyphyllum*	St. John's-wort									I			
	CLUSIACEAE	*Hypericum cistifolium*	St. John's-wort						I						
	CLUSIACEAE	*Hypericum hypericoides*	St. John's wort						I						

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Appendix A: Plant Species Observed by Vegetative Area (Continued – Ground Cover)

	FAMILY	SCIENTIFIC NAME	COMMON NAME	FDA	FWS	Citrus NW	Dist. scrub	Citrus NE	Dist. Flat-woods	Citrus SE	Dist. Marsh	Dist. Wet Prarie	old fields	ditch	berm
	CLUSIACEAE	*Hypericum tetrapetalum*	St. John's-wort						I						
	CISTACEAE	*Lechea torreyi*	Piedmont pinweed						I						
	TURNERACEAE	*Piriqueta cistoides subsp. Caroliniana*	Pitted stripeseed						I						
	CACTACEAE	*Opuntia humifusa*	Prickly-pear cactus			I	I								
	MELASTOMATACEAE	*Rhexia mariana*	Meadow beauty						I			F	I		
	ONAGRACEAE	*Gaura angustifolia*	Southern gaura					I							
*	ONAGRACEAE	*Ludwigia peruviana*	Primrose willow								I	I	I	C	
	ONAGRACEAE	*Ludwigia virgata*	Ludwigia						I						
	ARALIACEAE	*Centella asiatica*	Pennywort									I			
	APIACEAE	*Eryngium baldwinii*	Baldwin's coyote-thistle									I			
	ERICACEAE	*Lyonia fruticosa*	Staggerbush				I								
	ERICACEAE	*Vaccinium darrowii*	Blueberry						I						
	ERICACEAE	*Vaccinium myrsinites*	Shiny blueberry				C		I						
	BUDDLEJACEAE	*Polypremum procumbens*	Rustweed										I		
	GENTIANACEAE	*Sabatia grandiflora*	Marsh pink									I			
	HYDROLEACEAE	*Hydrolea corymbosa*	Corymb false-fiddle-leaf									I			
	LAMIACEAE	*Hyptis alata*	Musky mint									F			
	LAMIACEAE	*Piloblephis rigida*	Pennyroyal						I						
	VERONICACEAE	*Gratiola hispida*	Scrub hedge-hyssop									I			
	VERONICACEAE	*Scoparia dulcis*	Sweet broom						I				I		
	OROBANCHACEAE	*Buchnera americana*	Blueheart						I				I		
	RUBIACEAE	*Diodia teres*	Rough buttonweed			I									
*	RUBIACEAE	*Richardia scabra*	Richardia			I							I		
*	RUBIACEAE	*Spermacoce verticillata*	Spermacoce										I		
	ASTERACEAE	*Ambrosia artemisiifolia*	Common ragweed			F				I			F		

* = Exotic species; E=Endemic to Florida; Abundance Values listed above in Table __.
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Appendix A: Plant Species Observed by Vegetative Area (Continued – Ground Cover)

FAMILY	SCIENTIFIC NAME	COMMON NAME	FDA	FWS	Citrus NW	Dist. scrub	Citrus NE	Dist. Flat-woods	Citrus SE	Dist. Marsh	Dist. Wet Prarie	old fields	ditch	berm
ASTERACEAE	*Arnoglossum ovatum*	Egg-leaf indian-plantain				I								
ASTERACEAE	*Bidens alba var. radiata*	Beggar-ticks; Romerillo			A			F	C			F		F
ASTERACEAE	*Bigelowia nudata subsp. australis*	Rayless goldenrod									I			
ASTERACEAE	*Carphephorus corymbosus*	Coastal-plain chaffhead				I								
ASTERACEAE	*Conyza canadensis var. pusilla*	Dwarf horseweed			I				I			F		
ASTERACEAE	*Eupatorium capillifolium*	Dog fennel			I		C	F	F			C		F
ASTERACEAE	*Eupatorium leptophyllum*	Fennel									I			
ASTERACEAE	*Eupatorium mohrii*	Thoroughwort									I			
ASTERACEAE	*Euthamia caroliniana*	Flat-topped goldenrod					F	F	F					
ASTERACEAE	*Heterotheca subaxillaris*	Camphorweed			I							I		
ASTERACEAE	*Liatris chapmanii*	Liatris						I						
ASTERACEAE	*Lygodesmia aphylla*	Roserush										I		
ASTERACEAE	*Pityopsis graminifolia*	Golden aster						I	I			I		
ASTERACEAE	*Pluchea rosea*	Rosy camphorweed									I			
ASTERACEAE	*Pseudognaphalium obtusifolium*	Rabbit tobacco										I		
ASTERACEAE	*Pterocaulon pycnostachyum*	Blackroot				I		I						
ASTERACEAE	*Solidago fistulosa*	Goldenrod						F						
ASTERACEAE	*Solidago odora var. chapmanii*	Goldenrod				I								
ASTERACEAE	*Symphyotrichum carolinianum*	Climbing aster								I				
ASTERACEAE	*Symphyotrichum elliottii*	Elliott's aster									I			

* = Exotic species; E=Endemic to Florida; Abundance Values listed above in Table __.
FDA = Florida Department of Agriculture and Consumer Services; FWS = United States Fish and Wildlife Service
C = Commercially Exploited

Appendix A: Plant Species Observed by Vegetative Area (Continued – Vines and Epiphytes)

	FAMILY	SCIENTIFIC NAME	COMMON NAME	FDA	FWS	Citrus NW	Dist. scrub	Citrus NE	Dist. Flat-woods	Citrus SE	Dist. Marsh	Dist. Wet Prarie	old fields	ditch	berm
	Vines														
*	SCHIZAEACEAE	*Lygodium microphyllum*	Old World climbing fern											F	I
	SMILACACEAE	*Smilax auriculata*	Greenbrier						F						I
	SMILACACEAE	Smilax bona-nox	Saw greenbrier												I
	AGAVACEAE	*Yucca filimentosa*	Adam's needle				I								
*	FABACEAE	*Abrus precatorius*	Rosary pea												C
	FABACEAE	*Galactia elliottii*	Elliott's milkpea			C	F		I						I
	ANACARDIACEAE	*Toxicodendron radicans*	Poison ivy												I
	VITACEAE	*Ampelopsis arborea*	Pepper-vine			I			I	I					I
	VITACEAE	*Cissus verticillata*	Possum grape								I				
	VITACEAE	*Parthenocissus quinquefolia*	Virginia creeper			I									F
	VITACEAE	*Vitis rotundifolia*	Muscadine grape			F	I	C	C	C			I	F	A
	APOCYNACEAE	*Sarcostemma clausum*	White vine									I			
	CONVOLVULACEAE	*Ipomoea sagittata*	Saltmarsh morning-glory									I			
*	CUCURBITACEAE	*Momordica charantia*	Wild balsam apple			I			F						I
	ASTERACEAE	*Mikania scandens*	Climbing hempvine								F	I		I	
	Epiphytes														
	POLYPODIACEAE	*Pleopeltis polypodioides var. michauxiana*	Resurrection fern								I				
	BROMELIACEAE	*Tillandsia recurvata*	Ball-moss								I				
	BROMELIACEAE	*Tillandsia usneoides*	Spanish moss								I				

* = Exotic species; E=Endemic to Florida; Abundance Values listed above in Table __.
FDA = Florida Department of Agriculture and Consumer Services; FWS = United States Fish and Wildlife Service
C = Commercially Exploited

APPENDIX B

Wildlife Photos

Scrub Jays in live oak (*Quercus virginiana*) tree located in abandoned citrus NW,
September 2004

Gopher tortoise in burrow along Northern berm (above) & Fiber-optic scope device used to check burrows for tortoises and commensal species such as indigo snakes (below).

Selected Infrared/Motion Camera Images, September 2004

Camera 3: White-tailed Deer

Camera 3: Wild Turkeys

Camera 3: Feral Hog

Camera 4A: White-tailed Deer

Camera 2A: Bobcat

Camera 3A:White-tailed Deer

Eastern Spotted Skunk in Abandoned Agricultural Field

APPENDIX C

Latitude and Longitude of Gopher Tortoise Burrows,
Remote Cameras, and Vacant Nests

TYPE	LATITUDE	LONGITUDE
BURROW	26.44091355	-81.47492629
BURROW	26.45091190	-81.48502339
BURROW	26.45070269	-81.48497804
BURROW	26.45069380	-81.48497536
BURROW	26.45092506	-81.48465659
BURROW	26.45066774	-81.48478760
BURROW	26.45075357	-81.48448359
BURROW	26.45072482	-81.48442333
BURROW	26.45085365	-81.48349704
BURROW	26.45071484	-81.48318482
BURROW	26.45080076	-81.48249683
BURROW	26.45063077	-81.48439650
BURROW	26.45089354	-81.48233355
BURROW	26.44936259	-81.47749208
BURROW	26.45004706	-81.47667090
BURROW	26.45058584	-81.47646513
BURROW	26.44083325	-81.47483904
BURROW	26.44091221	-81.47492671
BURROW	26.45038962	-81.48156141
BURROW	26.44879027	-81.47591393
BURROW	26.44974246	-81.47545561
BURROW	26.45005720	-81.47544765
BURROW	26.45014294	-81.47544354
BURROW	26.44848241	-81.47500257
BURROW	26.45075876	-81.46809580
BURROW	26.44195022	-81.46729449
BURROW	26.44146876	-81.46738342
BURROW	26.44921431	-81.48134859
BURROW	26.44129015	-81.46721997
BURROW	26.44116350	-81.46739432
BURROW	26.44127254	-81.46775189
BURROW	26.44132376	-81.46772968
BURROW	26.44101757	-81.46805556

BURROW	26.44145116	-81.46797527
BURROW	26.44067265	-81.47373623
BURROW	26.45014906	-81.48490470
BURROW	26.44304121	-81.46727756
BURROW	26.45057252	-81.48508172
BURROW	26.44736560	-81.47260987
BURROW	26.44737088	-81.46967394
BURROW	26.44740885	-81.46900716
BURROW	26.44438399	-81.46703314
BURROW	26.44727147	-81.46837248
BURROW	26.44724607	-81.46912015
BURROW	26.44720517	-81.46881044
BURROW	26.44734716	-81.47001701
BURROW	26.44716360	-81.48098976
BURROW	26.45067184	-81.48515825
BURROW	26.45074736	-81.48119017
BURROW	26.45082632	-81.48102991
BURROW	26.45087619	-81.48052021
BURROW	26.45090000	-81.48042340
BURROW	26.45085004	-81.48022609
BURROW	26.45084610	-81.48001310
BURROW	26.45082506	-81.47977028
BURROW	26.45091559	-81.47983633
BURROW	26.45091861	-81.47965821
BURROW	26.45092179	-81.47852037
BURROW	26.45069070	-81.48511659
BURROW	26.45093948	-81.47841660
BURROW	26.45095280	-81.47838852
BURROW	26.45091953	-81.47831560
BURROW	26.45087385	-81.47139508
BURROW	26.45046397	-81.48405863
BURROW	26.45092531	-81.48371866
BURROW	26.44814696	-81.48208863
BURROW	26.44976065	-81.47957222
BURROW	26.44781562	-81.47687215
BURROW	26.45026138	-81.48157029
BURROW	26.45001227	-81.47589248
BURROW	26.45050638	-81.47077960
BURROW	26.44941816	-81.46961485
BURROW	26.44976643	-81.46897917
BURROW	26.44503174	-81.46546053
BURROW	26.44725001	-81.46628195
BURROW	26.44673260	-81.47004258
BURROW	26.45093487	-81.48097325
BURROW	26.45083998	-81.48017311
BURROW	26.45094945	-81.47951807
BURROW	26.45093353	-81.47910870

BURROW	26.45093361	-81.47874685
BURROW	26.44123415	-81.47518605
BURROW	26.44171670	-81.47523425
BURROW	26.44190052	-81.47441936
BURROW	26.44196087	-81.47415575
BURROW	26.44362601	-81.48094215
BURROW	26.44069872	-81.47433193
BURROW	26.45068450	-81.48069958
BURROW	26.44064239	-81.47427921
BURROW	26.44087692	-81.47516325
BURROW	26.44192457	-81.47022254
BURROW	26.44192608	-81.46985097
BURROW	26.44219087	-81.46994661
BURROW	26.44076745	-81.47420998
BURROW	26.44058137	-81.47500953
BURROW	26.44114581	-81.47440025
BURROW	26.44087373	-81.47421450
BURROW	26.44354823	-81.47671717
BURROW	26.44144856	-81.46786924
BURROW	26.45088273	-81.48426189
BURROW	26.44623371	-81.46528711
BURROW	26.44665046	-81.46515979
BURROW	26.44149869	-81.46682368
BURROW	26.44104749	-81.46687808
CAMERA	26.44731062	-81.48220061
CAMERA	26.45100008	-81.47759291
CAMERA	26.44979409	-81.48777374
CAMERA	26.45117668	-81.46812086
CAMERA	26.45087703	-81.48715717
CAMERA	26.44239279	-81.46705778
CAMERA	26.45066321	-81.48166560
CAMERA	26.44053259	-81.47726267
NEST	26.44775393	-81.48301383
NEST	26.44888130	-81.48376996

From: Cassler, Constance
To: Johnson, Bruce
Cc: Mcdonald, Kenneth
Subject: Fwd: Updated Information for Bruce Johnson
Date: Thursday, February 21, 2019 10:42:59 AM
Attachments: updatedinformationforbrucejohnson.zip

Hi Bruce,

The attached information is from Ken. The folder has the rodenticide information and some panther information you may not have.

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
office: 772-469-4243
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Visit our web site at www.fws.gov/verobeach/

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---------- Forwarded message ---------
From: **Mcdonald, Kenneth** <kenneth_mcdonald@fws.gov>
Date: Thu, Feb 21, 2019 at 10:24 AM
Subject: Updated Information for Bruce Johnson
To: Cassler, Constance <constance_cassler@fws.gov>

Second try. See attached.

--
Kenneth McDonald
Fish & Wildlife Biologist
South Florida Ecological Services Field Office
1339 20th Street
Vero Beach, Florida 32960-3559
Office: 772.469.4284
Fax: 772.562.4288
kenneth_mcdonald@fws.gov

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Act (FOIA) and may be disclosed to third parties.

Energy and persistence will conquer all things

- Benjamin Franklin

Attachment _.zip (22414898 Bytes) cannot be converted to PDF format.

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Title

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Journal

Proceedings of the Vertebrate Pest Conference, 25(25)

Authors

Moriarty, Joanne Gale
Riley, Seth P. D.
Serieys, Laurel E.
et al.

Publication Date

2012

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Exposure of Wildlife to Anticoagulant Rodenticides at Santa Monica Mountains National Recreation Area: From Mountain Lions to Rodents

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Abstract: A 15-year study of carnivores in an urban landscape in southern California has revealed a high incidence of exposure of non-target wildlife to anticoagulant rodenticides (ARs). All carnivore species studied, including mountain lions, coyotes, bobcats, and gray foxes, have tested positive for exposure to the toxicants. Anticoagulant residues have been detected in post-mortem liver samples at a rate of 83-93% of individuals tested, for coyotes, bobcats, and mountain lions, the 3 species for which we have extensive sampling. We have also documented mortalities caused directly by exposure to ARs in all 4 species, particularly in the canids. In both felid species, we found a positive correlation between AR exposure and mange disease, specifically notoedric mange. The incidence of fatal mange infection in bobcats has been at epizootic levels since 2002 in our study area, and more recently outbreaks of the disease have been documented in several other populations in California, all apparently (where testing has been done) in association with exposure to ARs. There are no previously reported instances of epizootics of notoedric mange in any wild felid population. Carnivore exposure to these toxicants appears to be largely secondary (or tertiary, as may be the case in mountain lions) through consumption of their natural prey. In our most recent work, we have evaluated AR exposure of carnivore prey species, including rodents and lagomorphs. We have documented exposure in ground squirrels and woodrats, both of which are regularly consumed by gray foxes, coyotes, and bobcats. Overall, we have found widespread exposure of non-target wildlife to these toxicants, with potentially significant consequences for some species.

Key Words: anticoagulants, bobcat, *Canis latrans*, coyote, gray fox, *Lynx rufus*, mountain lion, *Puma concolor*, rodenticides, secondary hazard, small mammals

Proc. 25th Vertebr. Pest Conf. (R. M. Timm, Ed.)
Published at Univ. of Calif., Davis. 2012. Pp. 144-148.

INTRODUCTION

Small mammal behavior and ecology, particularly that of rodents, can conflict with human interests in urban and agricultural settings, but current control practices are affecting non-target wildlife species as well. The abundant resources in these urban and agricultural areas attract some small mammal species, as well as enable their high proliferation. As a result, these animals can cause major losses of and damages to goods and property, which has lead to widespread efforts to control small mammal populations in these areas. Currently one of the most popular rodent control methods is using anticoagulant rodenticides (ARs), which interrupt the animal's vitamin K recycling process and inhibit clotting factors, eventually allowing fatal hemorrhaging. First-generation anticoagulant rodenticides (FGARs) have been in use since the 1950s and require multiple feedings in order to have a lethal effect on the target species. However, due to the development of resistance of target species to FGARs, second-generation anticoagulants rodenticides (SGARs) were introduced in the 1970s and 1980s (Erickson and Urban 2004). These compounds can have effects from a single feeding, but they also persist longer in the environment and in the livers of exposed animals (Erickson and Urban 2004; Giraudoux et al. 2006; Vandenbroucke et al. 2008). This, coupled with the relatively long delay of effect of these compounds (5-10 days from feeding to death) (Erickson and Urban 2004), leaves other wildlife especially vulnerable to secondary poisoning from consumption of the target species. Secondary exposure and toxicosis has been reported from both FGARs and SGARs in many species from raptors to mammals (e.g., Giraudoux et al. 2006, McMillin et al. 2008, Elmeros et al. 2011, Thomas et al. 2011). Animals that exist in or near areas of heavy human use may be particularly vulnerable to possible deleterious effects of exposure to ARs.

Santa Monica Mountains National Recreation Area (SMMNRA) is the largest urban park within the U.S., and it is next to one of the largest urban centers in the U.S., Los Angeles. There are many areas of natural habitat in and around the mountains that have been completely isolated from core areas of open space by roads and urbanization. However, there still exist within the mountains large areas of natural habitat, as well as significant plant and animal resources in both these large core areas and in the smaller fragmented areas. In addition, both the large and

fragmented natural areas provide significant recreational resources for a large number of park visitors every day. These natural landscapes also provide a desirable location for residents, leading to an interwoven network of urbanized and natural landscapes in the interface areas. Furthermore, neighborhood parks and golf courses interdispersed through the residential areas create altered open space which, while often used by wildlife, may not provide all of the same elements of natural space for all species. This type of complex urban wildland interface can present significant human-wildlife conflicts and additional challenges for wildlife.

Carnivores are particularly sensitive to urban habitat fragmentation due to their large food and space requirements (Crooks 2002). Habitat fragments often become too small to support individual animals, so they must link multiple fragments together if they are to persist in these areas, and therefore they must navigate through the urban partitions. Additionally, resources such as the lush lawns, green foliage, and inhabitable structures found in the urban areas attract small mammals and other herbivores to the area, which subsequently may further attract carnivores to the area. These are likely some of the contributing factors leading to the use of urban areas and adjacent open spaces by carnivores, which leave them particularly vulnerable to anthropogenic influences and conflicts with humans. This is likely the case in SMMNRA where large carnivores, including mountain lions (*Puma concolor*), coyotes (*Canis latrans*), bobcats (*Lynx rufus*), and gray foxes (*Urocyon cinereoargenteus*), still persist in some areas, but the highly fragmented landscape has led to carnivores using areas in and directly adjacent to human development.

REVIEW OF PAST SMMNRA CARNIVORE STUDIES

In 1996, the National Park Service began studying carnivores in the SMMNRA region, including coyotes, bobcats, and gray foxes. Initial studies were conducted through radio telemetry, scat analysis, and remote camera traps. Animals were captured with padded footholds early in the study and later caught with neck snares (for coyotes, the Collarum™, Wildlife Control Supplies, East Granby, CT) and cage traps. For handling, bobcats were anesthetized while coyotes and foxes where physically restrained. Animals were marked with unique ear tags and fitted with radio telemetry collars. Morphometric measurements, as well as tissue and blood samples, were taken. Animals were then monitored through ground triangulation supplemented with remote camera captures. Scat was initially collected opportunistically and analyzed for diet consumption for all three species. Beginning in 2001, standard scat lines were designated and scat numbers for coyotes and bobcats were used to compare relative densities of each of the carnivores spatially and temporally, in addition to collection for diet analysis. For animals that died during the study, full necropsies were performed and organ samples were collected for further analysis. Livers were sent to the California Animal Health and Food Safety Laboratory at UC Davis for anticoagulant residue analyses. They were analyzed using an HPLC method, previously published by Palazoglu et al. (1998) and modified for tissue analysis (see also Riley et al. 2007).

We found all 3 carnivores present in the study area, including in many of the small habitat fragments, where there was evidence of use at least from bobcats and coyotes. In and around SMMNRA among areas with varying levels of urbanization, 114 coyotes (1996-2004) and 160 bobcats (1996-2011) have been followed through telemetry. Coyotes and bobcats both had relatively high densities in the urban fragmented areas, and survival rates were relatively high as well (Riley et al. 2003, 2010). Both species frequently utilized natural habitat in areas directly adjacent to urbanization and occasionally utilized urban areas as well. However, both species prefer the natural habitat, and the majority of their telemetry locations fell in these areas (Riley et al. 2010). Gray foxes were also prevalent in the larger core areas of habitat, where we followed 28 foxes with radio telemetry, but seemed to be rare in the smaller more urbanized habitats fragments, where only 2 foxes were captured and followed.

Coyotes, foxes, and bobcats were all found to have similar prey in their diets, although coyotes and foxes also consumed fruits, while bobcats were strictly carnivorous. Rabbits (*Sylvilagus* spp.) were the most frequently consumed item for bobcats and after fruit were also the most frequently consumed item for coyotes. Rabbits were also important in fox diets (Fedriani et al. 2000). Bobcats and coyotes consumed pocket gophers (*Thomomys bottae*), voles (*Microtus californicus*), woodrats (*Neotoma* spp.), and squirrels (*Otospermophilus beecheyi*, *Sciurus niger*) and for bobcats, these were all important prey, second only to rabbits. However, woodrats and squirrels were significantly less frequent in coyote scats than some of the other prey items. When combined, rodents were the most important prey type for foxes (Fedriani et al. 2000).

In the fall 1997, we detected the first coyote mortality due to AR toxicosis. The necropsy showed large amounts of free blood in the body cavities and the liver contained high levels of FGAR residues. Subsequently, 13 additional cases of fatal AR toxicosis were detected in coyotes between 1996 and 2004. All of these cases had high levels of SGARs, and 4 cases had both SGARs and FGARs. AR toxicosis was the second highest source of mortality for coyotes behind vehicle collisions, and constituted 23% of the total mortality observed and 30% of the observed mortality for which there was a known source. Further, 83% (n=24) of all coyotes tested post-mortem were positive for one or more AR compound residues in their liver.

In addition to high exposure of coyotes to ARs, we also observed exposure in the other 2 carnivore species, bobcats and foxes, all likely due to secondary poisoning. Of bobcats tested post-mortem from 1997-2011, 93% (n=89) were positive for one or more AR compound residues (largely SGARs) in their liver, and 77% were positive for multiple compounds. Additionally, 1 of the 2 urban foxes followed died directly from AR toxicosis. As generalists, it is feasible that coyotes and foxes could be eating the baits directly. However, due to their strictly carnivorous diets, it is unlikely that bobcats are being exposed through direct consumption of the AR baits. Commonly targeted pest species such as squirrels, woodrats, and pocket gophers

(Morzillo and Schwartz 2011), are regularly consumed by bobcats, coyotes, and foxes in urban areas, and these prey species are likely the source of AR exposure in carnivores. SGARs are only labeled for use on commensal rodents, but comprise a large portion of the ARs detected in the carnivores. Carnivores may consume some commensal rodents (*Rattus* spp., *Mus musculus*) as well, although these rodents were not common in the carnivore diet studies or in small mammal studies carried out in the area (Schutte 2005, Moriarty, unpubl. data). They may also be acquiring SGARs from ingesting non-target small mammals consuming baits placed for commensal rodents, or because of off-label use of these baits by homeowners or others.

Despite the high exposure rates, we observed just 1 bobcat mortality directly attributed to AR toxicosis. Rather, the largest source of mortality for bobcats from 2002 to 2008 was notoedric mange (*Notoedres cati*), a parasitic skin disease that causes severe puritis (itching), skin lesions, alopecia (hair loss), and cachexia (weight loss and muscle atrophy), eventually leading to death. We detected the first case of mange in a bobcat in late 2001, after which the disease seemed to quickly elevate to epizootic levels by 2003 when it resulted in 9 out 15 mortalities and the annual bobcat survival rate (probability of an animal surviving one year) dropped dramatically to 0.255 from a previous 7-year average of 0.710. In the years following, mange continued to cause widespread mortality in the study area, and in 2005 it was responsible for 100% of the observed mortalities (Riley et al. 2010). This epizootic-driven population decline was further detected through capture success which diminished in 2004-2008 despite similar trapping effort, and was also strikingly apparent in the numbers of scats counted over this time period, which dropped off dramatically in 2003 and continued to remain low through 2008.

There is little information in the literature about mange disease in felids and almost none on mange disease in wild felids. There are also no present reports of mange epizootics in wild felid with severe population effects similar to that seen in the local SMMNRA populations, although recently outbreaks of the disease have been documented in several other bobcat populations in California (Riley et al. 2010; Serieys, unpubl. data; D. Clifford, CA Dept of Fish & Game, Sacramento, pers. commun.; M. Jennings, CA State Univ., San Diego, pers. commun.). Mange in felids may act as an opportunistic disease, affecting individuals that have been compromised in some other way, and there is evidence to suggest that that may be the case here. We have found a strong statistical correlation and possibly synergistic effect in bobcats between AR exposure and mange disease (for data collected prior to 2004 see Riley et al. 2007), although at this point we have not determined a mechanism producing this correlation. However, bobcats exposed to ARs at a liver residue level of 0.05 ppm or greater are 9 times more likely to die with severe notoedric mange disease than to die of other causes (Serieys, unpubl. data). Further, the other state-wide mange outbreaks (where testing has been done) have all shown concurrent exposure to ARs as well (Riley et al. 2010; Serieys, unpubl. data; D. Clifford pers. commun.; M. Jennings, pers. commun.).

Beginning in 2002, the SMMNRA carnivore project was expanded to include mountain lions, the top predator in the region, and subsequently we have seen high AR exposure in lions as well. Lions were captured primarily with footsnares and with cage traps, and were anesthetized for handling. Hounds were used for some recaptures. They were marked with unique ear tags and fitted with GPS and radio telemetry collars. Morphometric measurements and tissue and blood samples were also taken. Animals were then monitored remotely through downloads of GPS locations as well as VHF triangulation, especially for kittens marked with VHF implants (Moriarty et al. 2011). Lions used much larger areas for their home ranges than any of the other carnivores, with ranges up to 100 times larger than those of bobcats. They also used natural areas directly adjacent to urbanization and occasionally made excursions into the urban areas. However, like the other carnivores, they spent most of their time in natural areas.

Mountain lion scat is rarely found and therefore it is not easily used for diet analysis. However, mountain lions often make large kills on which they will feed for multiple days, and therefore we were able to identify areas where their GPS locations become localized for greater than 24 hours, which generally indicates they are feeding on a kill. We were then able to investigate these kill areas at a later date and determine the prey taken. From these kill investigations, we have learned that lions in our area consume 3-4 mule deer (*Odocoileus hemionus*) per month and occasionally take smaller prey such as coyotes, raccoons (*Procyon lotor*), and badgers (*Taxidea taxus*). They may be also consuming even smaller items, such as rabbits and woodrats that we were not detecting through this method. Further, this method may inherently underestimate the amount of all of the smaller prey items lions are taking, which can be consumed in less than 24 hours, including other carnivores such as coyotes. Therefore, despite the low observation of AR targeted species consumption, lions may be acquiring anticoagulants secondarily similarly to the other carnivores. However, in the case of lions, they are also likely acquiring ARs on a tertiary level from ingesting other carnivores such as coyotes. Nine out of 10 lions tested post-mortem were positive for SGAR residues in their liver, including a 3-month-old kitten, and 6 of these cases had FGAR residues as well. Further, 2 of these lions died directly from AR toxicosis, both of whom had consumed coyotes shortly before their death (Riley et al. 2007; Uzal et al. 2007).

CURRENT SMMNRA RESEARCH

In response to the mange epizootic in bobcats and its potential link with AR exposure, we initiated additional components of our carnivore research in 2007. This included expanding sample collection and testing at carnivore captures to better assess animal health and detect early mange disease or AR exposure. Expanded sampling included collecting scat, hair, skin scrapings, ear swabs, urine, and additional blood for expanded blood chemistry, AR residue, and clotting time (PT– prothombin time, and PIVKA – proteins involved in vitamin K absence) tests. We also began trapping efforts in more remote areas of SMMNRA to gather health information on individuals less likely to be exposed to urbanization and therefore

ARs. Further, we began using GPS-equipped collars on bobcats in order to obtain more frequent and more precise location data on both the urban and more remote animals. Finally, we began a project to look at exposure to ARs in common prey species of bobcats and coyotes. This project included trapping rabbits, woodrats, and squirrels along urban edges and in more remote areas for comparison, as well as collecting liver samples from small mammals found dead from vehicle collisions or other causes.

For our expanded trapping efforts, we trapped and monitored bobcats in the western, least developed end of SMMNRA. A total of 13 bobcats were trapped, GPS-collared, and monitored in this area over a 3-year period (2008-2011). Most of the home ranges of these bobcats consisted entirely of natural areas, with only 2 individuals' home ranges encompassing small amounts of agricultural area, and no home ranges encompassing any urbanized areas. We observed 5 mortalities during the study, none of which resulted from AR toxicosis or mange disease. Exposure to ARs in these animals was low, but not absent. In fact, 2 individuals that appeared to have no urbanization or agricultural lands within their home range both had trace levels of AR residues in their livers tested post-mortem. Although these animals were in the most natural areas of the park, the edge of their observed home ranges were still within 1 km of private ranches, so exposed prey may have been present in their home ranges, or these bobcats may have made visits to the ranches that we did not document. It is also possible these bobcats were exposed to ARs through illegal marijuana cultivation, a known issue in SMMNRA. Gabriel et al. (2012) saw high AR exposure in fishers (*Martes pennanti*) from remote areas in central California, which they hypothesized to result from rodent control activities at marijuana grow sites.

Small mammal sample testing is still in progress; however, preliminary results show potentially high exposure in small mammals available to predators. Small mammals were live trapped, bled, and tested for clotting times and blood AR residues in 10 sites, 2 in natural areas and 8 urban. Clotting time was assessed using the CoagDX machine (Idexx, Westbrock, ME) for prothrombin time (PT). Our detection of AR exposure from blood tests taken during trapping was low. There was no difference in the mean PT between natural and urban sites for any species. However, there were 2 outliers observed in the urban area, 1 woodrat and 1 rabbit, with PTs around 3 times greater than the means for each species. We also had 2 blood samples test positive for AR residues, both from woodrats and both from urban sites. Our detection of ARs was much greater in post-mortem liver samples taken from small mammals found dead, mostly on roads. Of livers tested, 20% (n=51) were positive for AR compounds including 20% of squirrels (n=21) and 4 out of 5 woodrats, one of which was found dead 500 m away from the urban edge. No evidence of AR exposure has been detected in rabbits.

DISCUSSION

Our research has shown that there is widespread exposure of multiple carnivore species to the common ARs used for rodent control. Over 85% of mountain lions, coyotes, and bobcats tested have been exposed to ARs, as well as 1 of 2 foxes. These species that prey on the species targeted for control are not just acquiring incidental exposure to ARs, but rather they are being clinically affected by their exposure. Further, ARs are not only affecting individual coyotes, mountain lions, and foxes, as well as potentially indirectly affecting individual bobcats, but they may also be having population level effects on bobcats and potentially foxes. Mange disease is affecting bobcats at a rate in which it appears to be regulating the local population level (Riley et al. 2007). Our research has shown that mange disease is correlated with exposure to ARs, and indicates there may be a potential synergistic relationship. It is unclear why fox densities are so low in the urban areas, but we do know that they are sensitive to and exposed to ARs in these areas. ARs may potentially be a contributing factor.

High levels of exposure in free-roaming small mammals in conjunction with widespread carnivore exposure indicates that current rodent control activities (whether legal or off-label use) are putting all predatory species at risk. All of the small mammals from which samples were collected, both live captures and those found dead, were collected outside of residential homes and yards, and therefore represent animals that would have been available for predation. Furthermore, these exposed animals may actually be more likely to be predated, as they may become sickly and slower before their demise. The habitat loss and fragmentation in urbanized areas may already represent the upper tolerance limits for disturbance of some species. Additional challenges, such as exposure to toxicants, may increase the pressures on some populations and make it harder for them to survive in this landscape. This may be the case with gray foxes in SMMNRA. We know they are sensitive to AR toxicosis, and that they are in low densities in the urban areas. We also know that fox densities seem to have an inverse relationship with coyote densities (Fedriani et al. 2000), which are relatively higher in the more urban parts of SMMNRA (Fedriani et al. 2001). Coyotes alone may keep fox densities low, but AR toxicants may also contribute or at least further reduce their ability to maintain stable populations in fragmented areas.

As urbanization increases both nationally and globally, insuring human coexistence with wildlife will become imperative for some species if they are to persist. Rodents can cause large and costly amounts of damage to goods and property, and the need to control them in some areas is evident, but current methods appear to be costly to natural ecosystems. Comprehensive solutions may not be immediately available, but more targeted and controlled use of ARs, both temporally and spatially, might allow equally effective control with less secondary poisoning. Additionally, long-term use of SGARs may prove to have similar consequences as long-term use of FGARs, i.e. rodents may develop higher tolerances to the SGAR compounds. This may eventually render them ineffective for control. Ultimately, research such as ours will hopefully help pest control managers find more effective alternatives to ARs with fewer unintended consequences for non-target wildlife.

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From: Cassler, Constance
To: Johnson, Bruce
Cc: Kelso, Charles; Dell, David
Subject: Oil Well Road BO
Date: Friday, March 15, 2019 9:53:21 AM
Attachments: 20090226_letter_Service to Corps_FA0548 panther BO Oil Well Road.pdf

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Hi Bruce,

I'm attaching the Oil Well Road BO. It is the wetland mitigation for that project that is west of Ave Maria. Please let us know what you think when you have had a chance to look at it and talk to Tom Jones.

I'll send the other project I saw as soon as I track it down.

Connie

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
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February 26, 2009

Colonel Paul L. Grosskruger
District Commander
U.S. Army Corps of Engineers
Post Office Box 4970
Jacksonville, Florida 32207-8175

Service Activity Code:	41420-2006-FA-0548
Service Consultation Code:	41420-2006-F-1011
Corps Application No.:	SAJ-2006-7018 (IP-HWB)
Date Received:	February 27, 2008
Formal Consultation Initiation Date:	July 24, 2008
Applicant:	Collier County
Project:	Oil Well Road Widening
County:	Collier

Dear Colonel Grosskruger:

This document transmits the Fish and Wildlife Service's (Service) biological opinion for the widening of Oil Well Road from Immokalee Road (County Road 846) to approximately 0.5 mile East of Camp Keais Road and its effects on the endangered Florida panther (*Puma concolor coryi*) in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884;16 U.S.C. 1531 *et seq.*). The project site is located in Sections 13, 14, 23, and 24, Township 48 South, Range 27 East; Sections 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, and 24, Township 48 South, Range 28 East; and Sections 15, 16, 17, 18, 19, 20, 21, and 22, Township 48 South, Range 29 East in Collier County, Florida (Figure 1).

This biological opinion is based on information provided in the U.S. Army Corps of Engineer's (Corps) Public Notice dated January 7, 2008, and letter to the Service dated February 27, 2008; the Service's letter to the Corps dated March 27, 2008; the Corps' letter to the Service dated July 23, 2008, containing information on the project from the applicant's consultant Wilson-Miller Incorporated; and meetings, telephone conversations, emails, and other sources of information. A complete administrative record of this consultation is on file at the Service's South Florida Ecological Services Office (SFESO), Vero Beach, Florida.

In the letter to the Service dated February 22, 2008, the Corps determined the Oil Well Road widening project "may affect" the endangered Florida panther. The Corps also determined the project "may affect, but is not likely to adversely affect" the threatened Audubon's crested caracara (*Polyborus cheriway = Polyborus plancus audubonii*), the endangered wood stork (*Mycteria americana*), and the threatened eastern indigo snake (*Drymarchon corais couperi*).

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During construction, the applicant has agreed to follow the Service's *Standard Protection Measures for the Eastern Indigo Snake.* In a letter to the Corps dated March 27, 2008, the Service concurred with the Corps' determinations for the Florida panther, Audubon's crested caracara, the eastern indigo snake, and requested additional information for the Florida panther, and the wood stork.

In response to our letter to the Corps dated March 27, 2008, the Corps provided the Service with results of a wood stork biomass foraging assessment for the project impact site and the preserve site conducted by the applicant's consultant (Wilson-Miller Incorporated) (Table 1). The foraging assessment methodology can be found in the Service's November 9, 2007, Eastern Indigo Snake and Wood Stork Key (Service Federal Activity Code Number 41420-2007-FA-1494) provided to the Corps to guide their effect determinations for these species. Based on the information provided, the applicant's compensation proposal appears to adequately offset the loss of wood stork foraging habitat due to the project. The Service concurs with the Corps' determination for the wood stork.

The Use of Best Scientific and Commercial Information by the Service

The Service uses the most current and up-to-date scientific and commercial information available. The nature of the scientific process dictates that information is constantly changing and improving as new studies are completed. The scientific method is an iterative process that builds on previous information. As the Service becomes aware of new information, we will ensure it is fully considered in our decisions, evaluations, reviews, and analyses as it relates to the base of scientific knowledge and any publications cited in our documents.

Specifically, there is one such document cited in this biological opinion the Service acknowledges has been affected in its cited form by new scientific information. The Service has taken these new sources of information into account when using this document to help guide our analysis and decisions. This document is the South Florida Multi-Species Recovery Plan (MSRP) of 1999 (Service 1999).

South Florida Multi-Species Recovery Plan

The MSRP was designed to be a living document and it was designed to be flexible to accommodate the change identified through ongoing and planned research and would be compatible with adaptive management strategies. These principals are set forth in both the transmittal letter from the Secretary of the Interior and in the document itself. As predicted, this is what indeed occurred in the intervening years since the MSRP was published. The Service uses the MSRP in the context it still presents useful information when taken in conjunction with all the new scientific information developed subsequent to its publication.

Climate Change

According to the Intergovernmental Panel on Climate Change Report (IPCC 2007), warming of the earth's climate is "unequivocal," as is now evident from observations of increases in average global air and ocean temperatures, widespread melting of snow and ice, and rising sea level. The

IPCC Report (2007) describes changes in natural ecosystems with potential wide-spread effects on many organisms, including marine mammals and migratory birds. The potential for rapid climate change poses a significant challenge for fish and wildlife conservation. Species' abundance and distribution are dynamic, relative to a variety of factors, including climate. As climate changes, the abundance and distribution of fish and wildlife will also change. Highly specialized or endemic species are likely to be most susceptible to the stresses of changing climate. Based on these findings and other similar studies, the Department of the Interior requires agencies under its direction to consider potential climate change effects as part of their long-range planning activities (Service 2007a).

Climate change at the global level drives changes in weather at the regional level, although weather is also strongly affected by season and by local effects (*e.g.*, elevation, topography, latitude, proximity to the ocean. Temperatures are predicted to rise from 2°C to 5°C for North America by the end of this century (IPCC 2007). Other processes to be affected by this projected warming include rainfall (amount, seasonal timing and distribution), storms (frequency and intensity), and sea level rise. However, the exact magnitude, direction and distribution of these changes at the regional level are not well understood or easy to predict. Seasonal change and local geography make prediction of the effects of climate change at any location variable. Current predictive models offer a wide range of predicted changes.

Prior to the 2007 IPCC Report, Titus and Narayanan (1995) modeled the probability of sea level rise based on global warming. They estimated the increase in global temperatures could likely raise sea level 6 inches by 2050 and 13 inches by 2100. While these estimates are lower than the estimates described in the IPCC Report (2007), Titus and Narayanan's (1995) modeling efforts developed probability-based projections that can be added to local tide-gauge trends to estimate future sea level at specific locations.

The Southwest Florida Regional Planning Council (SWFRPC) used Titus and Narayanan's (1995) worst-case scenario estimate of a 4-meter (13.1-foot) rise in 200 years to project sea level rise in southwest Florida by 2200. According to the GIS maps produced by SWFRPC, this 13-foot rise in sea level would inundate the entire surface area of the Picayune Strand Restoration Project (PSRP) in Collier County, Florida. The loss of 55,391 acres of restored upland and wetland habitat to sea level rise by 2200 would have a negative effect on Florida panthers, red-cockaded woodpeckers, wood storks, bald eagles, American crocodiles, and West Indian manatees as well as migratory birds. When we consider lower sea level rise scenarios for the PSRP, a 1-meter (3.3-foot) rise would inundate 13,910 acres or 25 percent of the restored habitat; a 2-meter (6.6-foot) rise would inundate 41,978 acres or 76 percent; and a 3-meter (9.8-foot) rise would inundate 49,284 acres or 89 percent, respectively.

Whittle et al. (unpublished data 2008) applied several prominent climate change models to panther habitat in southwest Florida. Their review indicated a climate change-induced sea level rise of 1 meter (3 feet) will reduce southwest Florida panther habitat by 29 percent, at 3 meters (9.8 feet) by 62 percent, and at 5 meters (16.4 feet) by 90 percent. The consequences would be particularly dire for the panther which has no other populations outside of low-lying south Florida. Their cost surface analyses identified likely migration routes that would link the south

Florida panther population to suitable habitat to the north. However, without rapid conservation actions that establish a population to the north, they predict that the Florida panther may go extinct in the wild due to climate change effects.

Climatic changes in south Florida could exacerbate current land management challenges involving habitat fragmentation, urbanization, invasive species, disease, parasites, and water management (Pearlstine 2008). Global warming will be a particular challenge for endangered, threatened, and other "at risk" species. It is difficult to estimate, with any degree of precision, which species will be affected by climate change or exactly how they will be affected. The Service will use Strategic Habitat Conservation planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (Service 2006a).

It should be noted Titus and Narayanan's (1995) worst-case scenario was premised on a 1 percent chance that global warming would raise sea level that high. However, most climate change researchers agree with the findings in the IPCC Report (2007) which estimates a 90 percent probability of 7 to 23 inches of sea level rise by 2100. Scientific evidence that has emerged since the publication of the IPCC Report (2007) indicates an increase in the speed and scale of the changes affecting the global climate. Important aspects of climate change seem to have been underestimated and the resulting impacts are being felt sooner. For example, early signs of change suggest that the less than 1.0°C (1.8°F) of global warming that the world has experienced to date may have already triggered the first tipping point of the Earth's climate system – the disappearance of summer Arctic sea ice. This process could open the gates to rapid and abrupt climate change, rather than the gradual changes that have been currently forecasted.

Consultation History

In a letter to the Service dated April 4, 2006, Wilson-Miller Incorporated, the applicant's consultant, requested technical assistance on federally-listed species in or near the proposed Oil Well Road widening project corridor.

In an email to Wilson-Miller Incorporated dated April 12, 2006, the Service indicated the project was located in the geographic range of the endangered Florida panther and the endangered wood stork.

In a public notice dated January 7, 2008 (permit application SAJ-2006-7018), the Corps indicated the Collier Board of County Commissioners proposes to widen Oil Well Road (County Road 858) from near Immokalee Road to 0.5 mile east of Camp Keais Road. The Corps determined the project "may affect" the Florida panther, the wood stork, and Audubon's crested caracara.

In a letter to the Service dated February 22, 2008, the Corps changed its determination for the wood stork and Audubon's crested caracara from "may affect" to "may affect, not likely to adversely affect." The Corps also indicated the applicant has agreed to follow the Service's *Standard Protection Measures for the Eastern Indigo Snake*, and determined the project "may affect" but is not likely to adversely affect" the eastern indigo snake.

In a letter to the Corps dated March 27, 2008, the Service concurred with the Corps' determinations for Audubon's crested caracara, the eastern indigo snake, and the Florida panther. The Service requested additional information to initiate formal consultation for the project's affects to the Florida panther. The Service also indicated it could not provide concurrence for the Corps' determination for the wood stork, and requested further information regarding impacts to foraging habitat resulting from the project, and compensation for wetland impacts.

In a letter to the Service dated December 15, 2008, the applicant's consultant, Wilson-Miller Incorporated, provided additional information to the Service regarding the panther habitat compensation parcel proposed to minimize impacts of the project to the Florida panther.

On January 20, 2009, representatives of the Service, Barron Collier Incorporated, and Wilson-Miller Incorporated, participated in a conference call to discuss issues related to the panther habitat compensation parcel proposed to minimize impacts of the project to the Florida panther.

In a email to the Service dated February 23, 2009, the applicant's consultant, Wilson-Miller Incorporated, provided the additional information requested above regarding wood stork foraging. Based on the additional information provided, the Service concurs with the Corps' determination for the wood stork.

As of February 23, 2009, we have received all the information necessary for initiation of formal consultation on the Florida panther for this project as required in the regulations governing interagency consultations (50 CFR § 402.14). The Service is providing this biological opinion in conclusion of formal consultation.

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

The applicant proposes to widen Oil Well Road (County Road 858) from near Immokalee Road (County Road 846) to approximately 0.5 mile east of Camp Keais Road. The existing two-lane road will be enlarged to four lanes from Immokalee Road to west of Everglades Boulevard, and to six lanes from west of Everglades Boulevard to Camp Keais Road. In addition, connecting portions of Everglades Boulevard, DeSoto Boulevard, and Camp Keais Road will be widened in association with the project. The project will provide new connections to Oil Well Road at 33rd Terrace Northeast, and the Town of Ave Maria and Ave Maria University. The project will also include the construction of nine new stormwater treatment ponds along Oil Well Road, and the use of an existing lake for stormwater treatment within the adjacent Orange Blossom Ranch and the South Grove Lake project site. The project will also include the excavation of a 158.7 acre borrow pit. The existing Camp Keais Strand bridge will be replaced with two vertical box culverts each 12 feet long by 6 feet wide and a new bridge will be constructed 2,518 feet east of the box culverts. The project site is located in Sections 13, 14, 23, and 24, Township 48 South, Range 27 East; Sections 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, and 24, Township 48 South, Range 28 East; and Sections 15, 16, 17, 18, 19, 20, 21, and 22, Township 48 South, Range 29 East in Collier County, Florida (Figure 1).

The Oil Well Road project footprint consists of 364.2 acres of land. The land use and habitat types within the footprint consist of 160.3 acres of existing roadway (pavement), 34.0 acres of surface waters, 11.4 acres of exotic plants, 63.1 acres of croplands, 12.2 acres of orange groves, 40.2 acres of shrub/brush, 1.0 acre of shrub-swamp, 5.3 acres of grassland/pasture, 9.3 acres of cypress swamp, 0.2 acre of hardwood swamp, 10.7 acres of hardwood-pine forest, 16.2 acres of pine forest, and 0.3 acre of hardwood forest.

The Oil Well Road widening project will also impact lands within the 158.7-acre South Grove Lake (SGL) project site. The excavation of fill for development purposes is currently permitted by the Corps on the SGL site under Nationwide Permit number 2006-7350. Fill from the SGL project site will be used to widen Oil Well Road. In addition, the lake system on the SGL site will be part of the stormwater treatment system for the Oil Well Road project. The SGL site consists of 105.5 acres of cropland, 52.7 acres of orange grove, and 0.5 acre of cypress swamp. The SGL site is located adjacent to Oil Well Road in Section 18, Township 48 South, Range 29 East (Figure 2). The Service finds that the activities proposed on the SGL project site are a significant part of the Oil Well Road widening project. Consequently, for the purposes of this biological opinion, we will consider both projects when evaluating the adverse affects of the Oil Well Road widening project to the Florida panther.

Impacts to Wetlands and Proposed Compensation

A total of 49.19 acres of wetlands are proposed to be filled in association with the proposed works. As compensation for impacts to wetlands, the applicant has proposed to conserve and enhance 529.2 acres of land in Camp Keais Strand, hereafter known as the Camp Keais Strand Wetland Mitigation Site (CKSWMS). The CKSWMS is owned by Barron Collier Incorporated and located immediately north of Oil Well Road in Section 12 and 13, Township 48 South, Range 28 East, and Sections 7 and 18, Township 48 South, Range 29 East in Collier County, Florida (Figure 3). The CKSWMS currently consists of 2.64 acres of pine flatwoods, 1.53 acres of cabbage palm (*Sabal palmetto*), 5.42 acres of Carolina willow (*Salix caroliniana*) with cattail (*Typha domingensis*) and primrose willow (*Ludwigia peruviana*), 410.47 acres of cypress swamp with 1 percent to 49 percent cover of Brazilian pepper (*Schinus terebinthifolius*), 24.93 acres of pine-cypress-cabbage palm with 1 percent to 75 percent cover of Brazilian pepper, 28.8 acres of mixed hardwoods with 10 percent to 50 percent cover of Brazilian pepper, 1.19 acres of wetland scrub, 29.47 acres of primrose willow, and 26.66 acres of freshwater marsh with cattail and primrose willow.

A variety of wetland enhancement activities have been proposed within the CKSWMS. Improvement of hydrologic flow will occur through the construction of the new bridge and double box culverts described above, and the breaching of 1,778 feet of berm located in the northeast portion of the site (Figure 3). An initial treatment of the site with herbicides and hand removal will occur to eradicate invasive and exotic vegetation. Maintenance of invasive and exotic vegetation will occur in perpetuity as determined by annual inspections of the site. Invasive and exotic vegetation will account for no more than 5 percent of total plant cover. Supplemental planting of native wetland plant species will occur in the northeast section of the CKWWMS if natural recruitment of native vegetation is not observed within 2 years of

establishment. A conservation easement will be placed on the CKSWMS to preserve the land in perpetuity. Barron Collier Incorporated will maintain ownership of the parcel and be responsible for the long-term maintenance and monitoring of the site. The applicant will also provide financial assurance for the long-term monitoring and maintenance of the site in the form of a bond, estimated at $195,250.00, to the South Florida Water Management District.

The proposed wetland mitigation at the CKSWMS will provide 44.21 functional units, as defined by the State of Florida's Uniform Mitigation Method, to offset the 28.76 functional units of wetlands lost due to the project. The surplus of 15.45 functional units at the CKSWMS will be available to the applicant to compensate for the wetland losses associated with future development projects. The CKSWMS is proposed as compensation for impacts to wetlands only, and is not intended as compensation for the project's adverse affects to the Florida panther (as discussed below).

Adverse Effect to the Florida Panther and Proposed Compensation

The project occurs within the Service's "Focus Area" (Figure 4) of the endangered Florida panther. The Focus Area is based, in part, on the latest scientific information on panther habitat usage provided in Kautz et al. 2006, and Thatcher et al. 2006, and denotes areas in Florida where development projects could potentially affect the panther. The project is also located in the "Primary" and the "Secondary" zones of the Florida panther (Kautz et al. 2006)(Figure 5). The project site provides habitat suitable for panther feeding and dispersal. The footprints of the Oil Well Road widening project and the SGL project collectively total 522.9 acres. Of the 522.9 total acres, the Service finds that 328.6 acres (169.9 acres within the Oil Well Road corridor, and 158.7 acres with the SGL project site) currently provide habitat types suitable for the panther. The 194.3 acres of unsuitable habitat types are comprised of existing roadway pavement and surface waters. Therefore, the project will result in the loss of 328.6 acres of suitable panther habitat. The Service has determined that the 328.6 acres of panther habitat to be impacted provide a total of 3,162.2 Panther Habitat Units (PHUs) (Table 11, page 89) (Please also see page 40).

The applicant has proposed to minimize the adverse effects of the loss of panther habitat resulting from the project by enhancing and preserving a 363.7-acre parcel owned by Barron Collier Incorporated located in Section 21 Township 52, Range 29 East in Collier County, Florida (Figures 1 and 6). The compensation site is located in the panther Primary Zone defined by Kautz et al. (2006). The compensation site consists of 8.9 acres of surface waters, 3.1 acres of exotic plants, 226.4 acres of freshwater marsh, and 117.3 acres of hardwood-pine forest, and will provide 3,183.9 PHUs (Table 11, page 89). Barron Collier Incorporated will conduct an initial treatment of the site to remove invasive exotic vegetation plant species, as defined by the Florida Exotic Pest Plant Council's Pest Plant List Committee's (2007). Barron Collier Incorporated will donate this parcel to the State of Florida to be incorporated into the Fakahatchee Strand Preserve State Park. The donation will occur within 1 year of the issuance of the Corps' permit for the project. Barron Collier Incorporated will also provide a non-wasting management trust fund adequate to provide for the management and maintenance of the parcel in perpetuity within 1 year of the issuance of the Corps' permit for the project. The non-wasting management trust fund will be donated to the Friends of the Park, or other agent agreeable to the Service, who will administer the fund to ensure long-term management of the parcel is achieved.

To minimize the potential for vehicle collisions with panthers and to minimize the potential for panther habitat fragmentation resulting from the project, the applicant will also construct two wildlife crossings (each 8 feet by 24 feet) within the Camp Keais Strand (Figure 7). The approximate location of the crossings will be latitude 26.2939, longitude -81.4753, and latitude 26.2939, longitude -81.4688. Ten-foot tall chain link fencing, with barbed wire at the top, will be installed immediately north and south of the roadway (Figure 7). The purpose of the fencing is to funnel panthers to the crossing sites and prevent panthers from entering the roadway within the Camp Keais Strand. The fencing immediately north of the roadway will extend from Oil Grade Road to a point approximately 1.38 miles to the east, and a 100 foot spur of fence will also extend roughly northward at each terminus. The fencing north of the roadway will border wetlands within the Camp Keais Strand and a parcel of agricultural fields that is slated to be restored to native habitat types in association with the Ave Maria project (Figure 7). The fencing immediately south of the roadway will extend from Oil Grade Road to a point approximately 1.62 miles to the east and a 100 foot spur of fence will also extend roughly southward at each terminus.

The proposed compensation plan provides habitat preservation and restoration near the project area, and benefits the survival and recovery of the Florida panther as referenced in the draft Panther Recovery Plan (Service 2006b) goal 1.1.1.2.3. This goal recommends habitat preservation and restoration within the Primary Zone be provided in situations where land use intensification can not be avoided. The applicant has proposed equivalent habitat protection and restoration, to compensate for both the quantity and functional value of the lost habitat.

Panther Habitat Impact and Compensation Summary:

	Wetlands (acres)	**Surface Waters (acres)**	**Uplands (acres)**	**Total (acres)**
Impacts				
Roadway Corridor Impacts	49.2	34.0	86.7	169.9
SGL Project Site impacts	0.5	0.0	158.2	158.7
Total Project Site	49.7	34.0	244.9	328.6
Habitat Compensation				
Collier County Parcel	232.5	8.9	122.3	363.7

Total Florida panther Habitat Impacts: 328.6 acres within 522.9-acre Oil Well Roadway Corridor and SGL Project Site

Florida panther Habitat Compensation: 363.7 acres within off-site parcel

Action Area

The Service's Focus Area for the Florida panther includes lands in Charlotte, Glades, Hendry, Lee, Collier, Palm Beach, Broward, Miami-Dade, and Monroe Counties, as well as the southern

portion of Highlands County (Figure 4). Developed urban coastal areas in eastern Palm Beach, Broward, and Miami-Dade Counties, and in western Charlotte, Lee, and Collier Counties were excluded because they contain little or no panther habitat and it is unlikely that panthers would use these areas.

Movements of Florida panthers are much larger than the project site and, therefore, the Service's action area is larger than the proposed action area identified by the Corps' public notice. The action area, which is a subset of the current panther range, includes those lands where the Service expects panthers may experience direct and indirect effects from the proposed development. Maehr et al. (1990a) monitored five solitary panthers continuously for 130-hour periods seasonally from 1986 to 1989, rarely observing measurable shifts in location during the day, but nocturnal shifts in location exceeding 20.0 kilometers (km) (12.4 miles) were not unusual. Maehr et al. (2002a) in a later report documented a "mean maximum dispersal distance" of 68.1 km (42.3 miles) for subadult males and 20.3 km (12.6 miles) for subadult females. In the same report Maehr et al. (2002a) documented a "mean dispersal distance" of 37.3 km (23.1 miles) for subadult males. Comiskey et al. (2002) documented a "mean dispersal distance" for subadult male panthers as an average distance of 40.1 km (24.9 miles) from their natal range, which is similar to the dispersal distance referenced by Maehr et al. (2002a).

Therefore, for both direct and indirect effects, the Service defines the action area (Figure 8) as all lands within a 25-mile radius of the project, which is slightly greater than the mean dispersal distance for subadult males. This action area does not include urban lands or lands west of I-75. This action area includes lands anticipated to sustain direct and indirect effects, such as roadways experiencing increased traffic, lands with increased human disturbance (project area and periphery of project), and lands where habitat fragmentation and intraspecific aggression may occur.

STATUS OF THE SPECIES AND CRITICAL HABITAT RANGEWIDE

Status - Panther Biology/Ecology

The Florida panther is the last subspecies of *Puma* (also known as mountain lion, cougar, panther, or catamount) still surviving in the eastern United States. Historically occurring throughout the southeastern United States (Young and Goldman 1946), today the panther is restricted to less than 5 percent of its historic range in one breeding population of less than 100 animals, located in south Florida.

When Europeans first came to this country, pumas roamed most all of North, Central, and South America. Early settlers attempted to eradicate pumas by every means possible. By 1899, it was felt Florida panthers had been restricted to peninsular Florida (Bangs 1899). By the late 1920s to mid 1930s, it was thought by many the Florida panther had been completely eliminated (Tinsley 1970). In 1935, Dave Newell, a Florida sportsman, hired Vince and Ernest Lee, Arizona houndsmen, to hunt for panthers in Florida. They killed eight in the Big Cypress Swamp (Newell 1935). Every survey conducted since then has confirmed a panther population occurs in southern Florida south of the Caloosahatchee River, and no survey since then has been able to confirm a panther population outside of southern Florida.

Attempts to eradicate panthers and a decline in panther prey (primarily white-tailed deer) resulted in a panther population threatened with extinction. Prior to 1949, panthers could be killed in Florida at any time of the year. In 1950, the Florida Game and Freshwater Fish Commission (now the Florida Fish and Wildlife Conservation Commission [FWC]) declared the panther a regulated game species due to concerns over declining numbers. The FWC removed panthers from the game animal list in 1958 and gave them complete legal protection. On March 11, 1967, the Service listed the panther as endangered (32 FR 4001) throughout its historic range, and these animals received Federal protection under the passage of the Act. In addition, the Florida Panther Act (State Statute 372.671), a 1978 Florida State law, made killing a panther a felony. The Florida panther is listed as endangered by the States of Florida, Georgia, Louisiana, and Mississippi.

Since the panther was designated as an endangered species prior to enactment of the Act, there was no formal listing package identifying threats to the species as required by section 4(a)(1) of the Act. However, the technical/agency draft of the Florida Panther Recovery Plan, third revision, addressed the five-factor threats analysis (Service 2006a). No critical habitat has been designated for the panther.

Taxonomy

The Florida panther was first described by Charles B. Cory in 1896 as *Felis concolor floridana* (Cory 1896). The type specimen was collected in Sebastian, Florida. Bangs (1899), however, believed that the Florida panther was restricted to peninsular Florida and could not intergrade with other *Felis* spp. Therefore, he assigned it full specific status and named it *Felis coryi* since *Felis floridana* had been used previously for a bobcat (*Lynx rufus*). The taxonomic classification of the *Felis concolor* group was revised and described by Nelson and Goldman (1929), Young, and Goldman (1946). These authors differentiated 30 subspecies using geographic and morphometric (measurement of forms) criteria and reassigned the Florida panther to subspecific status as *Felis concolor coryi*. This designation also incorporated *F. arundivaga*, which had been classified by Hollister (1911) from specimens collected in Louisiana, into *F. c. coryi*. Nowell and Jackson (1996) reviewed the genus *Felis* and placed mountain lions, including the Florida panther, in the genus *Puma*.

Culver et al. (2000) examined genetic diversity within and among the described subspecies of *Puma concolor* using three groups of genetic markers and proposed a revision of the genus to include only six subspecies, one of which encompassed all puma in North America including the Florida panther. However, Culver et al. (2000) determined that the Florida panther was one of several smaller populations that had unique features. Specifically, the number of polymorphic microsatellite loci and amount of variation were lower, and it was highly inbred (eight fixed loci). The degree to which the scientific community has accepted the results of Culver et al. (2000) and the proposed change in taxonomy is not resolved at this time. The Florida panther remains listed as a subspecies and continues to receive protection pursuant to the Act.

Species Description

An adult Florida panther is unspotted and typically rusty reddish-brown on the back, tawny on the sides, and pale gray underneath. There has never been a melanistic (black) puma

documented in North America (Tinsley 1970, 1987). Adult males can reach a length of 7 feet (ft) (2.1 meters [m]) from their nose to the tip of their tail and may exceed 161 pounds (lbs) (73 kg) in weight; but, typically adult males average around 116 lbs (52.6 kg) and stand about 24-28 inches (in) (60-70 centimeters [cm]) at the shoulder (Roelke 1990). Female panthers are smaller with an average weight of 75 lbs (34 kg) and length of 6 ft (1.8 m) Roelke 1990). The skull of the Florida panther is unique in that it has a broad, flat, frontal region, and broad, high-arched or upward-expanded nasal bones (Young and Goldman 1946).

Florida panther kittens are gray with dark brown or blackish spots and five bands around the tail. The spots gradually fade as the kittens grow older and are almost unnoticeable by the time they are 6 months old. At this age, their bright blue eyes slowly turn to the light-brown straw color of the adult (Belden 1988).

Three external characters – a right angle crook at the terminal end of the tail, a whorl of hair or cowlick in the middle of the back, and irregular, white flecking on the head, nape, and shoulders – not found in combination in other subspecies of *Puma* (Belden 1986), were commonly observed in Florida panthers through the mid-1990s. The kinked tail and cowlicks were considered manifestations of inbreeding (Seal 1994); whereas the white flecking was thought to be a result of scarring from tick bites (Maehr 1992, Wilkins et al. 1997). Four other abnormalities prevalent in the panther population prior to the mid-1990s were cryptorchidism (one or two undescended testicles), low sperm quality, atrial septal defects (the opening between two atria in the heart fails to close normally during fetal development), and immune deficiencies; and these were suspected to be the result of low genetic variability (Roelke et al. 1993a).

A plan for genetic restoration and management of the Florida panther was developed in September 1994 (Seal 1994) and eight non-pregnant adult female Texas panthers (*Puma concolor stanleyana*) were released in five areas of south Florida from March to July 1995. Since this introgression, rates of genetic defects, including crooked tails and cowlicks, have dramatically decreased (Land et al. 2004). In addition, to date, neither atrial septal defects nor cryptorchidism have been found in introgressed panthers (M. Cunningham, FWC, pers. comm. 2005). As of January 27, 2003, none of the eight female Texas panthers introduced in 1995 remain in the wild.

Population Trends and Distribution

The Florida panther once ranged throughout the southeastern United States from Arkansas and Louisiana eastward across Mississippi, Alabama, Georgia, Florida, and parts of South Carolina and Tennessee (Young and Goldman 1946). Historically, the panther intergraded to the north with *P. c. cougar*, to the west with *P. c. stanleyana*, and to the northwest with *P. c. hippolestes* (Young and Goldman 1946).

Although generally considered unreliable, sightings of panthers regularly occur throughout the Southeast. However, no reproducing populations of panthers have been found outside of south Florida for at least 30 years, despite intensive searches to document them (Belden et al. 1991, McBride et al. 1993, Clark et al. 2002). Survey reports and more than 70,000 locations of radio-collared panthers recorded between 1981 and 2004 clearly define the panther's current

breeding range. Reproduction is known only in the Big Cypress Swamp/Everglades physiographic region in Collier, Lee, Hendry, Miami-Dade, and Monroe Counties, south of the Caloosahatchee River (Belden et al. 1991). Although the breeding segment of the panther population occurs only in south Florida, panthers have been documented north of the Caloosahatchee River over 125 times since February 1972. This has been confirmed through field signs (*e.g.*, tracks, urine markers, scats), camera-trap photographs, seven highway mortalities, four radio-collared animals, two captured animals (one of which was radiocollared), and one skeleton. From 1972 through 2004, panthers have been confirmed in 11 counties (Flagler, Glades, Highlands, Hillsborough, Indian River, Okeechobee, Orange, Osceola, Polk, Sarasota, and Volusia) north of the river (Belden et al. 1991, Belden and McBride 2005). However, no evidence of a female or reproduction has been documented north of the Caloosahatchee River since 1973 (Nowak and McBride 1974, Belden et al. 1991, Land and Taylor 1998, Land et al. 1999, Shindle et al. 2000, McBride 2002, Belden and McBride 2005).

Puma are wide ranging, secretive, and occur at low densities. However, their tracks, urine markers, and scats are readily found by trained observers, and resident populations are easily located. Van Dyke (1986a) determined all resident puma, 78 percent of transient puma, and 57 percent of kittens could be detected by track searches in Utah. In south Florida, the Florida panther's limited range and low densities may make the population count derived from track searches more accurate than in Utah. During 2 month-long investigations – one late in 1972 and early 1973 and another in 1974 – funded by the World Wildlife Fund to determine if panthers still existed in Florida, McBride searched for signs of panthers in portions of south Florida. In 1972, McBride authenticated a road-killed male panther in Glades County and a female captured and released from a bobcat trap in Collier County (R. McBride, Livestock Protection Company, pers. comm. 2005). In 1973, McBride captured one female in Glades County (Nowak and McBride 1974). Based on this preliminary evidence, Nowak and McBride (1974) estimated the "population from the Lake Okeechobee area southward to be about 20 or 30 individuals." In 1974, McBride found evidence of only two additional panthers in the Fakahatchee Strand and suggested "there could be as few as ten individuals panthers in the area around Lake Okeechobee and southward in the state" (Nowak and McBride 1975). This initial survey, while brief in nature, proved that panthers still existed in Florida and delineated areas where a more exhaustive search was warranted. After this initial investigation, more comprehensive surveys on both public and private lands were completed (Reeves 1978; Belden and McBride 1983a, b; Belden et al. 1991). Thirty individual panthers were identified during a wide-ranging survey in 1985 in south Florida (McBride 1985).

Maehr et al. (1991) provides the only published estimate of population density based on a substantial body of field data (Beier et al. 2003). Maehr et al. (1991) estimated a density of one panther per 27,520 acres [11,137 hectares (ha)] based on 17 concurrently radio-collared and 4 uncollared panthers. They extrapolated this density to the area occupied (1,245,435 acres [504,012 ha]) by radio-collared panthers during the period 1985-1990 to achieve a population estimate of 46 adult panthers for southwest Florida (excluding Everglades National Park [ENP], eastern Big Cypress National Preserve [BCNP], and Glades and Highlands Counties). Beier et al. (2003), however, argued that this estimate of density, although "reasonably rigorous," could not be extrapolated to other areas because it was not known whether densities were comparable in those areas.

More recently, McBride (2000, 2001, 2002, 2003) reported minimum population counts (*i.e.*, number known alive) based on panthers treed with hounds, physical evidence (*e.g.*, tracks where radio-collared panthers were not known to occur), documentation by trail-camera photos, and sightings of uncollared panthers by a biologist or pilot from a monitoring plane or via ground telemetry. He counted adults and subadult panthers but not kittens at the den.

The population estimate in 2000 was 62 panthers (McBride 2000), with estimates of 78 in 2001 (McBride 2001), 80 in 2002 (FWC 2002), 87 in 2003 (FWC 2003), 78 in 2004 (R. McBride, Personal Communication, 2006), 82 in 2005 (R. McBride, Personal Communication, 2006), 97 in 2006 (R. McBride, Personal Communication, 2006), and 117 in 2007 (R. McBride, Personal Communication, 2008) and 104 (R. McBride, Personal Communication 2009). The 3-year running average of the verified panther population shows an annual increase in the population over the reported years.

Life History

Reproduction: Male Florida panthers are polygynous, maintaining large, overlapping home ranges containing several adult females and their dependent offspring. The first sexual encounters for males normally occur at about 3 years based on 26 radio-collared panthers of both sexes (Maehr et al. 1991). Based on genetics work, some males may become breeders as early as 17 months. Breeding activity peaks from December to March (Shindle et al. 2003). Litters (n = 82) are produced throughout the year, with 56-60 percent of births occurring between March and June (Jansen et al. 2005, Lotz et al. 2005). The greatest number of births occurs in May and June (Jansen et al. 2005, Lotz et al. 2005). Female panthers have bred as young as 18 months (Maehr et al. 1989) and successful reproduction has occurred up to 11 years old. The mean age of denning females is 4.6 ± 2.1 (standard deviation [sd]) years (Lotz et al. 2005). Age at first reproduction for 19 known-aged female panthers averaged 2.2 ± 0.246 (sd) years and ranged from 1.8-3.2 years. Average litter size is 2.4 ± 0.91 (sd) kittens. Seventy percent of litters are comprised of either two or three kittens. Mean birth intervals (elapsed time between successive litters) are 19.8 ± 9.0 (sd) months for female panthers (n = 56) (range 4.1-36.5 months) (Lotz et al. 2005). Females that lose their litters generally produce another more quickly; five of seven females whose kittens were brought into captivity successfully produced another litter an average of 10.4 months after the removal of the initial litter (Land 1994).

Den sites are usually located in dense, understory vegetation, typically saw palmetto (Maehr 1990, Shindle et al. 2003). Den sites are used for up to two months by female panthers and their litters from birth to weaning. Independence and dispersal of young typically occurs at 18 months, but may occur as early as one year (Maehr 1992).

Survivorship and Causes of Mortality: Mortality records for uncollared panthers have been kept since February 13, 1972, and for radio-collared panthers since February 10, 1981. Through January 14, 2007, 210 mortalities have been documented, with 96 (45.7 percent) of known deaths occurring in the past 5 years (FWC 2007, FWC unpublished data). Documented mortality averaged 3.8 per year through December 2002, and 18.2 per year from January 2003 through December 2007. Of the 210 total mortalities, 116 were radio-collared panthers that have

died since 1981 (FWC 2007, FWC unpublished data). From 1990-2004, mean annual survivorship of radio-collared adult panthers was greater for females (0.894 ± 0.099 sd) than males (0.779 ± 0.125 sd) (Lotz et al. 2005). Except for intraspecific aggression, the causes of mortality were found to be independent of gender (Lotz et al. 2005).

Intraspecific aggression was the leading cause of death for radio-collared panthers, accounting for 42 percent (Jansen et al. 2005, Lotz et al. 2005). Most intraspecific aggression occurs between male panthers; but, aggressive encounters between males and females have occurred, resulting in the death of the female. Defense of kittens and\or a kill is suspected in half (5 of 10) of the known instances through 2003 (Shindle et al. 2003).

Unknown causes and collisions with vehicles accounted for 24 and 19 percent of radio-collared panther mortalities, respectively. From February 13, 1972, through June 30, 2007, Florida panther vehicular trauma (n = 112) averaged 3.1 per year for radio-collared and uncollared panthers (FWC 2007). Eight of the collisions were not fatal. Since the publication of the 2006-2007 report (FWC 2007), one additional panther was killed by a vehicle in September 2007 (FWC, unpublished data), bringing the total to 113 panthers killed or injured by vehicles.

Female panthers are considered adult residents if they are older than 18 months, have established home ranges and bred (Maehr et al. 1991). Land et al. (2004) reported that 23 of 24 female panthers first captured as kittens survived to become residents and 18 (78.3 percent) produced litters; one female was too young to determine residency. Male panthers are considered adult residents if they are older than 3 years and have established a home range that overlaps with females. Thirty-one male panthers were captured as kittens and 12 (38.7 percent) of these cats survived to become residents (Jansen et al. 2005, Lotz et al. 2005). "Successful male recruitment appears to depend on the death or home-range shift of a resident adult male" (Maehr et al. 1991). Turnover in the breeding population is low with documented mortality in radio-collared panthers being greatest in subadults and non-resident males (Maehr et al. 1991, Shindle et al. 2003).

Den sites of female panthers have been visited since 1992 and the number of kittens that survived to 6 months for 38 of these litters has been documented. Florida and introgressed panther kitten survival to 6 months were estimated to be 52 and 72 percent, respectively, but were not significantly different (P = 0.2776) (Lotz et al. 2005). Survival of kittens greater than 6 months old was determined by following the fates of 55 radio-collared dependent-aged kittens, including 17 introgressed panthers, from 1985 through 2004. Only one of these 55 kittens died before reaching independence, resulting in a 98.2 percent survival rate (Lotz et al. 2005). The FWC and NPS are continuing to compile and analyze existing reproductive and kitten data.

Dispersal: Panther dispersal begins after a juvenile becomes independent from its mother and continues until it establishes a home range. Dispersal distances are greater for males (n = 18) than females (n = 9) (42.5 mi [68.4 km] vs. 12.6 mi [20.3 km], respectively) and the maximum dispersal distance recorded for a young male was 139.2 mi (224.1 km) over a 7-month period followed by a secondary dispersal of 145 mi (233 km) (Maehr et al. 2002a). Males disperse an average distance of 25 mi (40 km); females typically remain in or disperse short distances from their natal ranges (Comiskey et al. 2002). Female dispersers are considered philopatric because

they usually establish home ranges less than one average home range width from their natal range (Maehr et al. 2002a). Maehr et al. (2002a) reported all female dispersers (n = 9) were successful at establishing a home range whereas only 63 percent of males (n = 18) were successful. Young panthers become independent at 14 months on average for both sexes, but male dispersals are longer in duration than female dispersals (9.6 months and 7.0 months, respectively) (Maehr et al. 2002a). Dispersing males usually go through a period as transient (non-resident) subadults, moving through the fringes of the resident population and often occupying suboptimal habitat until an established range becomes vacant (Maehr 1997).

Most panther dispersal occurs south of the Caloosahatchee River with only four radio-collared panthers crossing the river and continuing north since 1981 (Land and Taylor 1998, Land et al. 1999, Shindle et al. 2000, Maehr et al. 2002a, Belden and McBride 2005). Western subspecies of *Puma* have been documented crossing wide, swift-flowing rivers up to a mile in width (Seidensticker et al. 1973, Anderson 1983). The Caloosahatchee River, a narrow (295-328 ft [90-100 m]), channelized river, probably is not a significant barrier to panther movements, but the combination of the river, State Route (SR) 80, and land uses along the river seems to have restricted panther dispersal northward (Maehr et al. 2002a). Documented physical evidence of at least 15 other uncollared male panthers have been confirmed north of the river since 1972, but no female panthers nor reproduction have been documented in this area since 1973 (Belden and McBride 2005).

Home Range Dynamics and Movements: Panthers require large areas to meet their needs. Numerous factors influence panther home range size, including: habitat quality, prey density, and landscape configuration (Belden 1988, Comiskey et al. 2002). Home range sizes of 6 radio-collared panthers monitored between 1985 and 1990 averaged 128,000 acres (51,800 ha) for resident adult males and 48,000 acres (19,425 ha) for resident adult females; transient males had a home range of 153,599 acres (62,160 ha) (Maehr et al. 1991). Comiskey et al. (2002) examined the home range size for 50 adult panthers (residents greater than 1.5 years old) monitored in south Florida from 1981-2000 and found resident males had a mean home range of 160,639 acres (65,009 ha) and females had a mean home range of 97,920 acres (39,627 ha). Beier et al. (2003) found home range size estimates for panthers reported by Maehr et al. (1991) and Comiskey et al. (2002) to be reliable. Annual minimum convex polygon home range sizes of 52 adult radio-collared panthers monitored between 1998 and 2002 ranged from 15,360 – 293,759 acres (6,216 – 118,880 ha), averaging 89,600 acres (36,260 ha) for 20 resident adult males and 44,160 acres (17,871 ha) for 32 resident adult females (Land et al. 1999, Shindle et al. 2000, Shindle et al. 2001, Land et al. 2002). The most current estimate of home-range sizes (minimum convex polygon method) for established, non-dispersing, adult, radio-collared panthers averaged 29,056 acres (11,759 ha) for females (n = 11) and 62,528 acres (25,304 ha) for males (n = 11) (Lotz et al. 2005). The average home range was 35,089 acres (14,200 ha) for resident females (n = 6) and 137,143 acres (55,500 ha) (n = 5) for males located at BCNP (Jansen et al. 2005). Home ranges of resident adults tend to be stable unless influenced by the death of other residents; however, several males have shown significant home range shifts that may be related to aging. Home-range overlap is extensive among resident females and limited among resident males (Maehr et al. 1991).

Activity levels for Florida panthers are greatest at night with peaks around sunrise and after sunset (Maehr et al. 1990a). The lowest activity levels occur during the middle of the day. Female panthers at natal dens follow a similar pattern with less difference between high and low activity periods.

Telemetry data indicate panthers typically do not return to the same resting site day after day, with the exception of females with dens or panthers remaining near kill sites for several days. The presence of physical evidence such as tracks, scats, and urine markers confirm that panthers move extensively within home ranges, visiting all parts of the range regularly in the course of hunting, breeding, and other activities (Maehr 1997, Comiskey et al. 2002). Males travel widely throughout their home ranges to maintain exclusive breeding rights to females. Females without kittens also move extensively within their ranges (Maehr 1997). Panthers are capable of moving large distances in short periods of time. Nightly panther movements of 12 mi (20 km) are not uncommon (Maehr et al. 1990a).

Intraspecific Interactions: Interactions between panthers occur indirectly through urine markers or directly through contact. Urine markers are made by piling ground litter using a backwards-pushing motion with the hind feet. This pile is then scent-marked with urine and occasionally feces. Both sexes make urine markers. Apparently, males use them as a way to mark their territory and announce presence while females advertise their reproductive condition.

Adult females and their kittens interact more frequently than any other group of panthers. Interactions between adult male and female panthers last from one to seven days and usually result in pregnancy (Maehr et al. 1991). Aggressive interactions between males often result in serious injury or death. Independent subadult males have been known to associate with each other for several days and these interactions do not appear to be aggressive in nature. Aggression between males is the most common cause of male mortality and an important determinant of male spatial and recruitment patterns based on radio-collared panthers (Maehr et al. 1991, Shindle et al. 2003). Aggressive encounters between radio-collared males and females also have been documented (Shindle et al. 2003, Jansen et al. 2005).

Food Habits: Primary panther preys are white-tailed deer (*Odocoileus virginianus*) and feral hog (*Sus scrofa*) (Maehr et al. 1990b, Dalrymple and Bass 1996). Generally, feral hogs constitute the greatest biomass consumed by panthers north of the Alligator Alley section of I-75, while white-tailed deer are the greatest biomass consumed to the south (Maehr et al. 1990b). Secondary prey includes raccoons (*Procyon lotor*), nine-banded armadillos (*Dasypus novemcinctus*), marsh rabbits (*Sylvilagus palustris*) (Maehr et al. 1990b) and alligators (*Alligator mississippiensis*) (Dalrymple and Bass 1996). No seasonal variation in diet has been detected. A resident adult male puma generally consumes one deer-sized prey every 8 to11 days; this frequency would be 14 to 17 days for a resident female; and 3.3 days for a female with three 13-month-old kittens (Ackerman et al. 1986). Maehr et al. (1990b) documented domestic livestock infrequently in scats or kills, although cattle were readily available on their study area.

Infectious Diseases, Parasites, and Environmental Contaminants:
Viral Diseases - Feline leukemia virus (FeLV) is common in domestic cats (*Felis catus*), but is quite rare in non-domestic felids. Routine testing for FeLV antigen (indicating active infection)

in captured and necropsied panthers was negative from 1978 (when testing began) to the fall of 2002. Between November 2002 and February 2003, however, two panthers tested FeLV antigen positive (Cunningham 2005). The following year, three more cases were diagnosed. All infected panthers had overlapping home ranges in the Okaloacoochee Slough ecosystem. Three panthers died due to suspected FeLV-related diseases (opportunistic bacterial infections and anemia) and the two others died from intraspecific aggression. Testing of serum samples collected from 1990-2005 for antibodies (indicating exposure) to FeLV indicated increasing exposure to FeLV beginning in the late 1990s and concentrated north of I-75. There was apparently minimal exposure to FeLV during this period south of I-75. Positive antibody titers in different areas at different times may indicate that multiple introductions of the virus into the panther population may have occurred. These smaller epizootics were apparently self-limiting and did not result in any known mortalities. Positive antibody titers, in the absence of an active infection (antigen positive), indicate panthers can be exposed and overcome the infection (Cunningham 2005). Management of the disease includes vaccination as well as removal of infected panthers to captivity for quarantine and supportive care. As of June 1, 2005, about one-third of the population had received at least one vaccination against FeLV (FWC and NPS, unpublished data). No new positive cases have been diagnosed since July 2004.

Pseudorabies virus (PRV) (Aujeszky's disease) causes respiratory and reproductive disorders in adult hogs and mortality in neonates, but is a rapidly fatal neurologic disease in carnivores. At least one panther died from PRV infection presumably through consumption of an infected feral hog (Glass et al. 1994). At least one panther has also died of rabies (Taylor et al. 2002). This panther was radiocollared but not vaccinated against the disease.

Feline immunodeficiency virus (FIV) is a retrovirus of felids that is endemic in the panther population. About 28 percent of Florida panthers were positive for antibodies to the puma lentivirus strain of FIV (Olmstead et al. 1992); however, the prevalence may be increasing. Between November 2004 and April 2005, 13 of 17 (76 percent) panthers tested were positive (M.Cunningham, FWC, unpublished data). The cause of this increase is unknown but warrants continued monitoring and investigation. There is also evidence of exposure to Feline panleukopenia virus (PLV) in adult panthers (Roelke et al. 1993b) although no PLV-related mortalities are known to have occurred.

Serological evidence of other viral diseases in the panther population includes feline calicivirus, feline herpes virus, and West Nile virus (WNV). However, these diseases are not believed to cause significant morbidity or mortality in the population. All panthers found dead due to unknown causes are tested for alphaviruses, flaviviruses (including WNV), and canine distemper virus. These viruses have not been detected in panthers by viral culture or polymerase chain reaction (FWC, unpublished data).

Other Infectious Diseases - Bacteria have played a role in free-ranging panther morbidity and mortality as opportunistic pathogens, taking advantage of pre-existing trauma or FeLV infections (FWC, unpublished data). Dermatophytosis (ringworm infection) has been diagnosed in several panthers and resulted in severe generalized infection in at least one (Rotstein et al. 1999). Severe infections may reflect an underlying immunocompromise, possibly resulting from inbreeding depression or immunosuppressive viral infections.

Parasites - The hookworm, *Ancylostoma pluridentatum,* is found in a high prevalence in the panther population. Other parasites identified from live-captured or necropsied panthers include: eight arthropod species, eight nematode species, three cestode species, two trematode species, and three protozoa species (Forrester et al. 1985, Forrester 1992, Wehinger et al. 1995, Rotstein et al. 1999, Land et al. 2002). Of these, only an arthropod, *Notoedres felis*, caused significant morbidity in at least one panther (Maehr et al. 1995).

Environmental Contaminants - Overall, mercury in south Florida biota has decreased over the last several years (Frederick et al. 2002). However, high mercury concentrations are still found in some panthers. At least one panther is thought to have died of mercury toxicosis and mercury has been implicated in the death of two other panthers in ENP (Roelke 1991). One individual panther had mercury concentrations of 150 parts per million (ppm) in its hair (Land et al. 2004). Elevated levels of p, p'– DDE were also detected in fat from that panther. The role of mercury and/or p, p'– DDE in this panther's death is unknown and no cause of death was determined despite extensive diagnostic testing. Elevated mercury concentrations have also been found in panthers from Florida Panther National Wildlife Refuge (FPNWR). Two sibling neonatal kittens from this area had hair mercury concentrations of 35 and 40 ppm. Although other factors were believed to have been responsible, these kittens did not survive to leave their natal den. Consistently high hair mercury values in ENP and FPNWR and the finding of elevated values in some portions of BCNP warrant continued monitoring (Land et al. 2004). Other environmental contaminants found in panthers include polychlorinated biphenyls (Arochlor 1260) and organochlorines (p, p'–DDE) (Dunbar 1995, Land et al. 2004).

Habitat Characteristics/Ecosystem

Landscape Composition: Noss and Cooperrider (1994) considered the landscape implications of maintaining viable panther populations. Assuming a male home range size of 137,599 acres (55,685 ha) (Maehr 1990), an adult sex ratio of 50:50 (Anderson 1983), and some margin of safety, they determined that a reserve network as large as 15,625 - 23,438 mi^2 (40,469 to 60,703 km^2) would be needed to support an effective population size of 50 individuals (equating to an actual adult population of 100 to 200 panthers [Ballou et al. 1989]). However, to provide for long-term persistence based on an effective population size of 500 individuals (equating to 1,000 to 2,000 adult panthers [Ballou et al. 1989]), could require as much as 156,251 to 234,376 mi^2 (404,687 to 607,031 km^2). This latter acreage corresponds to roughly 60 to 70 percent of the Florida panther's historical range. Although it is uncertain, whether this much land is needed for panther recovery, it does provide some qualitative insight into the importance of habitat conservation across large landscapes for achieving a viable panther population (Noss and Cooperrider 1994).

Between 1981 and 2003, more than 55,000 locations were collected from more than 100 radio-collared panthers. Belden et al. (1988), Maehr et al. (1991), Maehr (1997), Kerkoff et al. (2000), and Comiskey et al. (2002) provide information on habitat use based on various subsets of these data. Since almost all data from radio-collars have been collected during daytime hours (generally 0700 to 1100), and because panthers are most active at night (Maehr et al. 1990a), daytime radio locations are insufficient to describe the full range of panther habitat use (Beyer and Haufler 1994, Comiskey et al. 2002, Beier et al. 2003, Dickson et al. 2005, Beier et al. 2006).

A landscape-level strategy for the conservation of the panther population in south Florida was developed using a Florida panther potential habitat model based on the following criteria: (1) forest patches greater than 4.95 acres (2 ha); (2) non-urban cover types within 656 ft (200 m) of forest patches; and (3) exclusion of lands within 984 ft (300 m) of urban areas (Kautz et al. 2006). In developing the model, data from radio-collared panthers collected from 1981 through 2000 were used to evaluate the relative importance of various land cover types as panther habitat, thus identifying landscape components important for panther habitat conservation. Those components were then combined with a least cost path analysis to delineate three panther habitat conservation zones for south Florida: (1) Primary Zone – lands important to the long-term viability and persistence of the panther in the wild; (2) Secondary Zone – lands which few panthers use contiguous with the Primary Zone, but given sufficient habitat restoration could accommodate expansion of the panther population south of the Caloosahatchee River; and (3) Dispersal Zone – the area which may facilitate future panther expansion north of the Caloosahatchee River (Kautz et al. 2006) (Figure 8). The Primary Zone is currently occupied and supports the breeding population of panthers. Although panthers move through the Secondary and Dispersal Zones, they are not permanently occupied. The Secondary Zone could support panthers with sufficient restoration.

These zones vary in size, ownership, and land cover composition. The Primary Zone is 2,270,711 acres (918,928 ha) in size, 73 percent of which is publicly owned, and includes portions of the BCNP, ENP, Fakahatchee Strand Preserve State Park (FSPSP), FPNWR, Okaloacoochee Slough State Forest, and Picayune Strand State Forest. This zone's composition is 45 percent forest, 41 percent freshwater marsh, 7.6 percent agriculture lands, 2.6 percent prairie and shrub lands, and 0.52 percent urban lands (Kautz et al. 2006). The Secondary Zone is 812,157 acres (328,670 ha) in size, 38 percent of which is public land. This zone's composition is 43 percent freshwater marsh, 36 percent agriculture, 11 percent forest, 6.1 percent prairie and shrub lands, and 2.3 percent low-density residential areas and open urban lands (Kautz et al. 2006). The Dispersal Zone is 28,160 acres (11,396 ha) in size, 12 percent of which is either publicly owned or in conservation easement. This zone's composition is 49 percent agriculture (primarily improved pasture and citrus groves), 29 percent forest (wetland and upland), 8.8 percent prairie and shrub land, 7.5 percent freshwater marsh, and 5.1 percent barren and urban lands (Kautz et al. 2006).

As part of their evaluation of occupied panther habitat, in addition to the average density estimate of one panther per 27,181 acres (11,000 ha) developed by Maehr et al. (1991), Kautz et al. (2006) estimated the present average density during the timeframe of the study, based on telemetry and other occurrence data, to average one panther per 31,923 acres (12,919 ha). In the following discussions of the number of panthers that a particular zone may support, the lower number is based on the 31,923 acres (12,919 ha) value (Kautz et al. 2006) and the higher number is based on the 27,181 acres (11,000 ha) value (Maehr et al. 1991).

Based on these average densities, the Primary Zone could support 71 to 84 panthers; the Secondary Zone could support 8 to 10 panthers without habitat restoration and 25 to 30 panthers with habitat restoration (existing high quality panther habitat currently present in the Secondary Zone is estimated at 32 percent of the available Secondary Zone lands); and the Dispersal Zone could support 0 panthers. Taken together, the three zones in their current condition apparently have the capacity to support about 79 to 94 Florida panthers.

Kautz et al.'s (2006) assessment of available habitat south of the Caloosahatchee River determined that non-urban lands in the Primary, Secondary, and Dispersal Zones were not sufficient to sustain a population of 240 individuals south of the Caloosahatchee River. However, Kautz et al. (2006) determined sufficient lands were available south of the Caloosahatchee River to support a population of 79 to 94 individuals (although not all lands are managed and protected).

Even though some suitable panther habitat remains in south-central Florida, it is widely scattered and fragmented (Belden and McBride 2005). Thatcher et al. (2006) used a statistical model in combination with a geographic information system to develop a multivariate landscape-scale habitat model based on the Mahalanobis distance statistic (D^2) to evaluate habitats in south central Florida for potential expansion of the Florida panther population. They identified four potential habitat patches: the Avon Park Bombing Range area, Fisheating Creek/Babcock-Webb Wildlife Management Area, eastern Fisheating Creek, and the Duette Park/Manatee County area. These habitat patches are smaller and more isolated compared with the current Florida panther range, and the landscape matrix where these habitat patches exist provides relatively poor habitat connectivity among the patches (Thatcher et al. 2006). Major highways and urban or agricultural development isolate these habitat patches, and they are rapidly being lost to the same development that threatens southern Florida (Belden and McBride 2005).

Diurnal Habitat Use: Diurnal panther locations appear to be within or closer to forested cover types, particularly cypress swamp, pinelands, hardwood swamp, and upland hardwood forests (Belden 1986, Belden et al. 1988, Maehr 1990, Maehr et al. 1991, Maehr 1992, Smith and Bass 1994, Kerkhoff et al. 2000, Comiskey et al. 2002). Dense understory vegetation comprised of saw palmetto provides some of the most important resting and denning cover for panthers (Maehr 1990). Shindle et al. (2003) shows 73 percent of panther dens were in palmetto thickets.

Radio-collar data and ground tracking indicate that panthers use the mosaic of habitats available to them as resting and denning sites, hunting grounds, and travel routes. These habitats include cypress swamps, hardwood hammocks, pine flatwoods, seasonally flooded prairies, freshwater marshes, and some agricultural lands. Although radio-collar monitoring indicates that forest is a preferred cover type, panthers also utilize non-forest cover types (Belden et al. 1988, Maehr et al. 1991, Comiskey et al. 2002). Compositional analyses by Kautz et al. (2006) confirmed previous findings that forest patches comprise an important component of panther habitat in south Florida, but other natural and disturbed cover types are also present in the large landscapes that support panthers (Belden et al. 1988, Maehr et al. 1991, Comiskey et al. 2002). Kautz et al. (2006) found the smallest class of forest patches (*i.e.*, 9 to 26 acres [3.6 to 10.4 ha]) were the highest ranked forest patch sizes within panther home ranges. This indicates forest patches of all sizes appear to be important components of the landscapes inhabited by panthers, not just the larger forest patches.

Nocturnal Habitat Use: Maehr et al. (1990a) provides the only descriptions of panther nocturnal activities and represents the available radio-collar data collected during night time hours. However, this paper does not provide analyses of nocturnal habitat use. Dickson et al. (2005) examined the movements of 10 female and 7 male puma at 15-minute intervals during 44 nocturnal periods of hunting or traveling in southern California. They found traveling puma

monitored over nocturnal periods used a broader range of habitats than what they appeared to use based on diurnal locations alone. The use of Global Positioning System (GPS) radio-collars is now being investigated to determine if this technology will be suitable to answer questions regarding Florida panther's nocturnal habitat use.

Prey Habitat Use: Panther habitat selection is related to prey availability (Janis and Clark 1999, Dees et al. 2001) and, consequently, prey habitat use. Adequate cover and the size, distribution, and abundance of available prey species are critical factors to the persistence of panthers in south Florida and often determine the extent of panther use of an area. Duever et al. (1986) calculated a deer population of 1,760 in BCNP, based on Harlow (1959) deer density estimates of 1 per 210 acres (85 ha) in pine forest, 1 per 299 acres (121 ha) in swamps, 1 per 1,280 acres (518 ha) in prairie, 1 per 250 acres (101 ha) in marshes, and 1 per 111 acres (45 ha) in hammocks. Schortemeyer et al (1991) estimated deer densities at 1 per 49 to 247 acres (20 to100 ha) in three management units of BCNP based on track counts and aerial surveys. Labisky et al. (1995) reported 1 per 9 acres (20 ha) in southeastern BCNP. Using track counts alone, McCown (1994) estimated 1 per 183 to 225 acres (74 to 91 ha) on the FPNWR and 1 per 133 to 200 acres (54 to 81 ha) in the FSPSP.

Hardwood hammocks and other forest cover types are important habitat for white-tailed deer and other panther prey (Harlow and Jones 1965, Belden et al. 1988, Maehr 1990, Maehr et al. 1991, Maehr 1992, Comiskey et al. 1994, Dees et al. 2001). Periodic understory brushfires (Dees et al. 2001) as well as increased amounts of edge (Miller 1993) may enhance deer use of hardwood hammocks, pine, and other forest cover types. However, wetland and other vegetation types can support high deer densities. In the Everglades, for example, deer appear to be adapted to a mosaic of intergrading patches comprised of wet prairie, hardwood tree islands, and peripheral wetland habitat (Fleming et al. 1994, Labisky et al. 2003). High-nutrient deer forage, especially preferred by females, includes hydrophytic marsh plants, white waterlily (*Nymphaea odorata*), and swamp lily (*Crinum americana*) (Loveless 1959, Labisky et al. 2003). Wetland willow (*Salix spp.*) thickets also provide nutritious browse for deer (Loveless 1959, Labisky et al. 2003).

Marshes, rangeland, and low-intensity agricultural areas support prey populations of deer and hogs. The importance of these habitat types to panthers cannot be dismissed based solely on use or lack of use when daytime telemetry are the only data available (Comiskey et al. 2002, Beier et al. 2003, Comiskey et al. 2004, Beier et al. 2006).

Travel and Dispersal Corridors: In the absence of direct field observations/measurements, Harrison (1992) suggested landscape corridors for wide-ranging predators should be half the width of an average home range size. Following Harrison's (1992) suggestion, corridor widths for Florida panthers would range 6.1 to 10.9 mi (9.8 to17.6 km) depending on whether the target animal was an adult female or a transient male. Beier (1995) suggested corridor widths for transient male puma in California could be as small as 30 percent of the average home range size of an adult. For Florida panthers, this would translate to a corridor width of 5.5 mi (8.8 km). Without supporting empirical evidence, Noss (1992) suggests that regional corridors connecting larger hubs of habitat should be at least 1.0 mi (1.6 km) wide. Beier (1995) makes specific recommendations for very narrow corridor widths based on short corridor lengths in a California

setting of wild lands completely surrounded by urban areas; he recommended that corridors with a length less than 0.5 mi (0.8 km) should be more than 328 ft (100 m) wide, and corridors extending 0.6 to 4 mi (1 to 7 km) should be more than 1,312 ft (400 m) wide. The Dispersal Zone encompasses 44 mi^2 (113 km^2) with a mean width of 3.4 mi (5.4 km). Although it is not adequate to support even one panther, the Dispersal Zone is strategically located and expected to function as a critical landscape linkage to south-central Florida (Kautz et al. 2006). Transient male panthers currently utilize this zone as they disperse northward into south-central Florida.

Panther Recovery Objectives

The recovery objectives identified in the draft third revision of the Florida Panther Recovery Plan (Service 2006a) are to: (1) maintain, restore, and expand the Florida panther population and its habitat in south Florida and, if feasible, expand the known occurrence of Florida panthers north of the Caloosahatchee River to maximize the probability of the long-term persistence of this metapopulation; (2) identify, secure, maintain, and restore habitat in potential reintroduction areas within the panther's historic range, and to establish viable populations of the panther outside south and south-central Florida; and (3) facilitate panther conservation and recovery through public awareness and education.

Panther Management and Conservation

Habitat Conservation and Protection

Panthers, because of their wide-ranging movements and extensive spatial requirements, are particularly sensitive to habitat fragmentation (Harris 1984). Mac et al. (1998) defines habitat fragmentation as: "The breaking up of a habitat into unconnected patches interspersed with other habitat which may not be inhabitable by species occupying the habitat that was broken up. The breaking up is usually by human action, as, for example, the clearing of forest or grassland for agriculture, residential development, or overland electrical lines." The reference to "unconnected patches" is a central underpinning of the definition. For panther conservation, this definition underscores the need to maintain contiguous habitat and protected habitat corridors in key locations in south Florida and throughout the panther's historic range. Habitat fragmentation can result from road construction, urban development, and agricultural land conversions.

Habitat protection has been identified as being one of the most important elements to achieving panther recovery. While efforts have been made to secure habitat (Figure 9 and Table 1d), continued action is needed to obtain additions to and inholdings for public lands, assure linkages are maintained, restore degraded and fragmented habitat, and obtain the support of private landowners for maintaining property in a manner that is compatible with panther use. Conservation lands used by panthers are held and managed by a variety of entities including the Service, NPS, Seminole Tribes of Florida, Miccosukee Tribe of Indians of Florida, FWC, FDEP, Florida Division of Forestry (FDOF), Water Management Districts, non-governmental organizations, counties, and private landowners.

Public Lands: Public lands in south Florida that benefit the panther are listed below and shown in Figure 9:

1. In 1947, ENP was established with 1,507,834 acres (610,199 ha) and in 1989 was expanded with the addition of 104,320 acres (42,217 ha).

2. In 1974, Congress approved the purchase and formation of BCNP, protecting 570,238 acres (230,767 ha); they later added 145,919 acres (59,051 ha).

3. In 1974, the State of Florida began acquiring land for the FSPSP, which encompasses over 80,000 acres (32,375 ha). Efforts are underway to acquire about 16,640 acres (6,734 ha).

4. In 1985, acquisition of Picayune Strand State Forest and Wildlife Management Area (WMA) began with the complex Golden Gate Estates subdivision buyouts and now comprises over 76,160 acres (30,821 ha). The Southern Golden Gate Estates buyout through State and Federal funds is complete. The South Belle Meade portion of Picayune Strand is about 90 percent purchased; and, although the State is no longer purchasing in South Belle Meade, Collier County's Transfer of Development Rights program is helping to secure the in-holdings.

5. In 1989, FPNWR was established and now protects 26,240 acres (10,619 ha).

6. In 1989, the Corkscrew Regional Ecosystem Watershed (CREW) Land and Water Trust, a public/private partnership, was established and to date has coordinated the purchase of approximately 60,000 acres (24,281 ha).

7. In 1996, the South Florida Water Management District (District) purchased the 32,000-acre (12,950-ha) Okaloacoochee Slough State Forest.

8. In 2002 Spirit of the Wild WMA, consisting of over 7,040 acres (2,849 ha), was taken into public ownership by the State of Florida and is managed by FDOF.

9. In 2003, Dinner Island Ranch WMA, consisting of 21,760 acres (8,806 ha) in southern Hendry County, was taken into public ownership by the State of Florida and is managed by FDOF.

10. The State of Florida in 2006 in cooperation with Lee and Charlotte Counties and with coordination with the Babcock Ranch family, the Babcock Florida Company, interested environmental advocacy groups, and concerned citizens, acquired 73,575 acres of the 91,362-acre Babcock Ranch. The 73,575-acre acquisition is referred to as the Babcock Ranch Preserve. The remaining 17,787 acres were purchased by the Babcock Ranch Community, an affiliate Babcock Ranch family company. The purchase agreement for the Babcock Ranch Preserve expressly reserved the ability to utilize portions of the property acquired by the State for mitigation of impacts from the Babcock Ranch Community's proposed residential development. These reserved lands are referred to as the Babcock Ranch Mitigation Park and encompass about 16,925 acres.

Tribal Lands: Lands of the Seminole Tribes of Florida and Miccosukee Tribe of Indians of Florida encompass over 350,079 acres (141,673 ha) in south Florida. Of these, 115,840 acres (46,879 ha) are used by panthers, and comprise 5 percent of the Primary Zone. In general, these lands are not specifically managed for the panther and are largely in cultivation. However, in 2007, the Seminole Tribes of Florida reserved about 4,144 acres within the Big Cypress Seminole Indian Reservation Native Area, an area encompassing about 14,724 acres, specifically for the benefit of the Florida panther. The remaining native area, about 10,580 acres, although not specifically managed for the Florida panther, provides high quality value habitat for the Florida panther and panther prey species.

Private Lands: A variety of Federal, State, and private incentive programs are available to assist private landowners and other individuals with the protection and management of wildlife habitat. Voluntary agreements, estate planning, conservation easements, land exchanges, and mitigation banks are all methods that hold untapped potential for conserving private lands. In 1954, the National Audubon Society established the nearly 10,880-acre (4,403-ha) Corkscrew Swamp Sanctuary. However, little additional private land has been protected south of the Caloosahatchee River for panther conservation. A number of properties identified by the State Acquisition and Restoration Council (ARC) for purchase by the Florida Forever Program are used by panthers (*e.g.*, Devil's Garden, Half Circle F Ranch, Pal Mal, and Panther Glades). North of the Caloosahatchee River, the Fisheating Creek Conservation Easement consists of 41,600 acres (16,835 ha) in Glades County and is a private holding used by dispersing male panthers.

Habitat and Prey Management

Land management agencies in south Florida are implementing fire programs that mimic a natural fire regime through the suppression of human-caused wildfires and the application of prescribed natural fires. No studies have been conducted to determine the effects of invasive plant management on panthers. However, invasive vegetation may reduce the panther's prey base by disrupting natural processes, such as water flow and fire, and by significantly reducing available forage for prey (Fleming et al. 1994). All public lands in south Florida have active invasive plant treatment programs. Management for panther prey consists of a variety of approaches such as habitat management and regulation of hunting and off-road vehicle (ORV) use.

Response to Management Activities

Few studies have examined the response of panthers to various land/habitat management activities. Dees et al. (2001) investigated panther habitat use in response to prescribed fire and found that panther use of pine habitats was greatest for the first year after the area had been burned and declined thereafter. Prescribed burning is believed to be important to panthers because prey species (*e.g.*, deer and hogs) are attracted to burned habitats to take advantage of changes in vegetation structure and composition, including exploiting hard mast that is exposed and increased quality or quantity of forage (Dees et al. 2001). Responses of puma to logging activities (Van Dyke et al. 1986b) indicate they generally avoid areas within their home range with intensification of disturbance.

There is the potential for disturbance to panthers from recreational uses on public lands. Maehr (1990) reported indirect human disturbance of panthers may include activities associated with hunting and that panther use of Bear Island (part of BCNP) is significantly less during the hunting season. Schortemeyer et al. (1991) examined the effects of deer hunting on panthers at BCNP between 1983 and 1990. They concluded that, based on telemetry data, panthers may be altering their use patterns because of hunting. Janis and Clark (2002) compared the behavior of panthers before, during, and after the recreational deer and hog hunting season (October through December) on areas open (BCNP) and closed (FPNWR, FSPSP) to hunting. Variables examined were: (1) activity rates, (2) movement rates, (3) predation success, (4) home range size, (5) home range shifts, (6) proximity to ORV trails, (7) use of areas with concentrated human activity, and (8) habitat selection. Responses to hunting for variables most directly related to panther energy intake or expenditure (i.e., activity rates, movement rates, predation success of females) were not detected (Janis and Clark 2002). However, panthers reduced their use of Bear Island, an area of concentrated human activity, and were found farther from ORV trails during the hunting season, indicative of a reaction to human disturbance (Janis and Clark 2002). Whereas the reaction to trails was probably minor and could be related to prey behavior, decreased use of Bear Island most likely reflects a direct reaction to human activity and resulted in increased use of adjacent private lands (Janis and Clark 2002).

Roads and Highways

Roads and highways facilitate the movement of people and goods by cars and trucks, and may adversely affect the Florida panther. The construction of new roads and the widening of existing roads can result in the direct loss of wildlife habitat (Fornan et al. 2003). Moreover, disturbance resulting from motorized vehicles may cause panthers to avoid busy roads. Maher (1990) reported that female panthers are less likely to cross busy highways. Consequently, roads may act as barriers affecting panther movement and fragmenting panther habitat. Panthers can also be injured or killed due to collisions with motorized vehicles when attempting to cross highways, and the potential for collisions increases as traffic increases. Adverse effects resulting from roads and highways represent a potential threat to the existing panther population.

Collisions with motor vehicles on highways appear to be a significant source of mortality for the Florida panther. The FWC documented 134 vehicle-related panther mortalities and 11 vehicle-related panther injuries from 1972 to the present on highways in south Florida. In portions of the panther's range the rate of panther vehicle-related mortalities may be increasing. Smith et al. (2006) found that vehicle-related panther mortalities in Collier County have increased by a factor of four from 2000 to the present compared to previous decades. This increase in panther mortality is likely related to the increase in traffic from Collier County's burgeoning population growth. Unfortunately, the effect of vehicle-related mortality on the existing panther population is largely unknown.

Wildlife underpasses, or crossings, can be constructed within highway corridors to reduce the potential for panther injuries and mortalities resulting from vehicle collisions. Underpasses allow panthers and other wildlife to safely cross under busy roadways, and maintain connectivity and gene flow within the panther population. Underpasses usually consist of a open-span bridge,

prefabricated concrete box, or culvert (Fornan et al. 2003). Effective crossing structures are large enough to allow the passage of panthers and include adequate wing fencing to funnel panthers to the crossing site. Crossings should be designed so that panthers have an unobstructed view of habitat on the opposite side of the underpass (Foster and Humphrey, 1995). The status of lands adjacent to the crossing site should also be considered when determining the location of a crossing. Unprotected private lands adjacent to the crossing could be developed and render the crossing unviable. Accordingly, lands adjacent to crossings should be acquired or placed under a conservation easement or other protective covenant to ensure the crossing will function in perpetuity.

A number of wildlife crossings with associated fencing have already been constructed within major roadways in southwest Florida to benefit the panther and other wildlife species (Figure 10). In the 1991, the Florida Department of Transportation (FDOT) constructed 28 wildlife crossings within I-75 corridor from U.S. Highway 27 to just west of Everglades Boulevard. A total of 4 vehicle-related panther mortalities were documented within this corridor prior to construction of the crossings. However, following construction of the crossings to the present, only 1 vehicle-related panther mortality was recorded in the corridor. In addition, the FDOT constructed six wildlife crossings on SR 29 between Oil Well Road and U.S. Highway 41. Crossings A, B, C, and D are located north of I-75 and Crossings E and F are located south of I-75 (Figure 10). Crossings A and B were constructed in 2007, Crossings C and D were constructed in 1995, Crossing E was constructed in 1997, and Crossing F was constructed in 1999. Prior to construction of the SR 29 Crossings, a total of 10 vehicle-related panther mortalities were recorded near the locations of Crossings A and B from 1980 through 2004, and 2 vehicle-related panther mortalities were recorded near the location of Crossings C and D from 1979 through 1990. Vehicle-related panther mortalities have not been recorded in the vicinity of Crossings A, B, C, or D following their installation. A total of 2 vehicle–related panther mortalities were documented within 3.5 miles of the location of Crossing E prior to construction, and vehicle-related panther mortalities were not observed within 2.5 miles of the location of Crossing F prior to construction. Following construction of Crossings E and F, a total of 3 vehicle-related panther mortalities have been reported within 3 miles of Crossing E, and 1 vehicle-related panther mortality has been documented within 1 mile of Crossing F. The observed increase in the number of vehicle-related panther mortalities following the construction of Crossings E and F may be related to the increase in the panther population within recent years.

The wildlife crossings described above represent a commendable effort by the FDOT to reduce panther deaths resulting from collisions with vehicles; however, more crossings are needed within the major roadways of south Florida to significantly reduce this threat to the panther and other wildlife species (Smith et al. 2006). Accordingly, recent studies have been conducted to identify locations for wildlife crossings in south Florida. Swanson et al. (2005) used a least cost path (LCP) modeling approach to identify the most likely travel routes for panthers among six major use areas in southwest Florida. LCP modeling considers elements in the landscape that permit or impede panther movement when traveling. Swanson et al. (2005) identified 20 key highway segments where LCPs intersected improved roadways. Smith et al. (2006) studied the movements of the Florida panther, the Florida black bear, and other wildlife species along SR 29, CR 846 and CR 858 in Collier County, Florida. Data analyzed in the study were obtained from

roadkill and track surveys, infra-red camera monitoring stations, existing data provided by the FWC (Florida panther radio telemetry and vehicle mortality reports), and other studies. Smith et al. (2006) recommended that new wildlife crossings be considered at various sites along these roadways to reduce road-related mortality of panthers and other wildlife species, and increase connectivity among wildlife populations. County governments are also working with the Service to construct needed crossings for the panther. As discussed above (see Description of Proposed Action), Collier County has committed to construct two wildlife crossings and associated fencing in association with the Oil Well Road widening project. These crossings will be located within the Oil Well Road (CR 858) corridor at Camp Keais Strand. The locations of these crossings have been identified as travel corridors for panthers and other wildlife.

Agriculture, Development, and Mining

The Service developed a Panther Habitat Assessment methodology and refugia design in 2003 to help guide the agency in evaluating permit applications for projects that could affect panther habitat (see discussion below). This methodology was a way to assess the level of impacts to panthers expected from a given project, and to evaluate the effect of any proposed compensation offered by the project applicant. Prior to the development of this methodology, the Service, from March 1984 through July 2003, concluded consultation on 40 projects involving the panther and habitat preservation (Table 3). The minimum expected result of these projects is impacts to 71,308 acres and the preservation on of 14,179 acres of panther habitat. Of the 71,308 acres of impacts, 38,932 acres are due to agricultural conversion and 32,376 acres to development and mining. Portions (10,370 acres) of the largest agricultural conversion project, 28,700 acres by U.S. Sugar Corporation, were re-acquired by the Federal Government as a component of the Talisman Land Acquisition (Section 390 of the Federal Agricultural Improvement and Reform Act of 1996 [Public Law 104-127] Farm Bill Cooperative Agreement, FB4) for use in the Comprehensive Everglades Restoration Project. The non-agriculture impacts are permanent land losses, whereas the agricultural conversions may continue to provide some habitat functional value to panthers, depending on the type of conversion.

From August 2003 through February 12, 2009, the Service concluded consultations on 84 projects affecting 21,468 acres with preservation of 25,448 acres (Table 3). Following our refugia design assessment approach, the projects affected 12,507 acres in the Primary Zone, 7,161acres in the Secondary Zone, and 4,477 acres in the Other Zone. Compensation provided included 24,007 acres in the Primary Zone, 272 acres in the Secondary Zone, 652 acres in the Dispersal Zone, and 1,646 acres in the Other Zone. The project-affected lands were primarily agricultural fields consisting of row crops and citrus groves and natural lands with varying degrees of exotic vegetation. Functional habitat value of these lands to the Florida panther, following our Panther Habitat Assessment methodology provided a PHU loss from development of 81,112 primary equivalent PHUs, with a corresponding PHU preservation and enhancement complement of 206,665 primary equivalent PHUs. The preservation lands were generally native habitat lands or disturbed lands that included restoration components. Restoration components included exotic species removal, fire management, wetland hydrology improvement, improved forest management practices, and full habitat restoration from agriculture uses to native habitats.

Panther Habitat Evaluation and Compensation

Population Viability Analysis

Population Viability Analysis (PVA) has emerged as a key component of endangered species conservation. This process is designed to incorporate demographic information into models that predict if a population is likely to persist in the future. PVAs incorporate deterministic and stochastic events including demographic and environmental variation, and natural catastrophes. PVAs have also been criticized as being overly optimistic about future population levels (Brook et al. 1997) and should be viewed with caution; however, they are and have been shown to be surprisingly accurate for managing endangered taxa and evaluating different management practices (Brook 2000). They are also useful in conducting sensitivity analyses to determine where more precise information is needed (Hamilton and Moller 1995, Beissinger and Westphal 1998, Reed et al. 1998, Fieberg and Ellner 2000).

As originally defined by Shaffer (1981), "a minimum viable population for any given species in any given habitat is the smallest isolated population having a 99 percent chance of remaining extant for 1,000 years despite the foreseeable effects of demographic, environmental and genetic stochasticity, and natural catastrophes." However, the goal of 95 percent probability of persistence for 100 years is the standard recommended by population biologists and is used in management strategies and conservation planning, particularly for situations where it is difficult to accurately predict long-term effects (Shaffer 1978, 1981, 1987, Sarkar 2004).

Since 1981, 139 Florida panthers have been radio-collared and monitored on public and private lands throughout south Florida (Lotz et al. 2005). These data were used by researchers to estimate survival rates and fecundity and were incorporated into PVA models previously developed for the Florida panther (Seal et al. 1989, 1992, Cox et al. 1994, Kautz and Cox 2001, Maehr et al. 2002b). These models incorporated a range of different model parameters such as general sex ratios, kitten survival rates, age distributions, and various levels of habitat losses, density dependence, and intermittent catastrophes or epidemics. The outputs of these models predicted a variety of survival scenarios for the Florida panther and predicted population levels needed to ensure the survival of the species.

Root (2004) developed an updated set of PVA models for the Florida panther based on RAMAS GIS software. These models were used to perform a set of spatially explicit PVAs. Three general single-sex (*i.e.,* females only) models were constructed using demographic variables from Maehr et al. (2002b) and other sources. A conservative model was based on Seal and Lacy (1989), a moderate model was based on Seal and Lacy (1992), and an optimistic model was based on the 1999 consensus model of Maehr et al. (2002b). In each model, first-year kitten survival was set at 62 percent based on recent information from routine panther population monitoring (Shindle et al. 2001). All of the models assumed a 1:1 sex ratio, a stable age distribution, 50 percent of females breeding in any year, and an initial population of 41 females (82 individuals including males), which was the approximate population size in 2001 to 2002 (McBride 2001, 2002).

The use of 41 females in the model was based on the best available data when the model was developed. The 41 females represent the number of individual panthers documented in surveys by McBride (2001, 2002). While the 41 females includes subadults that do not yet breed, it is reasonable to use this total number in modeling to evaluate population trends for several reasons. First, it is not feasible to differentiate between subadults and adults through field observation. Second, although it is possible that some of the 41 females were not breeding in year one of the model, these females would mature to breeding age by year two of the model. Third, the Root (2004) model assumed females to have "a 50 percent chance of breeding in a given year," and therefore only half of the 41 females were modeled as breeding each year. The primary reason the model (Root, 2004) assumed a 50 percent chance of breeding in a given year is that kittens stay with their mother from 15 to 24 months prior to dispersal, however, this assumption accounts for the likelihood some of the 41 females would not breed in a given year, including subadult status of some individuals. Fourth, the Service recognizes the McBride data is not intended to provide a total population estimate. Although the Service believes population estimates derived through field surveys are close to the actual population number, it is likely some individuals in the current panther population have not been documented. Finally, the Service notes population modeling is only one of several tools used by the Service to assess possible effects on the panther. As detailed elsewhere in this biological opinion, the Service's conclusions about possible effects on the panther are also supported by the Service's assessment of remaining habitat, as well as consideration of other factors such as the overall recovery objectives and other cumulative effects from actions in the action area. In light of these factors, the Service believes it is reasonable to use the best available count of 41 subadult and adult females as the breeding population for modeling purposes.

Basic Versions: The basic versions of each model incorporated no catastrophes or epidemics, no change in habitat quality or amount, and a ceiling type of density dependence. The basic versions of the models incorporated a carrying capacity of 41 females (82 panthers – 50:50 sex ratio). Variants of the models were run with differing values for density dependence, various levels of habitat loss, and intermittent catastrophes or epidemics. Each simulation was run with 10,000 replications for a 100-year period. The minimum number of panthers needed to ensure a 95 percent probability of persistence for 100 years was estimated in a series of simulations in which initial abundance was increased until probability of extinction at 100 years was no greater than 5 percent. More detailed information concerning the PVA model parameters appears in Root (2004).

The results of these model runs predicted a probability of extinction for the conservative model of 78.5 percent in 100 years with a mean final total abundance of 3.5 females. Also, the probability of a large decline in abundance (50 percent) was 94.1 percent. The moderate model resulted in a 5 percent probability of extinction and mean final abundance of 42.3 females in 100 years. The probability of panther abundance declining by half the initial amount was 20 percent in 100 years under the moderate model. The optimistic model resulted in a 2 percent probability of extinction and mean final abundance of 51.2 females in 100 years. The probability of panther abundance declining by half the initial amount was only 9 percent in 100 years under the optimistic model. These models also provide a probability of persistence (100 percent minus probability of extinction) over a 100-year period of 95 percent for the moderate model and 98 percent for the optimistic model.

One Percent Habitat Loss: Model results were also provided by Root (2004) for probability of extinctions for one percent loss of habitat, within the first 25 years of the model run. The 1 percent loss of habitat equates to essentially all remaining non-urban privately owned lands in the Primary Zone and corresponds to the estimated rate of habitat loss from 1986 to 1996 for the five southwest counties based on land use changes (Root 2004). For the moderate model, the model runs predict a probability of extinction increase of about 1 percent, from a probability of extinction of about 5 percent with no loss of habitat to 6 percent with 1.0 percent habitat loss per year, for the first 25 years. For the optimistic model, probability of extinction increased from about 2 percent with no loss of habitat to 3 percent with 1.0 percent habitat loss per year, for the first 25 years. These models also predicted that the mean final abundance of females would decrease from 41 to 31 females, a 24.3 percent reduction for the moderate model and from 41 to 38 females, a 7.3 percent reduction for the optimistic model.

The model runs predict a probability of persistence (100 percent minus the probability of extinction) over a 100-year period of about 94 percent for the moderate model and 97 percent for the optimistic model. The model runs also predict a mean final abundance of 62 individuals (31 females and 31 males) for the moderate model and 76 individuals (38 females and 38 males) for the optimistic model.

Population Guidelines: Kautz et al. (2006), following review of the output of Root's PVA models and those of other previous PVAs for the Florida panther, suggested a set of population guidelines for use in the management and recovery of the Florida panther. These guidelines are: (1) populations of less than 50 individuals are likely to become extinct in less than 100 years; (2) populations of 60 to 70 are barely viable and expected to decline by 25 percent over 100 years; (3) populations of 80 to 100 are likely stable but would still be subject to genetic problems (i.e., heterozygosity would slowly decline); and (4) populations greater than 240 have a high probability of persistence for 100 years and are demographically stable and large enough to retain 90 percent of original genetic diversity.

Population guidelines for populations of panthers between 50 and 60 individuals and between 70 and 80 individuals were not specifically provided in Kautz et al. (2006). However, the Service views the guidelines in Kautz et al. (2006) as a continuum. Therefore, we consider populations of 50 to 60 individuals to be less than barely viable or not viable with declines in population and heterozygosity. Similarly, we consider populations of 70 to 80 to be more than barely viable or somewhat viable with some declines in population and heterozygosity. Like other population guidelines presented in Kautz et al. (2006), these assume no habitat loss or catastrophes.

PVA Summaries and Population Guidelines: Root's (2004) moderate model runs, which have a carrying capacity 41 females (82 individuals), show final populations of 42.3 females (84 total) and 31.2 females (62 total) with extinction rates of 5 percent and 6 percent, respectively, for the basic and 1 percent habitat loss scenarios. The predicted final populations in Root (2004) are 84 and 62 panthers for no loss of habitat and 1 percent loss of habitat, respectively, over a 100-year period.

Kautz et al.'s (2006) population guidelines, when applied to the populations predicted by Root's (2004) moderate models, describe the "with habitat loss" population (62 panthers) as barely viable and expected to decline by 25 percent over a 100-year period. The "without habitat loss" population (84 panthers) is likely stable but would still be subject to genetic problems.

As discussed in the section on "Population Trends and Distribution," the 3-year average verified panther population estimate has shown an increase in the number of panthers reported yearly, beginning in 2000. The Service believes McBride's verified population of 97 panthers in 2006 and 117 panthers in 2007 is within Kautz et al.'s (2006) population guidelines representing a population that is likely stable but would still be subject to genetic problems.

The Service also believes the model runs show lands in the Primary Zone are important to the survival and recovery of the Florida panther and sufficient lands need to be managed and protected in south Florida to provide for a population of 80 to 100 panthers, the population range defined as likely stable over 100 years, but subject to genetic problems. As discussed in the following section, the Service has developed a landscape level program that through regulatory reviews and coordinated conservation efforts with landowners and resource management partners provides a mechanism to achieve this population threshold.

Model Violations: The actual likelihood of population declines and extinctions may be different than the guidelines and models suggest, depending upon the number of and severity of assumptions violated. The Service realizes habitat loss is occurring at an estimated 0.8 percent loss of habitat per year. The Service has accounted for some habitat loss and changes in habitat quality within its regulatory program, specifically through its habitat assessment methodology (discussed below). For example, we have increased the base ratio used within this methodology to account for unexpected increases in habitat loss. Similarly, we consider changes in habitat quality and encourage habitat restoration wherever possible.

With regard to the assumption of no catastrophes, the Service has considered the recent outbreak of feline leukemia in the panther population at Okaloacoochee Slough as a potential catastrophe. The FWC is carefully monitoring the situation and it appears to be under control at this time due to a successful vaccination program. However, if the outbreak spreads into the population, the Service will consider this as a catastrophe and factor this into our decisions.

We acknowledge uncertainties exist, assumptions can be violated, and catastrophes can occur. The Service and the FWC, along with our partners, will continue to monitor the panther population and the south Florida landscape and incorporate any new information and changes into our decision-making process.

South Florida Panther Population Objective

Although the Service supports Kautz et al.'s (2006) guideline 4 "that a population greater than 240 panthers have a high probability of persistence for 100 years and are demographically stable and large enough to retain 90 percent of original genetic diversity," we believe that for the southwest Florida population, Kautz et al.'s (2006) guideline 3 is a more appropriate threshold. The support for this guideline is that there is an insufficient acreage of non-urban lands, based on Kautz et al.'s (2006) average density value of 31,923 acres per panther, available in southwest Florida south of the Caloosahatchee River for a panther population of this size. However, based on Kautz et al.'s (2006) average density value, sufficient lands are available for a population between 80 and 100 panthers. Although this size population does not meet the recovery goals in the Service's draft Florida Panther Recovery Plan (Service 2006a), a population of this size,

based on Kautz et al. (2006) evaluation, would provide a population that is likely stable but would still be subject to genetic problems and would meet the Service's draft Florida Panther Recovery Plan (Service 2006a) objective (1), which is to maintain, restore, and expand the Florida panther population and its habitat in south Florida and, if feasible, expand the known occurrence of Florida panthers north of the Caloosahatchee River to maximize the probability of the long-term persistence of this metapopulation.

The Service proposes to achieve this landscape scale effort through land management partnerships with private landowners, through coordination with private landowners during review of development proposals, and through land management and acquisition programs with Federal, State, local, private, and Tribal partners. The acreages of lands necessary to achieve this landscape scale effort, based on Kautz et al. (a) average density of 31,923 acres (12,919 ha) per panther is 2,553,840 acres (1,033,520 ha) for 80 panthers or 3,192,300 acres (1,291,900 ha) for 100 panthers.

The principle regulatory mechanism that allows the Service to work directly with private landowners during review of development and land alteration projects is section 10 of the Act. The Service coordinates with Federal agencies pursuant to section 7 of the Act. In August 2000, the Service, to assist the Corps in assessing project effects to the Florida panther in accordance with their 7a(1) responsibilities under the Act, developed the Florida panther interim Standard Local Operating Procedures for Endangered Species (SLOPES) (Service 2000)(update in 2007) (Service 2007b). The document is available on the Corps web site at:

http://www.saj.usace.army.mil/regulatory/what/species/panther.htm

The Florida panther SLOPES provide guidance to the Corps for assessing project effects to the Florida panther and recommends actions to minimize these effects. The Florida panther SLOPES also includes a consultation area map that identifies an action area where the Service believes land alteration projects may affect the Florida panther.

In the original SLOPES, the consultation area map (Map) was generated by the Service by overlaying existing and historical panther telemetry data on a profile of Florida and providing a connecting boundary surrounding most of these points. Since the development of the Map, we have received more accurate and up-to-date information on Florida panther habitat usage. Specifically, we have received two documents that the Service believes reflect the most likely panther habitat usage profiles, although documentation clearly shows panther use of areas outside these locations. These documents are the publications by Kautz et al. (2006) and Thatcher et al. (2006). Based on the information in these documents, we clarified the boundaries of the Map to better reflect areas where Florida panthers predominate (Figure 5) and refer to these areas cumulatively as the Panther Focus Area (Service 2007b). As part of this review, we also made revisions in coordination with the Corps to components in the SLOPES documents that address actions that can be taken by the Service, Corps, and project applicants that may benefit panthers and minimize effects from proposed actions (Service 2007b).

The Panther Focus Area was determined from the results of recent panther habitat models south of the Caloosahatchee River (Kautz et al. 2006) and north of the Caloosahatchee River (Thatcher et al. 2006). The Kautz et al. (2006) model of landscape components important to Florida

panther habitat conservation was based on an analysis of panther habitat use and forest patch size. This model was used in combination with radio-telemetry records, home range overlaps, land use/land cover data, and satellite imagery to delineate primary and secondary areas that would be most important and comprise a landscape mosaic of cover types important to help support the current panther breeding population south of the Caloosahatchee River.

Thatcher et al. (2006) developed a habitat model using Florida panther home ranges in south Florida to identify landscape conditions (land-cover types, habitat patch size and configuration, road density and other human development activities, and other similar metrics) north of the Caloosahatchee River that were similar to those associated with the current panther breeding population.

The Panther Focus Area Map south of the Caloosahatchee River is divided into Primary, Secondary, and Dispersal Zones, and north of the Caloosahatchee River into the Primary Dispersal/Expansion Area. These zones are defined as follows:

Primary Zone: The area that is currently occupied and supports the only known breeding population of Florida panthers in the world. These lands are important to the long-term viability and persistence of the panther in the wild.

Secondary Zone: These lands are contiguous with the Primary Zone and although they are used to a lesser extent by panthers, they are important to the long-term viability and persistence of the panther in the wild. Panthers use these lands in a much lower density than in the Primary Zone.

Dispersal Zone: A known corridor between the Panther Focus Area south of the Caloosahatchee River and the Panther Focus Area north of the Caloosahatchee River that may facilitate future panther expansion north of the Caloosahatchee River (Kautz et al. 2006). This Zone is necessary to facilitate the dispersal of panthers and future panther population expansion to areas north of the Caloosahatchee River. Marked panthers have been documented using this zone.

Primary Dispersal/Expansion Area: This is the Fisheating Creek/Babcock-Webb Wildlife Management Area region. These are lands identified by Thatcher et al. (2006) as potential panther habitat with the shortest habitat connection to the Panther Focus Area in south Florida. Several collared and uncollared male panthers have been documented in this area since 1973, and the last female documented north of the Caloosahatchee River was found in this area.

Landscape Preservation Need and Compensation Recommendations

Land Preservation Needs: To further refine the land preservation needs of the Florida panther and to specifically develop a landscape-level program for the conservation of the Florida panther population in south Florida, the Service appointed a Florida Panther Subteam in February 2000. The Subteam was charged with developing a landscape-level strategy for the conservation of the Florida panther population in south Florida. The results of this collaborative effort are partially presented in Kautz et al. (2006). One of the primary population thresholds of this effort was to

identify a strategically located set of lands containing sufficient area and appropriate land cover types to ensure the long-term survival of the south population of the Florida panther. Kautz et al. (2006) focused their efforts on the area south of the Caloosahatchee River, where the reproducing panther population currently exists.

Kautz et al. (2006) created an updated Florida panther potential habitat model based on the following criteria: (1) forest patches greater than 4.95 acres (2 ha); (2) non-urban cover types within 656 ft (200 m) of forest patches; and (3) exclusion of lands within 984 ft (300 m) of urban areas. The potential habitat map was reviewed in relation to telemetry data, recent satellite imagery (where available), and panther home range polygons. Boundaries were drawn around lands defined as the Primary Zone (Figure 8), defined as the most important area needed to support a self-sustaining panther population. Kautz et al. (2006) referred to these lands as essential; however, as observed in the two previous plans (Logan et al. 1993; Cox et al. 1994), lands within the boundaries of the Primary Zone included some urban areas and other lands not considered to be truly panther habitat (*i.e.*, active rock and sand mines). The landscape context of areas surrounding the Primary Zone was modeled and results were used to draw boundaries of the Secondary Zone (Figure 8), defined as the area capable of supporting the panther population in the Primary Zone, but where habitat restoration may be needed (Kautz et al. 2006).

Kautz et al. (2006) also identified, through a least cost path model, the route most likely to be used by panthers dispersing out of south Florida, crossing the Caloosahatchee River, and dispersing into south-central Florida. Kautz et al. (2006) used ArcView GIS© version 3.3 and ArcView Spatial Analyst© version 2 (Environmental Systems Research, Incorporated, Redlands, California) to construct the least-cost path models and identify optimum panther dispersal corridor(s). The least-cost path models operated on a cost surface that ranked suitability of the landscape for use by dispersing panthers with lower scores indicating higher likelihood of use by dispersing panthers. Those dispersal routes connecting lands between the Panther Focus Area south of the Caloosahatchee River and the Panther Focus Area north of the Caloosahatchee River, which may facilitate future panther expansion north of the Caloosahatchee River, were defined as the Dispersal Zone (Figure 4) (Kautz et al. 2006). The preservation of lands within this zone is important for the survival and recovery of the Florida panther, as these lands are the dispersal pathways for expansion of the south Florida panther population. The Primary Zone covers 2,270,590 acres (918,895 ha); the Secondary Zone covers 812,104 acres (328,654 ha); and the Dispersal Zone covers 27,883 acres (11,284 ha); providing a total of 3,110,578 acres (1,258,833 ha) (Kautz et al. 2006).

As part of their evaluation of occupied panther habitat, in addition to the average density estimate of one panther per 27,181 acres (11,000 ha) developed by Maehr et al. (1991), Kautz et al. (2006) estimated the present average density during the timeframe of the study, based on telemetry and other occurrence data, to average 1 panther per 31,923 acres (12,919 ha). In the following discussions of the number of panthers a particular zone may support, the lower number is based on the 31,923 acres (12,919 ha) value (Kautz et al. 2006) and the higher number is based on the 27,181 acres (11,000 ha) value (Maehr et al. 1991).

Based on these average densities, the Primary Zone could support 71 to 84 panthers; the Secondary Zone could support 8 to 10 panthers without habitat restoration and 25 to 30 panthers

with habitat restoration (existing high quality panther habitat currently present in the Secondary Zone is estimated at 32 percent of the available Secondary Zone lands); and the Dispersal Zone could support 0 panthers. Taken together, the three zones in their current condition apparently have the capacity to support about 79 to 94 Florida panthers.

Kautz et al.'s (2006) assessment of available habitat south of the Caloosahatchee River determined that non-urban lands in the Primary, Secondary, and Dispersal Zones were not sufficient to sustain a population of 240 individuals south of the Caloosahatchee River. However, Kautz et al. (2006) determined sufficient lands were available south of the Caloosahatchee River to support a population of 79 to 94 individuals (although not all lands are managed and protected).

Compensation Recommendations: To achieve our landscape scale effort to locate, preserve, and restore sets of lands containing sufficient area and appropriate land cover types to ensure the long-term survival of a population of Florida panthers south of the Caloosahatchee River, the Service chose the mid point (90 panthers) in Kautz et al.'s (2006) population guidelines that a population of 80 to 100 panthers is likely to be stable, although subject to genetic problems, through 100 years. In addition, a population of 90 individuals is eight individuals greater than a population of 82 individuals, which according to the best available PVA (Root 2004) is 95 percent likely to persist over 100 years (assuming a 50:50 male to female ratio). These eight individuals provide a buffer for some of the assumptions in Root's (2004) PVA. Our process to determine compensation recommendations for project affects that cannot be avoided in both our section 7 and section 10 consultations is based on the amount and quality of habitat that we believe is necessary to support a population of 90 panthers in south Florida. The Service, based on Kautz et al.'s (2006) average panther population density of 31,923 acres per panther, determined 2,873,070 acres of Primary Zone "equivalent" lands need to be protected and managed. This equivalency factor is needed, since Secondary Zone lands are of less value than Primary Zone lands to the panther, to assure that additional acreage (special consideration) is required in the Secondary Zone to compensate for its lower quality panther habitat. In other words, more than 31,923 acres per panther would be needed, hypothetically, if this acreage were all in the Secondary Zone (see discussion of Primary Zone equivalent lands in the following section). The combined acreage of lands within the Primary, Dispersal, and Secondary Zones is 3,110,577 acres (1,258,833 ha) (Kautz et al. 2006). Currently, 2,073,865 acres of Primary Zone equivalent lands are preserved (Table 4), so 799,205 additional acres need to be preserved to support a population of 90 panthers in south Florida (2,873,070 minus 2,073,865 equals 799,205).

The Service also consults on lands outside of the Primary, Secondary, and Dispersal zones that may effect panthers, such as agricultural lands adjacent to the Panther Focus Area and proposals in urbanized areas that could generate traffic in or adjacent to the Panther Focus Area or have other identifiable impacts.

Primary Zone Equivalent Lands: Kautz et al. (2006), through their habitat evaluation of lands important to the Florida panther, identified three categories of lands, *i.e.,* Primary Zone, Secondary Zone, and Dispersal Zone, and documented the relative importance of these lands to the Florida panther. These lands generally referred to as Kautz et al.'s panther core lands, include the majority of the home ranges of the current population of the Florida panther. The Service, in our evaluation

of habitat needs for the Florida panther expanded the boundaries of the Kautz et al. (2006) lands to include those lands south of the Caloosahatchee River where additional telemetry points historically were recorded. These additional lands (about 819,995 acres), referred to as the "Other" Zone, are added to the lands in Kautz et al.'s (2006) panther core lands and represent the lands within the Service's 2000 consultation area boundary south of the Caloosahatchee River as shown in Figure 5. These lands (core lands and other zone lands) together are referred to by the Service as the Panther Core Area (labeled on Figure 5 as "Original Panther Consultation Area South of the Caloosahatchee River"). The "Other" Zone lands, as well as the lands within the Secondary Zone, provide less landscape benefit to the Florida panther than the Primary and Dispersal Zones, but are important as a component of our strategy to preserve sufficient lands to support a population of 90 panthers in South Florida.

To account for the lower landscape importance of these lands in our preservation strategy and in our habitat assessment methodology, we assigned lands in the Other Zone a value of 0.33 and lands in the Secondary Zone a value of 0.69 to convert these lands to Primary Zone value, *i.e.,* Primary Zone equivalents (Table 5). Kautz et al. (2006) identifies the need for restoration in the Secondary Zone to achieve maximum benefits. To estimate the Primary Zone equivalent of Secondary Zone lands, we derived a relative habitat value (average PHU value) for each by comparing the habitat ranks estimated in Kautz et al. (2006) for each habitat type per zone. The average PHU value for the Primary Zone is 6.94 and for the Secondary Zone 4.79. Based on this analysis, the habitat value of the Secondary Zone is roughly 69 percent of the Primary Zone, and restoration is needed to achieve landscape function (4.79/6.94=0.69). Using this assessment, the 503,481 acres of Secondary Zone lands equate to 347,402 acres of Primary Zone equivalent lands. Dispersal Zone lands are considered equivalent to Primary Zone lands with a 1 to 1 value. At-risk lands in the Other Zone total 819,995 acres. Actions on some of the Other Zone lands, such as actions in areas that have already been urbanized, will in most situations not have an impact on panthers or their habitat. We are considering that within the Other Zone lands, these types of actions will account for 20 percent of the available lands and that actions on the remaining 80 percent of available lands may have an impact on panthers and could affect our southwest Florida panther population strategy. We will monitor this consideration carefully as we review proposed actions within the Other Zone. To estimate the acres of Primary Zone equivalent lands the 819,995 acres of Other Zone lands represent, we applied the 80 percent factor and the 33 percent factor to the available acres, which equate to 216,479 acres of Primary Zone equivalent lands (819,995 times 0.8 equals 655,996 times 0.33 equals 216,479).

These equivalent values, 0.33 and 0.69, for Other and Secondary Zones, respectively, and 1 to 1 for the Dispersal Zone, are important components in our assessment of compensation needs for a project in the panther consultation area and are components of our habitat assessment methodology as discussed below.

Habitat Assessment Methodology

To evaluate project effects to the Florida panther, the Service considers the contributions the project lands provide to the Florida panther, recognizing not all habitats provide the same functional value. Kautz et al. (2006) also recognized not all habitats provide the same habitat value to the Florida panther and developed cost surface values for various habitat types, based on use by and presence in home ranges of panthers. The FWC (2006), using a similar concept, assigned likely use values of

habitats to dispersing panthers. The FWC's habitats were assigned habitat suitability rank between 0 and 10, with higher values indicating higher likely use by dispersing panthers.

The Service chose to evaluate project effects to the Florida panther through a similar process. We incorporated many of the same habitat types referenced in Kautz et al. (2006) and FWC (2006) with several adjustments to the assigned habitat use values reflecting consolidation of similar types of habitats and the inclusion of Everglades Restoration water treatment and retention areas. We used these values as the basis for habitat evaluations and the recommended compensation values to minimize project effects to the Florida panther (Table 5), as discussed below.

Base Ratio: To develop a base ratio that will provide for the protection of sufficient acreage of Primary Zone equivalent lands for a population of 90 panthers from the acreage of Primary Zone equivalent non-urban lands at risk, we developed the following approach.

The available Primary Zone equivalent lands are estimated at 3,276,563 acres (see Tables 4 and 6). Currently 2,073,865 acres of Primary Zone equivalent lands of non-urban lands are preserved. The remaining non-urban, at-risk, private lands are estimated at 1,202,698 acres of Primary Zone equivalent lands. To meet the protected and managed lands threshold for a population of 90 panthers, an additional 799,205 acres of Primary Zone equivalent lands are needed. The base ratio is determined by dividing the primary equivalents of at-risk habitat to be secured (799,205 acres) by the result of the acres of at-risk habitat in the Primary Zone (610,935 acres) times the value of the Primary Zone (1); plus the at-risk acres in the Dispersal Zone (27,883 acres) times the value of the Dispersal Zone (1); plus the at-risk acres in the Secondary Zone (503,481 acres) times the value of the Secondary Zone (0.69); plus the at-risk acres in the Other Zone (655,996 acres) times the value of the Other Zone (0.33); minus the at-risk acres of habitat to be protected (799,205 acres). The results of this formula provide a base value of 1.98.

$$799{,}205 / ((610{,}935 \times 1.0) + (27{,}883 \times 1) + (503{,}481 \times 0.69) + (655{,}996 \times 0.33)) - 799{,}205 = 1.98$$

In evaluating habitat losses in the consultation area, we used an estimate of 0.8 percent loss of habitat per year to predict the amount of habitat loss anticipated in south Florida during the next 5 years (*i.e.,* 6,000 ha/year; 14,820 acres/ year). We chose a 5-year time frame because we believe a time period less (2 to 3 years) would not show a changing trend in habitat alterations and a period longer (7 to 10 years) would not allow the Service sufficient time to adjust for a changing trend. The Service intends to monitor this habitat loss and may periodically adjust our habitat methodology to reflect this change.

Based on an analysis of wetland permits issued for single-family residential projects in Northern Golden Gate Estates by FDEP (167 over a 30-month period [FDEP permit data- 2006 to 2008) and corresponding Collier County single-family residential building permits (267 permits [Collier County permit data – 2006 to 2008]) issued over the same time period (167/296=0.56), we conservatively assumed based on the joint Corps/FDEP wetland application submittal process and the Corps consultation process with the Service in accordance with the Act that we would have the opportunity to review these wetland permits and provide species impact reviews. Based on these assumptions, we estimated that about 41,496 acres would be developed without Federal review over a 5-year period (14,820*5*0.56=41,496), or an average of 8,299 acres per year. As a result, we adjusted the base value from 1.98 to 2.23.

We also realize habitat losses from individual single-family residential developments will collectively compromise the Service's landscape scale effort to secure sufficient lands for a population of 90 panthers. We believe that, on an individual basis, single-family residential developments by individual lot owners on lots no larger than 2.0 ha (5.0 acres) will not result in take of panthers on a lot-by-lot basis; however, collectively these losses may affect the panther. Panthers are a wide-ranging species, and individually a 2.0 ha (5.0 acre) habitat change will not have a measurable impact. Compensation for such small-scale losses on a lot-by-lot basis is unlikely to result in meaningful conservation benefits for the panther versus the more holistic landscape level conservation strategy used in our habitat assessment methodology. To account for these losses, we estimated about another 12,950 acres over a 5-year period (2,590 acres per year or about 0.14 percent of the at risk lands), or an average of 2,590 acres per year would be developed through this avenue. This estimate for individual single-family development is based on the yearly average level of development combined in Northern Golden Gate Estates and Lehigh Acres in Lee and Collier. To account for this loss, we further adjusted the base value from 2.23 to 2.48.

There is also a need for road crossings in strategic locations and we believe there are projects that may not have habitat loss factors but will have traffic generation factors. The Service considers increases in traffic as an indirect effect from a project, which can contribute to panther mortality. For assessment purposes, since our habitat methodology does not provide a mechanism to address this type of effect directly, we are providing a habitat surrogate of 500 acres per year of habitat loss for these types of projects, with a not to exceed value of 2,500 acres over the 5-year period. Therefore, we have added another 0.02 to the base ratio to address traffic impacts, which could provide an incentive to implement crossings in key locations. Following the same approach shown above, we adjusted the base ratio from 2.48 to 2.5. The Service intends to re-evaluate this base ratio periodically and adjust as needed to make sure all adverse effects are adequately ameliorated and offset as required under section 7 of the Act and to achieve the Service's landscape scale effort for the Florida panther.

The Service uses a very conservative density of panthers per area of habitat to calculate the compensation ratio for impacts south of the Caloosahatchee River. Specifically, the Service relied on the low estimate in the range presented in Kautz et al. (2006) to reach its factor of 2.5. This low estimate density value was calculated by dividing the documented number of panthers in 2000, or 62 panthers, by an estimate of the habitat in the Primary Zone that was most consistently occupied by panthers from 1981 to 2000. As previously mentioned, it is clear the panther population south of the river has increased notably since 2000, in 2001 = 78 panthers; in 2002 = 80; in 2003 = 87; in 2004 = 78; in 2005 = 82; in 2006 = 97; in 2007 = 117; and 2008=104. In 2007 more panthers were documented in south Florida than have been documented since current verified estimates have been collected. Furthermore, none of the panthers recorded south of the Caloosahatchee River lives exclusively outside of the Primary Zone, although some do venture outside of it on occasion (McBride, personal communication 2007).

The average population size south of the Calooshatchee River over the past 7 years is 86. If we were to use this number instead of 62 to calculate the compensation ratio and to use the entire acreage of the primary zone as the denominator, the revised compensation ratio requirement would be 0.32 acres protected for every acre developed. Furthermore, if we even excluded the

"Other Zone" altogether from the analysis, the ratio would be 1.01, still lower than the Service's current ratio. We believe this conservative approach is warranted because of the inherent importance of habitat protection to panther conservation.

Landscape Multiplier: As stated in the above section on Primary Zone Equivalent Lands, the location of a project in the landscape of the core area of the Florida panther is important. As we have previously discussed, lands in the Primary and Dispersal Zones are of the most importance in a landscape context to the Florida panther, with lands in the Secondary Zone of less importance, and lands in the Other Zone of lower importance. These zones affect the level of compensation the Service believes is necessary to minimize a project's effects to Florida panther habitat. Table 7 provides the landscape compensation multipliers for various compensation scenarios. As an example, if a project is in the Other Zone and compensation is proposed in the Primary Zone, a Primary Zone equivalent multiplier of 0.33 is applied to the PHUs (see discussion below) developed for the project. If the project is in the Secondary Zone and compensation is in the Primary Zone, then a Primary Zone equivalent multiplier of 0.69 is applied to the PHUs developed for the project.

Panther Habitat Units – Habitat Functional Value: Prior to applying the base ratio and landscape multipliers discussed above, we evaluate the project site and assign functional values to the habitats present. This is done by assigning each habitat type on-site a habitat suitability value from the habitats shown in Table 5. The habitat suitability value for each habitat type is then multiplied by the acreage of that habitat type resulting in a number representing PHUs. These PHUs are summed for a site total, which is used as a measurement of the functional value the habitat provides to the Florida panthers. This process is also followed for the compensation-sites.

Exotic Species Assessment: Since many habitat types in south Florida are infested with exotic plant species, which affects the functional value a habitat type provides to foraging wildlife species (*i.e.,* primarily deer and hog), we believe the presence of these species and the value these species provide to foraging wildlife needs to be considered in the habitat assessment methodology. As shown in Table 5, we have a habitat type and functional value shown for exotic species. This category includes not only the total acres of pure exotic species habitats present but also the percent-value acreages of the exotic species present in other habitat types.

For example, a site with 100 acres of pine flatwoods with 10 percent exotics would be treated in our habitat assessment methodology as 90 acres of pine flatwoods and 10 acres of exotics. Adding another 100 acres of cypress swamp with 10 percent exotics would change our site from 90 acres of pine flatwoods and 10 acres of exotics to 90 acres of pine flatwoods, 90 acres of cypress swamp, and 20 acres of exotics.

Habitat Assessment Methodology Application – Example: To illustrate the use of our habitat assessment methodology, we provide the following example. A 100-acre project site is proposed for a residential development. Plans call for the entire site to be cleared. The project site contains 90 acres of pine flatwoods and 10 acres of exotic vegetation, and is located in the "Secondary Zone." The applicant has offered habitat compensation in the "Primary Zone" to minimize the impacts of the project to the Florida panther. To calculate the PHUs provided by

the site, we multiply the habitat acreage by the "habitat suitability value" for each habitat type and add those values to obtain a value of 840 PHUs ((90 acres of pine flatwoods x 9 [the habitat suitability value for pine flatwoods] = 810 PHUs) + (10 acres of exotic vegetation x 3 [the habitat suitability value for exotics] = 30 PHUs) = 840 PHUs). The value of 840 PHUs is then multiplied by the 2.5 (the base ratio) and 0.69 (the landscape multiplier) resulting in a value of 1,149 PHUs for the project site. In this example, the acquisition of lands in the Primary Zone containing at least 1,149 PHUs is recommended to compensate for the loss of habitat to the Florida panther resulting from this project.

Analysis of the species likely to be affected

The Florida panther is an endangered animal restricted to 2 to 3 million acres of land (6 to 9 percent of the total land area of Florida) in south Florida. The panther is a wide-ranging species that requires a biotically diverse landscape to survive. Dispersing subadult males wander widely through unforested and disturbed habitat. Human population in south Florida has dramatically increased, from 1 million in 1950 to almost 8 million in 2000, resulting in secondary disturbances such as increased human presence and noise, light, air, and water pollution. Increasing human population has resulted in increasing impacts on native habitat and flora and fauna. Resulting threats to panthers include road mortality, habitat loss, habitat fragmentation, and human disturbance.

ENVIRONMENTAL BASELINE

The environmental baseline includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions, which occur simultaneously with the consultation in progress.

Status of the Species within the Action Area

As stated previously, for the purposes of this consultation, the action area includes the Corps' project area and surrounding lands frequently visited by panthers (Figure 8). The action area is a subset of the current geographic range of the panther and includes those lands that the Service believes may experience direct and indirect effects from the proposed development. Therefore, for both direct and indirect effects, the action area is defined as all lands within a 25-mile radius of the project. This action area does not include urban lands and lands west of I-75. The proposed action may have direct and indirect effects on the ability of panthers to breed, feed, and find shelter, and to disperse within the population.

The Service used current and historical radio-telemetry data, information on habitat quality, prey base, and evidence of uncollared panthers to evaluate panther use in the action area. Panther telemetry data are collected 3 days per-week from fixed-wing aircraft, usually in early to midmorning. However, researchers have shown panthers are most active between dusk and dawn (Maehr et al. 1990a, Beier 1995) and are typically at rest in dense ground cover during daytime monitoring flights (Land 1994). Therefore, telemetry locations may present an incomplete picture of panther activity patterns and habitat use (Comiskey et al. 2002).

Although telemetry data may not provide a complete picture of panther activity patterns, since less than half of the panther population is currently collared, telemetry locations are a good indicator, due to the extensive data set, of the approximate boundaries of home ranges, panther travel corridors, and the range of Florida panthers south of the Caloosahatchee River. The FWC also uses observational data collected during telemetry flights to assess the yearly breeding activity of radio-collared panthers. Female panthers accompanied by kittens or male panthers within close proximity of an adult female were assumed to have engaged in breeding activity during that year. Documentation by McBride (Shindle et al. 2003) shows that between July 2002 and June 2003, three-collared panthers, two-uncollared females, and two-uncollared males had home ranges in or home ranges that overlapped or were immediately adjacent to the same survey unit as the Premier Airport Park project. In addition, eight other panthers that used this same survey unit previously died during this time period (Shindle et al. 2003). This unit, designated as Unit 7, includes the Okaloacoochee Wildlife Management Area and adjacent private lands.

Within the 25-mile radius action area, based on telemetry data as of June 2008, at least 39 known living radio-collared panthers have overlapping home ranges with the project area. These panthers are FP 54 (male), FP 56 (female), FP 57 (female), FP 62 (male), FP 65 (male), FP 66 (female), FP 71 (female), FP 73 (female), FP 75 (female), FP 81 (male), FP, 83 (female), FP 88 (female), FP 93 (female), FP 101 (female), FP 102 (female), FP 110 (female), FP 113 (female), FP 119 (male), FP 121 (female), FP 133 (male), FP 137 (male), FP 139 (male), FP 140 (female), FP 141 (male), FP 143 (male), FP 144 (male), FP 145 (female), FP 146 (male), FP 147 (male), FP 148 (female), FP 149 (female), FP 150 (female), FP 151 (female), FP 153 (female), FP 154 (male), FP 156 (male), FP 158 (female), FP 159 (male), and FP 160 (female). In addition, McBride (2003) notes previous use of the action area by other panthers prior to their mortality. Four of these panthers were likely dispersing sub-adult males or sub-adult females without established territories. The nearest telemetry point to the site of a panther still alive as of this document was FP 154 (male) recorded about 0.41 mile to the east-south east of the eastern terminus of the project corridor.

Historically, there have been a total of 47 radio-collared male and female panthers recorded within 5 miles of the project site on 4,423 occasions based on telemetry data from February 1981 through June 2008 (Figure 11; Table 8). All of the instances of recorded panther telemetry within 5 miles occurred from April 14, 1982 through May 19, 2008. This translates to an average of 169.6 occurrences per year or 14.1 occurrences per month since the first telemetry point was recorded within 5 miles of the site (i.e., 18-year period of record). Six of these panthers were alive as of the date of this document (Table 8). Uncollared panthers are presumed to occur and cannot be confirmed or ruled out because there is documented use of the area by collared panthers so it would be impossible to determine whether any physical evidence came from collared panthers or uncollared panthers. The status and activities of non-collared Florida panthers within the action area are unknown. Based on the above information and because the site contains habitat types used by panthers and their prey, and the project vicinity has been used historically by panthers as indicated by telemetry locations, the Service believes the project site may be occasionally used by other non-collared panthers.

Past and ongoing Federal and State actions affecting panther habitat in the action area include the issuance of Corps permits and State of Florida Environmental Resource Permits authorizing the filling of wetlands for development projects and other purposes. Since 1982, the Corps and the State have had a joint wetland permit application process, where all permit applications submitted to the State are copied to the Corps and vice versa. Within the 25-mile action area, the Service, since January 14, 1992, has formally consulted on 29 projects and informally consulted on 4 projects (disregarding single-family homesites) regarding the panther that were a result of Federal actions (database entries for formal consultations prior to 1992 are incomplete for projects in the action area) (Table 3). These projects have impacted or are expected to impact about 35,578 acres of panther habitat. These projects have also provided a total of 30,513 acres of preservation and restoration of panther habitat. The impacted lands generally are: (1) on the western fringe of occupied panther habitat; (2) vegetated with dense stands of exotic species, which may adversely affect the density of the panther prey base; and/or (3) support agricultural enterprises, *i.e.*, row crops, citrus, etc., which provide a lower quality habitat value to the Florida panther. The preserved lands, which are generally proximate to larger tracts of Federal, State, and other preserves, provide a higher quality habitat value for the Florida panther. The Service determined in the biological opinions issued for these 29 Federal actions requiring formal consultation, that individually and cumulatively these projects do not jeopardize the survival and recovery of the Florida panther.

From July 2000 through September 2006, the Service engaged in informal consultation with the Corps for about 757 projects, all under 5 acres, that affected about 764.1 acres in Collier County (primarily Northern Golden Gate Estates) and 202.8 acres in Lee County (primarily Lehigh Acres), which averages about162 acres per year over the reported time frame (database entries for informal consultations prior to 2000 are incomplete). Almost all of these projects involved the construction of single-family residences in partially developed areas, in most cases involving less than an acre of direct impact per project. Although panthers have been known to cross these areas to other parts of their range, prey base and denning utilization of these areas have been affected by the level of development and the additions of these residences is not expected to significantly further impact these habitat functions. For these actions, the Service concurred with the Corps' determination of "may affect, but is not likely to adversely affect" for these individual projects. Assuming that these projects are representative of the number of informal consultations for projects less than 5 acres reviewed by the Corps for the action area, we can expect that about 162 acres of potential panther habitat could be developed each year. This annual level of loss has been anticipated as a component of our landscape scale assessment multiplier of 2.5, which provides for an increase above base of 0.05 and is estimated at 2,590 acres per year.

We have received information that within the Panther Focus Area that lies within 25 miles of the project site, the Corps has, between April 2004 and March 2006, issued non-jurisdictional wetland determinations for 16 projects totaling about 2,708 acres, with approximately 108 acres of isolated wetlands. These determinations were issued per jurisdictional guidance provided in the Supreme Court decision, *Solid Waste Agency of Northern Cook County vs. U.S. Army Corps of Engineers,* 531 U.S. 159 (2001) and, therefore, they will not require a Federal Clean Water Act 404 wetland permit. Assuming that these projects are representative of the number of non-jurisdictional wetland determinations the Corps issues for this area, we can expect that about

1,354 acres of potential panther habitat could be developed each year without a Corps permit. These projects have been incorporated in the Service's environmental baseline for the Florida panther in this biological opinion and the Service has determined, based on the location of these projects (generally in the western fringe of the panther's geographic range), the quality of the habitat present on these project sites, and the overall status of the Florida panther, these projects individually and cumulatively do not jeopardize the survival and recovery of the Florida panther. However, since loss of panther feeding habitat may occur from construction of these projects and no Corps wetland permit is required, the Service recommends the applicants pursue Habitat Conservation Plans in cooperation with the Service.

There have been 84 documented panther-vehicle collisions within the 25-mile action area (see Table 9 and Figure 10). The panther-vehicle collision closest to the project site occurred in 2008, on CR 848 (Oil Well Road), about 0.7 mile east of the project corridor. The panther was an uncollared female. Five panther-vehicle collisions occurred in the action area in 2008 and three have occurred so far in 2009 (Table 9).

Activities within the action area have also benefited panthers. The issuance of Corps and State of Florida Environmental Resource Permits has preserved 30,513 acres of high quality panther habitat for permitted impacts to 35,578 acres of poor quality panther habitat (1992 to present). Installation of wildlife crossings under SR 29 and I-75 within the action area has also benefited the panther by protecting habitat connectivity and eliminating panther-vehicle collision mortalities. Additional benefits have resulted from the acquisition of high quality habitat through acquisition programs by the other Federal, State, and County resource agencies. Table 10 provides a summary of the State and County acquisitions within the last 5 years. Moreover, the management of public lands, including prescribed fire and eradication of exotic vegetation in the Picayune Strand State Forest, Fakahatchee Strand State Preserve, Florida Panther NWR, ENP, and other conservation areas, is intended to improve habitat for panther prey species, which benefits panthers within these areas.

Factors Affecting Species Environment within the Action Area

Factors that affect the species environment (positively and negatively) within the action area include, but are not limited to, the presence and construction of highways and urban development, agriculture, resource extraction, public lands management (prescribed fire, public use, exotic eradication, etc.), hydrological restoration projects, public and private land protection efforts, effects of genetic inbreeding, and genetic restoration. Development activities may result in avoidance or limited use of remaining suitable habitat by panthers as well as habitat loss, habitat fragmentation, habitat degradation, and also an increase in risk of vehicular collision (*e.g.,* injury or death). Public and private land management practices can have a positive, neutral, or negative effect, depending on the management goals. Land protection efforts will help to stabilize the extant population. Hunting of the panther is no longer sanctioned, although there still may be instances of intentional or unintentional shooting of individuals for various reasons.

Wildlife Value and Habitat Quality

As discussed previously in the status of the species, the Service believes the existing habitat conditions present on a site and the feeding value that a site provides to the Florida panther and

panther prey species are an important parameter in assessing the importance of the project site to the Florida panther and other wildlife species. In order to assess this importance, the Service requires wildlife surveys and plant species compositions as part of the applicant's biological assessment prepared for the project.

Wildlife Value – Pedestrian surveys of the project site and surrounding area were conducted from January through March, 2006, by the applicant's consultant. Tracks of the Florida panther were observed along Oil Well Grade Road south of Oil Well Road and along a haul road adjacent to the eastern edge of Camp Keais Strand. Wood Storks were occasionally observed in agricultural ditches near the project corridor. The audubon's crested caracara was observed within the project site. However, caracaras have not been documented to nest on or near the project site. Wildlife species documented on the project site include (based on observations, tracks, or scat) include: white-tailed deer (*Odocoileus virginianus*), feral hog (*Sus scrofa*), American alligator (*Alligator mississippiensis*), Big Cypress fox squirrel (*Sciurus niger avicennia*), Florida black bear (*Ursus americanus floridanus*), gopher tortoise (*Gopherus polyphemus*), little blue heron (*Egretta caerulea*), snowy egret (*Egretta thula*), tricolored heron (*Egretta tricolor*), and white ibis (*Eudocimus albus*).

Track surveys to quantify deer and feral hog tracks within and near the project site were not conducted by the applicant's consultant. However, few deer and hog tracks observed during the pedestrian surveys on the project site and lands immediately surrounding the project site, as discussed above.

Habitat Quality – As indicated on page 7, the 522.9-acre project site contains 328.6 acres of habitat types that provide habitat for the Florida panther. About 37 percent of the project site (194.3 acres) contains existing paved roadway and surface waters unsuitable as habitat for panthers and their prey. Moreover, about 35 percent of the project site (183.5 acres) contains agricultural lands that provide lower quality habitat for panthers and panther prey. White-tailed deer densities and other panther prey species are influenced by the quality of the foraging habitat present in the project area. The proposed off-site mitigation will provide high-quality permanent foraging areas to regional deer populations and other panther prey species.

Habitat Assessment Methodology Application

The application of the habitat assessment methodology including the base ratio, landscape multiplier, PHU determinations, and compensation recommendations, are presented below for the Oil Well Road Widening project and compensation area.

Table 11 illustrates the PHU calculations for the Oil Well Road Widening project (including the South Grove Lakes Parcel) with impacts to 216.5 acres within the Primary Zone and 306.5 acres of impacts within the Secondary Zone, totaling 522.9 acres of land. The habitat compensation site located in the Primary zone is comprised of 363.7 acres of land. The 522.9-acre project site currently provides 645.2 PHUs in the Primary Zone and 898.1 PHUs in the Secondary Zone for a total of 1,543 PHUs. The 645.2 Primary Zone PHUs are multiplied by the 2.5 Base Ratio and a landscape multiplier of 1 for a product of 1,613.0 PHUs. The 898.1 Secondary Zone PHUs are multiplied by

the 2.5 Base Ratio and a landscape multiplier of 0.69 for a product of 1,549.2 PHUs. The lands to be impacted provide a total of 3,162.2 PHUs (1,613.0 PHUs + 1,549.2 PHUs = 3,162.2). The proposed off site compensation lands provides for a total of 3,183.9 PHUs. Therefore, the Service believes the impacts associated with the habitat lost by the proposed project will be minimized by the compensation actions proposed by the applicant.

Summary of Table 11
Panther Compensation

Oil Well Road Corridor and South Grove Lakes Site	328.6 acres	Compensation PHUs Needed	3,162.2 PHUs
Collier County Habitat Compensation Parcel	363.7 acres	Compensation PHUs Provided	3,183.9 PHUs

The lands proposed for development are on the western limits of the panther's range and panther habitat value has been diminished by agricultural development. Lands proposed for preservation are in the Primary Zone, adjacent to other natural lands, and are consistent with the Service's panther goal to strategically locate, preserve, and restore sets of lands containing sufficient area and appropriate land cover types to ensure the long-term survival of the Florida panther population south of the Caloosahatchee River.

Conservation Measures

The beneficial effects of the project includes the enhancement and preservation of 3,183.9 PHUs in the Primary Zone panther habitat. Though the project will result in a net loss in number of acres of habitat available to the panther, the habitat quality provided to the Florida panther through restoration and preservation will be of higher functional value to that of the areas to be impacted, and the habitat will be protected in perpetuity. The off-site panther habitat compensation parcels and surrounding areas are presently providing a diverse mosaic of native plant species, which provide foraging value to resident deer populations. The site will be managed to prevent infestation by exotic vegetation in perpetuity.

EFFECTS OF THE ACTION

This section analyzes the direct and indirect effects of the proposed action and interrelated and independent actions on the Florida panther and Florida panther habitat.

Factors to be Considered

Residential, commercial, and industrial development projects may have a number of direct and indirect effects on the Florida panther and panther habitat. Direct impacts, which are primarily habitat based, may include: (1) the permanent loss and fragmentation of panther habitat; (2) the permanent loss and fragmentation of habitat that supports panther prey; (3) the loss of available

habitat for feeding, breeding, and dispersing panthers; (4) a reduction in the geographic distribution of habitat for the species; (5) harassment of panthers due to construction activities; and (6) enhancement, restoration and preservation of panther habitat resulting from habitat compensation. Indirect effects may include: (1) an increased risk of roadway mortality to panthers traversing the area due to the increase in vehicular traffic; (2) increased disturbance to panthers and panther prey in the project vicinity due to human activities (human/panther interactions); (3) the reduction in value of panther habitat adjacent to the project due to habitat fragmentation; and (4) a potential increase of intraspecific aggression between panthers due to reduction of the geographic distribution of habitat of the panther. These indirect effects are habitat based, with the exception of vehicular mortality, which could result in lethal "take." Intraspecific aggression, though habitat based, could also result in lethal "take."

This project site contains panther habitat and is located within the geographic range of the Florida panther. The timing of construction for this project, relative to sensitive periods of the panther's lifecycle, is unknown. Panthers may be found on and adjacent to the proposed construction footprint year-round. The project will be constructed in a single, disruptive event, and result in permanent loss and alteration of a portion of the existing ground cover on the project site. The time required to complete construction of the project is not known, but it is likely that land clearing associated with the development will be undertaken in a single phase at the start of development activities. The disturbance associated with the project will be permanent and result in a loss of habitat currently available to the panther; however, fragmentation of habitat will not occur due to the proposed project's position in the landscape of existing development.

Analyses for Effects of the Action

The 522.9-acre Oil Well Road and the SGL project sites currently provide 328.6 acres of habitat of various quality for the Florida panther. The project site is located in the Primary Zone and Secondary Zone (Kautz et al. 2006), and is within the Service's Panther Focus Area. The project site is not located between larger publicly owned lands and much of the project site is located within or adjacent to agricultural lands. The project will result in the conversion of 522.9 acres of panther habitat and existing paved roadway and surface waters into a larger paved roadway and storm water treatment ponds. Compensation for the loss of 328.6 acres of panther habitat will be through the restoration and preservation of 3,183.9 PHUs associated with the 363.7-acre Collier County parcel containing high quality panther habitat.

Direct Effects

Direct effects are those effects that are caused by the proposed action, at the time of construction, are primarily habitat based, are reasonably certain to occur and include: (1) the permanent loss and fragmentation of panther habitat; (2) the permanent loss and fragmentation of habitat that supports panther prey; (3) the loss of available habitat for feeding, breeding, and dispersing panthers; (4) a reduction in the geographic distribution of habitat for the species; (5) harassment by construction activities; and (6) the enhancement, restoration, and preservation of panther habitat through habitat compensation. The direct effects this project will have on the Florida panther within the action area are discussed below.

Permanent Loss and Fragmentation of Panther Habitat: The project will result in the loss of 328.6 acres of panther habitat located within the Primary Zone and Secondary Zone. The land will be converted to a paved roadway and stormwater treatment ponds. The project site provides habitat of variable quality to the panther and the habitat loss may adversely affect the panther by decreasing the spatial extent of lands available to the panther.

Panthers, because of their wide-ranging movements and extensive spatial requirements, are particularly sensitive to habitat fragmentation (Harris 1984). Mac et al. (1998) defines habitat fragmentation as: "The breaking up of a habitat into unconnected patches interspersed with other habitat, which may not be inhabitable by species occupying the habitat that was broken up. The breaking up is usually by human action, as, for example, the clearing of forest or grassland for agriculture, residential development, or overland electrical lines." The reference to "unconnected patches" is a central underpinning of the definition. For panther conservation, this definition underscores the need to maintain contiguous habitat and protected habitat corridors in key locations in south Florida. Habitat fragmentation can result from road construction, urban development, and agricultural land conversions within migratory patterns of panther prey species and affect the ability of panthers to move freely throughout their home ranges. Construction of highways in wildlife habitat typically results in loss and fragmentation of habitat, traffic related mortality, and avoidance of associated human development. Roads can also result in habitat fragmentation, especially for females who are less likely to cross them (Maehr 1990).

The project will include the construction of two wildlife underpasses (each 8 feet by 24 feet) with barrier fencing immediately north and south of the roadway within the Camp Keais Strand. The wildlife underpasses will allow panthers and other wildlife species to safely cross under the roadway. Accordingly, we believe fragmentation of panther habitat is not expected to result from project implementation.

Permanent Loss and Fragmentation of Habitat that Supports Panther Prey: The project site and lands adjacent to the project site support panther prey species such as white-tailed deer and feral hog. However, few deer and hog tracks were observed during wildlife surveys conducted by the applicant's consultant. A significant portion of the project site contains agricultural lands that provide lower quality habitat for panther prey species. The project will result in the loss of about 328.6 acres of habitat available for use by panther prey species. The project will include the construction of two wildlife underpasses (each 8 feet by 24 feet) with barrier fencing immediately north and south of the roadway within the Camp Keais Strand. The wildlife underpasses will allow panther prey species such as deer and hog to safely cross under the roadway. Therefore, as a result of our analysis, fragmentation of panther prey habitat is not expected.

Loss of Available Habitat for Feeding, Breeding, and Dispersing Panthers: The site is bounded by existing development along the western portion of the project corridor. Agricultural lands occur throughout much of the remainder of the corridor excluding the Camp Keais Strand. Though habitat use of the site may be of limited value to the panther for feeding and breeding, it still has value to dispersing panthers. Thus, habitat loss may adversely affect the panther by decreasing the spatial extent of lands available to the panther dispersing, and to a lesser extent, breeding and feeding.

Reduction in the Geographic Distribution of Habitat for the Species: The project will result in the loss of about 328.6 acres of non-developed land within the Panther Focus Area. This loss represents only 0.02 percent of the 1,962,294 acres of available non-urban private lands in south Florida in the Service's panther core area of the Florida panther (Table 6). The Service finds the habitat values lost by the development will be minimized by the preservation and restoration actions proposed by the applicant. The lands proposed for development are adjacent to an existing paved roadway, developed residential areas along the western portion of the project corridor, and active agricultural along most of the remainder of the project corridor. The lands proposed for preservation are consistent with the Service's panther conservation strategy to locate, preserve, and restore sets of lands containing sufficient area, access, and appropriate cover types to ensure the long-term survival of the Florida panther south of the Caloosahatchee River.

Harassment by Construction Activities: The timing of construction for this project, relative to sensitive periods of the panther's lifecycle, is unknown. However, land clearing associated with the road widening will be completed in a single phase at the start of development activities. There are no known den sites within the project boundaries and the quality and quantity of the habitat foraging base for prey species is low. Therefore, we find that panther usage of the property is limited and project construction will not result in direct panther mortality, but may result in temporary disturbance to resident or dispersing panthers.

Compensation: The applicant's proposed preservation includes the purchase of 3,183.9 PHUs, which equates to about 363.7 acres of Primary Zone panther habitat. Much of the lands proposed for development have been disturbed for agricultural and residential development purposes, but are located within occupied range of the Florida panther. The lands proposed for preservation are connected to other larger tracts of preserved lands and are consistent with the Service's panther goal to locate and preserve sets of lands containing sufficient area and appropriate cover types to ensure the long-term survival of the Florida panther south of the Caloosahatchee River.

Interrelated and Interdependent Actions

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. No interrelated or interdependent actions are expected to result from the project.

Indirect Effects

Indirect effects are those effects that result from the proposed action and are reasonably certain to occur. The indirect effects this project will have on the Florida panther within the action area are discussed below and in the assessment of functional habitat values previously discussed. They include: (1) an increased risk of roadway mortality to panthers traversing the area due to the increase in vehicular traffic; (2) increased disturbance to panthers and panther prey in the project vicinity due to human activities (human/panther interactions); (3) a potential increase of intraspecific aggression between panthers due to reduction of the geographic distribution of habitat of the panther.

Increased Risk of Roadway Mortality: In evaluating a project's potential to increase roadway mortality to the Florida panther, we consider the location of the project in relation to surrounding native habitats, preserved lands, and wildlife corridors that are frequently used by the Florida panther. We also consider the current configuration and traffic patterns of surrounding roadways and the projected increase and traffic patterns expected to result from the proposed action. We evaluate the habitats present on-site, their importance in providing feeding needs for the Florida panther and panther prey species, and if the site development would further restrict access to surrounding lands important to the Florida panther and panther prey species.

Vehicular mortality and injury data (see Table 9 and Figure 10) provided by the FWC indicate collisions with motor vehicles have been increasing in the 25-mile radius project action area. From 1990 through 1999, there were 12 panther deaths resulting from vehicle collisions in the project action area, which equates to an average of 1.2 collisions per year. From 2000 through 2007, there have been 51 panthers killed by vehicle collisions, which equates to an average of 6.4 panther deaths per year. Of the 84 documented collisions in the action area, 48 (57 percent) have occurred more than 10 miles away from the project site; 12 (14 percent) have occurred within 5 miles of the project site. The closest collision occurred in 2008 about 0.7 miles east of the project sit. The most recent collision occurred on State Road 29 about 7 miles north of the project site in January 2009.

The projected widening of Oil Well Road is not expected to increase traffic in the project area. Although, traffic on Oil Well Road and roads within the project area is expected to increase as development of the area occurs. The Collier County Transportation Department and Metropolitan Planning Office have predicted traffic increases on the regional road network including Immokalee Road, Oil Well Road, and Camp Keais Road. To minimize the risk of vehicle-related panther mortality within the Oil Well Road corridor, the applicant will construct two wildlife underpasses (each 8 feet by 24 feet) with barrier fencing immediately north and south of the roadway within the Camp Keais Strand. The wildlife underpasses will provide crossing sites where panthers and other wildlife species can safely cross under the roadway. The risk to the panther from collisions with vehicles as a result of the Oil Well Road widening project is difficult to quantify. However, we find it is unlikely that the traffic using the widened roadway will significantly increase the risk of roadway mortality to panthers.

Panther and Prey Disturbance (Panther/Human Interactions): Potential increases in disturbance to the Florida panther and panther prey were evaluated. As discussed previously in our assessment of fragmentation, we considered habitat quality related factors and occurrence data for the Florida panther and panther prey species. This information is also the basis of our evaluation of disturbance to the Florida panther and to panther prey species. A significant portion of the existing habitat on the project site consists of agricultural lands that provide lower quality habitat to the panther's primary prey species. Moreover, the project site already provides significant disturbance to wildlife from heavy vehicle use on the existing two-lane Oil Well Road. Though panthers and panther prey may occasionally use the habitats within the project area, we find that panther usage of the property is infrequent and we do not expect project construction to result in a significant increase in panther/human interactions and prey disturbance.

Intraspecific Aggression: Potential increases in intraspecific aggression and disturbance to the Florida panther were evaluated. As discussed previously in our assessment of fragmentation and habitat for panther and panther prey, we considered habitat quality related factors and occurrence data for the Florida panther and panther prey species as factors affecting intraspecific aggression.

A total of 39 panther deaths due to intraspecific aggression (38 confirmed and one unconfirmed) have occurred within the 25-mile action area. In the past 5 years, there has been one unconfirmed panther death due to intraspecific aggression within 10 miles of the project site. The panther was a 9 year old collared male panther found about 7.7 miles south of the project site in November 2004. The most recent death occurred about 22 miles east of the project site in February 2009. The project area is largely bounded by lands converted to agricultural uses and some existing development occurs near the western boundary. As previously discussed, the habitats on the property provide for low quality feeding for panther prey, which directly affects the frequency and duration of use of the property by panthers. The reduction in the geographic range of habitat for feeding or dispersal may contribute to a potential increased risk of harm and harassment of panthers in the action area due to intraspecific aggression.

Species Response to the Proposed Action

The proposed action will result in increased human activity and noise in the project area during construction of the project. However, since panthers are not commonly known to use lands within and adjacent to the project site, activities associated with construction of the Oil Well Road widening project are not anticipated to significantly increase risk of disturbance to panthers, though some temporary disturbance may occur.

The project will result in the loss of a relatively small amount, 328.6 acres, of potential panther habitat. According to the most current home range estimates of the Florida panther (Lotz et al. 2005), this loss represents 1.1 percent of a female panther's average home range (29,059 acres) and 0.5 percent of a male panther's average home range (62,542 acres). The project area provides mostly poor quality habitat for panther prey and panthers are not known to commonly use the project area. However, the loss of habitat may contribute to increases in intraspecific aggression through decreasing the spatial extent of lands available to the panther for feeding, breeding, and dispersing. We anticipate any resident panthers with home ranges overlapping or in the vicinity of the project area will adjust the size and location of their ranges to account for this loss and that adjustment is anticipated to occur in concert with project construction.

Panthers are sensitive to habitat fragmentation. However, the project will include the construction of two wildlife underpasses (each 8 feet by 24 feet) with barrier fencing immediately north and south of the roadway within the Camp Keais Strand. The wildlife underpasses will allow panthers and other wildlife species to safely cross under the roadway. Therefore, fragmentation of panther habitat is not expected to result from project implementation.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, Tribal, local, or private actions reasonably certain to occur in the action area considered in this biological opinion. To identify future

private actions that would affect panthers and that may reasonably be certain to occur in the action area, the Service first identified the types of land alteration actions that could occur in the action area, then developed a mechanism to distinguish between those that will require future federal review and those that are not likely to be a future federal action, and thus meet the cumulative effects definition. To estimate future non-federal actions, the Service chose to identify and tabulate recent past non-federal actions and project this level of development as representative of future non-federal actions.

Within the action area, past and ongoing State and County actions affecting panther habitat include: (1) State of Florida DRI Orders (2003 to 2006); (2) Collier County's Planned Unit Developments (PUDs) (2003 to 2006); (3) Lee County's PUDs (2003 to 2006); and (4) South Florida Water Management District's Environmental Resource Permits (2003 to 2006) (Figure 12). To evaluate these effects, the Service incorporated the Florida Land Use, Cover and Forms Classification System (FLUCCS) mapping to determine properties that may be exempt from Federal Clean Water Act section 404 wetland regulatory reviews by the Corps. To determine which of these projects would likely be exempt from Federal Clean Water Act section 404 wetland regulatory reviews by the Corps, we identified the percentage of the project site that was classified as wetland habitat, based on the FLUCCS mapping units. The mapping units relied on by the Service included the 600 series (wetland classifications) and the 411 and 419 pine flatwood classifications (hydric pine systems). For listing purposes, properties with less than 5 percent wetlands were considered by the Service to be generally exempt from regulatory review as these quantities of wetlands could be avoided by project design.

Within the action area, based on FLUCCS mapping, 76 projects affecting 7,007 acres could be expected to be subject to development without Federal permit involvement through the Clean Water Act section 404. Within this action area, 8 projects representing 707 acres are within the panther Primary Zone, 16 projects representing 1,632 acres are within the Secondary Zone, and 52 projects representing 4,668 acres are outside the Panther Focus Area, some located in urban areas. For our assessment purposes, only those projects within the Panther Focus Area are likely to have an adverse effect to the Florida panther and represent 2,339 acres. This level of development represents 8 percent of a female panther's average home range (29,059 acres) and 3.7 percent of a male panther's average home range (62,542 acres).

State and County land alteration permits in southwest Florida not part of those actions listed above, generally included single-family residential developments within Northern Golden Gate Estates and Lehigh Acres. Vacant lands within the area of Northern Golden Gate Estates (north of I-75), also within the action area, totaled about 34,028 acres as of September 2004 (Figure 13). To evaluate these effects, the Service overlaid the plat boundaries on 2004 aerials, queried the parcel data from Collier County's Property Appraisers Office, noted lots with developments, compared those to 2003 aerials, and noted the changes. Vacant lands within the area of Northern Golden Gate Estates (north of I-75) totaled about 35,768 acres as of August 2003. The breakdown of acres for August 2003 is: (1) wetlands, about 17,572 acres; (2) uplands, about 17,990 acres; and (3) water, about 210 acres. These changes were overlain on the National Wetlands Inventory (NWI) maps for presence of wetlands. This evaluation was used to estimate the acreage of properties that may be exempt from Federal Clean Water Act section 404 wetland regulatory

reviews by the Corps. A comparison of the 2003 and 2004 data for Northern Golden Gate Estates indicates about 1,740 acres of land were converted from vacant to developed with the breakdown as: (1) wetlands, about 696 acres; and (2) uplands, about 1,740 acres.

The evaluation process provided an estimate of 417 lots totaling 1,740 acres for Northern Golden Gate Estates. Therefore, using NWI mapping for the Northern Golden Gate Estates, a total of about 1,740 acres could be expected to be subject to development in a year in these areas without Federal permit involvement. We expect that this level of annual development in Northern Golden Gate Estates has not significantly changed between 2004 and 2007. Based on historical records for wetland permits issued by the Corps for these areas, most of these projects will involve the construction of single-family residences in partially developed areas and will involve less than an acre of impact. This level of development represents 3.59 percent of a female panther's average home range (29,059 acres) and 1.67 percent of a male panther's average home range (62,542 acres).

Vacant lands within the area of Lehigh Acres, also within the action area, totaled about 34,852 acres as of April 2003 (Figure 14). The breakdown of acres is: (1) wetlands, about 1,057 acres; (2) uplands, about 33,592 acres; and (3) water, about 202 acres. A review of aerial photography and Lee County building permit data for Lehigh Acres from the 1-year period prior to April 2003, indicates about 441 acres of land was converted from vacant to occupied, during the 1-year period. The breakdown of converted acres is estimated as: (1) wetlands, 66 acres; (2) uplands, 375 acres; and (3) water, 0 acres. Therefore, using NWI mapping, about 375 acres could be expected to be subject to development in a year in this area without Federal permit involvement. We expect that this level of annual development in Lehigh Acres has not significantly changed between 2004 and 2007.

In conclusion, the Service's cumulative effects analysis has identified about 9,122 acres within the Panther Focus Area in the project action area that could be developed without Federal wetland permit involvement (7,007+ 1,740 + 375 = 9,122). This level of development, which the Service regards as representative of future non-Federal actions, is reasonably certain to occur and, therefore, meets the definition of cumulative effect. This level of projected future development represents 31.4 percent of a female panther's average home range (29,059 acres) and 14.6 percent of a male panther's average home range (62,542 acres). Impacts will be scattered with a considerable percentage located on the fringes of occupied panther habitat and/or supporting disturbed vegetative communities, agriculture, or in partially developed areas. These lands represent 0.46 percent of the non-urban private lands at risk in the Service's panther core area (1,962,294 acres) (Table 6). Based on the above analysis, we find that the loss of the habitat associated with these lands, though insignificant in the short term, may adversely impact the panther as development continues to occur in the future in the action area. The Service has accounted for some habitat loss and changes in habitat quality through its habitat assessment methodology and is encouraging state and county environmental staff to pursue the section 10 (HCP) process to account for and compensate for adverse effects to the Florida panther.

SUMMARY OF EFFECTS

Florida Panther

Panther Usage: The timing of construction for this project, relative to sensitive periods of the panther's lifecycle, is unknown. However, it is likely all land clearing associated with the development will be completed in phases over several months. There are no known den sites within the project boundaries and the quality and quantity of the panther's prey base is low. Though panthers likely use the habitats within the project's action area, we regard panther usage of the project site as infrequent and we do not expect that project construction will result in direct panther mortality, but may result in temporary disturbance to resident or dispersing panthers.

Traffic: The widening of Oil Well Road is not expected to increase traffic within the project corridor. Traffic on Oil Well Road and roads within the project area is expected to increase as development of the area occurs. The Collier County Transportation Department and Metropolitan Planning Office have predicted traffic increases on the regional road network including Immokalee Road, Oil Well Road, and Camp Keais Road. To minimize the risk of vehicle-related panther mortality within the Oil Well Road corridor, the applicant will construct two wildlife underpasses (each 8 feet by 24 feet) with barrier fencing immediately north and south of the roadway within the Camp Keais Strand. The wildlife underpasses will provide crossing sites where panthers and other wildlife species can safely cross under the roadway. The risk to the panther from collisions with vehicles as a result of the Oil Well Road widening project is difficult to quantify; however, we find it unlikely that the traffic using the widened roadway will significantly increase the risk of roadway mortality to panthers.

Habitat Loss: The Service, based on the habitat evaluations discussed previously, believes the project will result in the direct and indirect loss of about 328.6 acres of mostly low quality panther habitat within the Primary Zone (see discussion under Wildlife Assessment). Habitat types are primarily lands converted to agricultural uses and other natural communities. We expect that panther usage of the site is limited; however, the permanent loss of habitat is anticipated to adversely affect the panthers in the action area by decreasing the spatial extent of lands available for feeding, breeding, and dispersing. This loss of about 328.6 acres of panther habitat represents 0.02 percent of the 1,962,294 acres of available non-urban private lands in the Service's panther core area. This small loss (0.02 percent) of non-urban private lands on the western edge of the panther's range will not adversely affect the Service's land conservation and preservation goals.

Compensation: The project will provide for the purchase of 3,183.9 PHUs of Primary Zone habitat which equates to about 363.7 acres of panther Primary Zone habitat. The functional value of the habitats to the panther will be maintained long-term through the removal of exotic vegetation and hydrological restoration. The preservation of these lands in the Service's panther core area represents 0.05 percent of the 799,205 acres of private lands still needed for the population of 90 individuals. The restoration and preservation of about 363.7 acres of panther habitat in the Primary Zone will minimize the impact of the loss of 328.6 acres of lower quality habitat to the panther and will further the Service's panther conservation goal.

The proposed compensation plan, which provides habitat preservation and restoration inside the project action area, benefits the survival and recovery of the Florida panther as referenced in the draft Panther Recovery Plan (Service 2006b) goal 1.1.1.2.3. This goal recommends habitat preservation and restoration within the Primary Zone be provided in situations where land use intensification can not be avoided. The applicant has proposed equivalent habitat protection and restoration, to compensate for both the quantity and functional value of the lost habitat.

Fragmentation: The project will include the construction of two wildlife underpasses (each 8 feet by 24 feet) with barrier fencing immediately north and south of the roadway within the Camp Keais Strand. The wildlife underpasses will allow panthers and other wildlife species to safely cross under the roadway. Therefore, fragmentation of panther habitat is not expected to result from project implementation.

Intraspecific Aggression: Potential increases in intraspecific aggression and disturbance to the Florida panther were evaluated. The Service believes, as previously discussed, the habitat on the property provides low quality foraging for prey species, which directly affects the frequency and duration of use of the property by panthers. However, the reduction in the geographic range of habitat for feeding and dispersal may contribute to a potential increased risk of harm and harassment of panthers in the action area due to intraspecific aggression.

Cumulative Analysis: In the cumulative analysis, the Service identified the potential loss of about 9,122 acres within the Panther Focus Area in the action area that could be developed without Federal wetland permit involvement and we consider this level of development as representative of future non-Federal actions expected to occur in the action area. This level of development represents a small percentage (0.18 percent) of the 1,962,294 acres of available non-urban private lands in the core area. Impacts will be scattered with a considerable percentage located on the fringes of occupied panther habitat and/or supporting disturbed vegetative communities, agriculture, or in partially developed areas. These lands represent 0.18 percent of the non-urban private lands at risk in the Service's panther core area (1,962,294 acres) (Table 6).

Based on the above analysis, we believe the loss of the habitat associated with these lands may adversely impact the panther, however difficult to quantify, as is increased risk of vehicular collisions, as development continues to occur in the future in the action area. The Service has accounted for some habitat loss and changes in habitat quality through its habitat assessment methodology and is encouraging state and county environmental staff to pursue the section 10 (HCP) process to account for and compensate for adverse effects to the Florida panther. Although this small percentage of lands may be lost from the core area of private lands available for panther conservation, the Service finds that the loss of these lands will not adversely affect our land conservation and preservation goals.

Conservation Land Acquisitions: The State and County land acquisition programs acquired 3,924 acres of lands within the action area from 2003 to 2007 (Table 10), which represents 0.49 percent of the 799,205 acres of private lands still needed for the population of 90 individuals. These lands are generally located within the core lands of the Florida panther and are intended to be actively managed for the benefit of many wildlife species including the Florida panther. The preservation of these lands in the panther core lands will have a beneficial effect on the panther and further the Service's goal in panther conservation.

CONCLUSION

In conclusion, the Service believes there will be no direct take in the form of mortality or injury of the Florida panther resulting from this project. However, the motor vehicle traffic using the project corridor and the potential increase in intraspecific aggression in the action area as a result of the project may potentially contribute to indirect take of panthers in the form of death or injury. This indirect take is difficult to quantify due to the wide-ranging habit of the species and the challenge of linking the death or injury of a single panther to increases in panther interactions (intraspecific aggression) or traffic using the roadway as a result of the Oil Well Road Widening project. The adverse affects of roadway traffic and intraspecific aggression are not anticipated to appreciably diminish or preclude the survival and recovery of the panther.

According to the most current home range estimates of the Florida panther (Lotz et al. 2005), the loss of about 328.6 acres of panther habitat represents 1.13 percent of a female panther's average home range (29,059 acres) and 0.51 percent of a male panther's average home range (62,542 acres). This loss represents 0.02 percent of the 1,962,294 acres of available non-urban private lands in the Service's panther core area.

As discussed previously, the habitat to be impacted constitutes only a fraction of the panther's occupied habitat. The loss of habitat from implementing the project will be minimized by the conservation and restoration of about 363.7 acres of high value panther habitat in the Primary Zone. Additionally, the status of the species, remaining habitat, and other factors considered in this biological opinion, such as the overall recovery objectives and other cumulative effects from actions in the action area, have been accounted for in our decision. Taking all of the above into consideration, the Service believes the proposed construction and operation of the Oil Well Road Widening project is not likely to jeopardize the continued existence of the Florida panther. Critical habitat has not been designated for this species; therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. "Take" is defined as to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct." "Harm" is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking, that is incidental to and not intended as part of the agency action, is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

AMOUNT OR EXTENT OF TAKE

The Service anticipates that incidental take of the Florida panther will be difficult to detect for the following reasons: (1) the Florida panther is wide-ranging and occasionally uses the site; (2) the lands on the project site provide high quality habitat to the Florida panther and panther prey species; and (3) lands adjacent to the project site consist of residential development, agricultural operations, and natural lands.

The Service does not anticipate direct incidental take because project construction is an intensive disturbance action that will preclude site use by panthers or panther prey species. Upon project completion and occupation, habitat suitability for use by either resident or dispersing panthers will be reduced. Therefore, the Service does not anticipate project construction or post-construction activity will result in the direct mortality or injury of any Florida panthers.

However, the Service anticipates indirect take of the panther in the form of harassment and harm due to traffic using the roadway and the potential interspecific aggression within the 25-mile radius action area. Traffic and interspecific aggression are risks to the panther that are cumulative in nature, and, as such, they are difficult to quantify or to tie to any specific project.

Although there is a potential for indirect take to occur as described above, we find that the level of incidental take resulting from the loss of 328.6 acres of panther habitat within the Primary Zone and Secondary Zone is moderated by the 363.7 acres of Primary Zone habitat which will be enhanced and preserved to benefit the Florida panther and its prey. The impact area represents a loss of 645.2 PHUs in the Primary Zone and 898.1 PHUs in the Secondary Zone. The 2.5 base multiplier is multiplied to the 645.2 PHUs in the Primary Zone and then multiplied by a landscape multiplier of 1 to yield 1,613 PHUs. The 2.5 base multiplier is also multiplied to the 898.1 PHUs in the Secondary Zone, and then multiplied by a landscape multiplier of 0.69 to yield 1,549.2. Adding the 1,613 Primary Zone PHUs to the 1,549.2 Secondary Zone PHUs results in a recommended compensation value of 3,162.2 PHUs. The proposed compensation provides 3,183.9 PHUs.

The loss of 328.6 acres of panther habitat is equivalent to 1.13 percent of a female panther's home range (29,059 acres) and 0.53 percent of a male panther's home range (62,542 acres), using the conservative estimates. Since we do not expect the direct mortality of panther to result from the project, the acreage being lost equates to a fraction of a panther's home range, and the proposed mitigation is providing panther habitat value similar to what is being lost, the Service finds that the level of incidental take anticipated by this permit will not result in jeopardy of the species.

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined this level of anticipated take is not likely to result in jeopardy to listed species or destruction or adverse modification of critical habitat to either species.

REASONABLE AND PRUDENT MEASURES

The Service finds that the Corps and the applicant have developed a project that has conservation measures necessary and appropriate to minimize the effect of incidental take of the Florida panther. In summary, to compensate for impacts to 328.6 acres of panther habitat, Collier County proposes to enhance and preserve about 363.7 acres of habitat suitable for panthers.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must comply with the following terms and conditions which implement the reasonable and prudent measures described above and outline reporting and monitoring requirements. The terms and conditions described below are non-discretionary, and must be undertaken by the Corps so they become binding conditions of any grant or permit issued to Collier County as appropriate, for the exemption in section 7(o)(2) to apply.

The Corps has a continuing duty to regulate the activity covered by this Incidental Take Statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require Collier County to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the permit or grant document, the protection coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps or Collier County must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement (50 CFR § 402.14(i)(3)). Although we have not identified any specific Reasonable and Prudent Measures not incorporated in the project, we are providing the following for clarification:

1. An initial treatment will be conducted on the preservation site to remove invasive and exotic vegetation, within six months of the issuance of the Corps' permit. Invasive and exotic plant species are defined by the Florida Exotic Pest Plant Council's Pest Plant List Committee's 2007, or most recent, List of Invasive Species (Category 1)(2007).

2. The preservation site will be managed in perpetuity for the control of invasive exotic vegetation as defined by the Florida Exotic Pest Plant Council's Pest Plant List Committee's 2007, or most recent, List of Invasive Species (Category 1)(2007) and managed for the benefit of the Florida panther. This will be accomplished by donation of the preservation site to the State of Florida for incorporation into the Florida Department of Environmental Protection's Fakahatchee Strand Preserve State Park. The donation of the preservation site will occur within 1 year of the date of issuance of the Corps' permit.

3. A non-wasting management trust fund will be established to provide for the maintenance and management of the preservation site in perpetuity. The amount of the non-wasting trust fund shall be $329,667, based upon an assumed cap rate of 3 percent, and will be used to provide for long-term management and maintenance needs of the preservation site. Should the applicable cap rate be greater than 3 percent at the time of fund establishment, the permittee may request from the Service, an adjustment to the fund, based on the current acceptable cap

rate. The non-wasting management trust fund will be donated to the Friends of the Park, or other agent agreeable to the Service, to administer the fund and ensure continued management of the parcel is achieved. The donation of the non-wasting management trust fund for the preservation site will occur within 1 year of the date of issuance of the Corps' permit.

4. The Corps will provide a copy of the final permit to the Service upon issuance. The Corps will monitor the permit conditions regarding conservation measures to minimize incidental take of panthers by providing the Service a report on implementation and compliance with the conservation measure within 1 year of the issuance date of the permit;

5. Upon locating a dead, injured, or sick threatened or endangered species, initial notification must be made to the nearest Service Law Enforcement Office; Fish and Wildlife Service; 9549 Koger Boulevard, Suite 111; St. Petersburg, Florida 33702; 727-570-5398. Secondary notification should be made to the FWC; South Region; 3900 Drane Field Road; Lakeland, Florida; 33811-1299; 1-800-282-8002; and

6. Care should be taken in handling sick or injured specimens to ensure effective treatment and care or in the handling of dead specimens to preserve biological material in the best possible state for later analysis as to the cause of death. In conjunction with the care of sick or injured panthers or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

CONSERVATION RECOMMENDATIONS

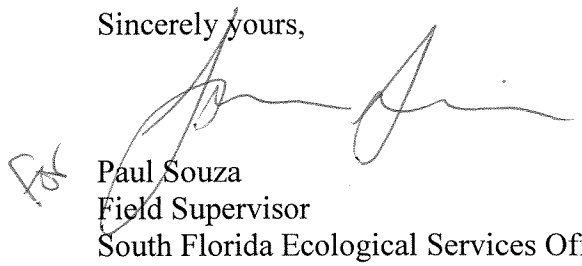
Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service is not proposing any conservation recommendations at this time.

REINITIATION NOTICE

This concludes formal consultation on the Oil Well Road Widening project. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded (see below); (2) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; (3) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. The amount of incidental take authorized by this consultation may be exceeded should impacts from the proposed project increase or mitigation fail to provide habitat values proposed and analyzed within this biological opinion. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Thank you for your cooperation and effort in protecting fish and wildlife resources. If you have any questions regarding this project, please contact Allen Webb at 772-562-3909, extension 246.

Sincerely yours,



Paul Souza
Field Supervisor
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Table 1. Results of the wood stork foraging habitat assessment* for Wetlands within the project corridor and the Camp Keais wetland mitigation site before and following enhancement activities.

Wetland Hydroperiod Class **	Project Corridor		Camp Keais Wetland Mitigation Site				Net Change	
			Pre-Enhancement		Post Enhancement			
	Acres	Forage Fish Biomass (Kilograms)	Acres	Forage Fish Biomass (Kilograms)	Acres	Forage Fish Biomass (Kilograms)	Acres***	Forage Fish Biomass (Kilograms)****
Short Hydroperiod	32.78	47.120	79.89	58.318	62.82	132.080	-49.85	26.642
Long Hydroperiod	16.81	149.491	445.15	3883.531	462.22	4323.231	0.26	290.209
TOTALS	49.59	196.611	525.04	3941.849	525.04	4455.311	-49.59	316.851

* The wood stork foraging habitat methodology can found in the Service's November 9, 2007, Eastern Indigo Snake and Wood Stork Key (Service Federal Activity Code Number 41420-2007-FA-1494) provided to the U. S. Army Corps of Engineers (Corps) to guide their effect determinations for these species.

** For purposes of this analysis: "Short Hydroperiod" wetlands are defined as all Class 1 (0-60 days standing water), Class 2 (60 to 120 days standing water), and Class 3 (120 to 180 days standing water) combined; "Long Hydroperiod" wetlands are defined as all Class 4 (180 to 240 days standing water), Class 5 (240 to 300 days standing water), Class 6 (300 to 330 days standing water), and Class 7 (330 days to 360 days standing water) combined.

*** The acreage net change is based on the overall increase/decrease in suitable wood stork foraging habitat within the project. In this analysis all wetlands were considered suitable for wood stork foraging. The project will result in the loss of 49.59 acres of Short Hydroperiod wetlands within the development footprint and the preservation of 525.04 acres in the preserve areas.

****The biomass net change is based on the overall increase/decrease of fish biomass available to wood storks. The proposed development will result in a loss of 196.611 kg of biomass. The preserve, prior to enhancement will provide a biomass of 3941.849 kg, with a post enhancement value of 4455.311 kg, equating to a net increase of 316.851 kg of biomass (4455.311Kg post enhancement – 3941.849 pre-enhancement – 196.611 Kg existing footprint = 316.851kg.

Table 2. *Targeted and Acquired Acreage Totals of Conservation Lands in South Florida directly affecting the Panther within the Panther Focus Area.

Name	Targeted[1] Acreage	Acquired Acreage	Indian Reservation
Federal Conservation Lands			
Everglades National Park	1,508,537	1,508,537	--
Big Cypress National Preserve	720,000	720,000	--
Florida Panther National Wildlife Refuge	26,400	26,400	--
Subtotal	**2,254,937**	**2,254,937**	--
State of Florida: Florida Forever Program			
Belle Meade	28,505	19,107	--
Corkscrew Regional Ecosystem Watershed	69,500	24,028	--
Twelvemile Slough	15,653	7,530	--
Panther Glades	57,604	22,536	--
Devil's Garden	82,508	0	--
Caloosahatchee Ecoscape	18,497	2,994	--
Babcock Ranch	91,361	0	--
Fisheating Creek	176,760	59,910	--
Subtotal	**540,388**	**136,105**	--
State of Florida: Other State Acquisitions			
Water Conservation Area Number 3	491,506	491,506	--
Holey Land Wildlife Management Area	33,350	33,350	--
Rotenberger Wildlife Management Area	25,019	20,659	--
Fakahatchee Strand State Preserve	74,374	58,373	--
Picayune Strand State Forest	55,200	55,200	--
Okaloacoochee Slough State Forest and WMA	34,962	34,962	--
Babcock-Webb Wildlife Management Area	79,013	79,013	--
Subtotal	**793,424**	**773,063**	--
Indian Reservations[2]			
Miccosukee Indian Reservation	--	--	81,874
Big Cypress Seminole Indian Reservation	--	--	68,205
Brighton Seminole Indian Reservation	--	--	37,447
Subtotal	**--**	**--**	**187,526**
GRAND TOTALS	**3,588,749**	**3,164,105**	**187,526**

[1]Targeted acres not available for all lands. In Such cases, targeted equals acquired acreage.
[2] Indian lands are included due to their mention in the MSRP. Acreages taken from GIS data.
*Table 1 was excerpted from the Brief of Amicus (2003). However, the lands shown as acquired in this table may include some private in-holdings and may include lands currently under sales negotiations or condemnation actions.

Table 3. Habitat preservation efforts resulting from formal and informal consultations with the Service for projects affecting Florida panther habitat from March 1984 through June 2008.

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
03/29/84	4-1-83-195	83M-1317	CMC Development Corporation (Ford Test Track)	Collier	530	0	0	0
02/21/85	4-1-85-018	FAP #?	USDOT, FHA (conversion of Hwy 84 to I-75)	Broward Collier	1,517	0	0	0
10/17/86	4-1-87-016 4-1-87-017	unknown	NPS, BCNP (Exxon Master Plan Modification)	Collier	9	0	0	0
01/07/87	4-1-86-303	86IPM-20130	Collier Enterprises (citrus grove)	Collier	11,178	0	0	0
01/11/88	4-1-88-029	unknown	NPS, BCNP (NERCO - Clements Energy, Inc.)	Collier	3	0	0	0
02/23/88	4-1-88-055	unknown	NPS, BCNP (Shell Western E&P, Inc.)	Collier Dade Monroe	0	0	0	0
02/10/89	4-1-89-001	FAP IR-75-4(88)81	USDOT, FHA (SR 29/I-75 Interchange)	Collier	350	0	0	0
08/15/90	4-1-90-289	unknown	NPS, BCNP [I-75 Rec. Access Plan (MM 31, 38, 49)]	Collier	150	0	0	0
09/24/90	4-1-90-212	89IPD-20207	U.S. Sugar Corp (46 mi2 ag conversion)	Hendry	28,740	700	0	700
03/12/91	4-1-91-229	90IPO-02507	Lourdes Cereceda (commercial rock mine)	Dade	97	0	0	0
01/14/92	4-1-91-325	199101279 (IP-HH)	Dooner Gulf Coast Citrus (32 acre citrus grove)	Collier	40	40	0	40
09/25/92	4-1-92-340	unknown	BIA, STOF, BCSIR (1,995 acre citrus grove)	Hendry	1,995	0	0	0
06/18/93	4-1-93-217	199200393 (IP-SL)	Lee County DOT (Corkscrew Road)	Lee	107	0	0	0
02/25/94	4-1-94-209	199301131 (IP-KC)	Lee County DOT (Daniels Road extension)	Lee	65	0	0	0
05/09/94	4-1-93-251	199202019 (IP-KA)	Corkscrew Enterprises (The Habitat)	Lee	900	100	100	200

Table 3. Continued.

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
10/27/94	4-1-94-430	199302371 (IP-BB) 199400807 (IP-BB) 199400808 (IP-BB)	Timberland and Tiburon Florida Gulf Coast University Treeline Boulevard	Lee	1,088	526	0	526
05/24/95	4-1-95-230	199302130 (IP-TB)	FDOT, I-75 (Turner River access @ MM 70)	Collier	1,936	0	0	0
08/07/95	4-1-95-274	199405501 (IP-AW)	Bonita Bay Properties, Inc. (golf course)	Collier	509	491	0	491
08/15/95	4-1-94-214	199301495 (IP-MN)	SWFIA, Northeast Access Road	Lee	14	0	0	0
09/19/96	4-1-95-F-230	199302052 (IP-TB) 199301404 (IP-TB)	FDOT, I-75 (Central and West Broward access) FDOT, I-75 (Miami Canal Access)	Broward	116	0	0	0
03/10/98	4-1-98-F-3	L30(BICY)	NPS, BCNP (Calumet Florida, Inc. seismic testing)	Collier Dade Broward	0	0	0	0
03/27/98	4-1-97-F-635	199604158 (IP-SB)	Bonness, Joseph D., Jr. Trustee (Willow Run Quarry)	Collier	359	190	0	190
06/11/99	4-1-98-F-398	199800622 (IP-SS)	STOF, BCSIR (water conservation plan)	Hendry	1,091	0	0	0
09/27/99	4-1-98-F-310	199130802 (IP-SB)	Lee County DOT (Daniels Parkway extension)	Lee	2,093	0	94	94
12/08/99	4-1-98-F-517	199607574 (IP-MN)	Kaufmann Holdings, Inc. (Cypress Creek Farms)	Collier	239	0	24	24
04/17/00	4-1-98-F-428	199507483 (IP-AM)	Miromar Development, Inc. (Miromar Lakes)	Lee	1,323	0	194	194
06/09/00	4-1-99-F-553	199900619 (IP-SB)	Vineyards Development Corp. (Naples Reserve GC)	Collier	833	0	320	320

Table 3. Continued.

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
02/21/01	4-1-00-F-135	199803037 (IP-SR)	Wortzel & Landl, Co-Trustees (Corkscrew Ranch)	Lee	106	0	0	0
04/17/01	4-1-00-F-584	200001436 (IP-MN)	WCI Communities, Inc. (Sun City - Ft. Myers)	Lee	1,183	0	408	408
07/30/01	4-1-94-357	199003460 (IP-TB)	Naples Golf Estates	Collier	439	175	0	175
08/31/01	4-1-00-F-183	199900411 (IP-SR)	Worthington Communities, Inc. (Colonial G&CC)	Lee	1,083	0	640	640
12/14/01	4-1-00-F-585	199301156 (IP-MN)	SWFIA, Mid-field Terminal Expansion	Lee	8,058	0	6,986	6,986
01/30/02	4-1-98-F-372	199402492 (IP-ML)	Florida Rock Industries, Inc. (Fort Myers Mine #2)	Lee	2,913	1,959	0	1,959
03/07/02	4-1-00-F-178	199901251 (IP-MH)	Benton, Charles (Southern Marsh GC)	Collier	121	75	80	155
04/24/02	4-1-01-F-148	199901378 (IP-SR)	Schulman, Robert, Trustee (Hawk's Haven)	Lee	1,531	267	0	267
09/24/02	4-1-01-F-135	200001574 (IP-DY)	State Road 80, LLC (Verandah)	Lee	1,456	0	320	320
10/08/02	4-1-02-F-014	199602945 (IP-DY)	Barron Collier Company (Winding Cypress)	Collier	1,088	840	1,030	1,870
05/19/03	4-1-02-I-1741	200200970 (IP-DEY)	Apex Center	Lee	95	10	18	28
06/10/03	4-1-01-F-1955	200003795 (IP-DY)	Walnut Lakes	Collier	157	21	145	166
06/18/03	4-1-01-F-136	199701947 (IP-SR)	Twin Eagles Phase II	Collier	593	57	98	155
06/23/03	4-1-01-F-143	199905571 (IP-SR)	Airport Technology Center	Lee	116	55	175	230
07/02/03	4-1-98-F-428	199507483 (IP-MN)	Addition to Miromar Lakes	Lee	342	158	340	498
09/04/03	4-1-02-F-1486	200206725 (IP-MN)	State Road 80 Widening	Lee	33	2	12	14
10/06/03	4-1-02-F-0027	200102043 (IP-MN)	Bonita Beach Road Development	Lee	1,117	145	640	785

Table 3. Continued.

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
12/29/03	4-1-02-F-1743	200202926 (IP-MGH)	The Forum - Saratoga Investments	Lee	650	0	310	310
01/18/05	4-1-04-F-4259	199702228 (TWM)	Bonita Springs Utilities	Lee	79	0	108	108
03/31/05	4-1-04-F-5656	200306759 (NW-MAE)	Gateway Shoppes II	Collier	82	0	122	122
04/08/05	4-1-04-F-8176	2004-5312 (AEK)	Big Cypress Rock Mine	Broward	110	0	220	220
04/29/05	4-1-04-F-5780 4-1-04-F-5982	2003-5331 (IP-TWM) 2003-6965 (IP-TWM)	Worthington Holdings - Arborwood Worthington Holdings - Treeline Avenue Extension	Lee	2,330	0	1,700	1,700
06/06/05	4-1-03-F-7855	2003-11156 (IP-RMT)	Collier Regional Medical Center	Collier	44	0	64	64
02/25/05 03/16/05 06/29/05 04/04/06	4-1-04-F-6866	200309416 (NW-MAE)	Ava Maria University	Collier	5,027	0	6,114	6,114
06/29/05	4-1-03-F-3915	199806220 (IP-MAE)	Wenthworth Estates - V.K. Development	Collier	917	0	458	458
07/15/05	4-1-04-F-5786	199405829 (IP-CDC)	Land's End Preserve	Collier	231	0	61	61
09/26/05 10/26/05	4-1-04-F-9348	2004-1122 (IP-RMT)	Super Target/Brentwood Land Partners	Collier	34	0	20	20
11/23/05	4-1-04-F-6043	20039414	Waterways Join Venture IV	Collier	108	0	61	61
11/29/05	4-1-04-F-8847	20048995	Seminole Tribe of FL Administrative Complex	Collier	6	0	8	8
12/06/05	4-1-03-F-3483	200302409	Southwest Florida Investment Property, LLC	Lee	207	0	305	305
12/6/05	4-1-04-F-6691	200310689	Rattlesnake Hammock Road	Collier	47	0	23	23
01/04/06	4-1-04-F-8388	2004554	Immokalee Regional Airport - Phase I	Collier	163	0	43	43
01/04/06	4-1-04-F-9777	20048577	Logan Boulevard Extension	Collier	40	0	10	10
01/13/06	4-1-04-F-6707	20042404	Journey's End	Collier	66	0	34	34
01/26/06	4-1-04-F-8940	20047053	The Orchard	Lee	93	0	81	81

Table 3. Continued.

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
02/09/06	4-1-05-11724	2005384	Firano at Naples	Collier	24	0	19	19
02/22/06	4-1-04-F-6505	200101122	Corkscrew Road	Lee	63	0	47	47
02/23/06	4-1-04-F-5244	200312276	Summit Church	Lee	10	0	13	13
03/31/06	4-1-05-PL-11343	20051909	Coral Keys Homes	Dade	31	0	61	61
05/05/06	41420-2006-I-0274	2005-6176	Santa Barbara , Davis to Radio Road, Widening	Collier	6	0	3	3
05/09/06	41420-2006-I-0263	2005-6298	Santa Barbara and Radio Road Widening	Collier	29	0	20	20
05/09/06	41420-2006-F-0089	200403248	Collier Boulevard, Immokalee Rd. to Goldengate Blvd.	Collier	14	0	16	16
05/16/06	4-1-05-F-10309	19971924	Sabal Bay	Collier	1,017	1,313	223	1,536
06/05/06	4-1-05-PL-8486	20041688	Seacrest School	Collier	31	0	16	16
06/09/06	4-1-05-PL-10965	200303733	HHJ Development	Dade	3	0	4	4
06/14/06	4-1-05-F-11855	200411010	Keysgate School Site	Dade	39	0	62	62
06/15/06	41420-2006-I-0362	20056176	Collier County Wellfield	Collier	29	0	36	36
07/12/06	41420-2006-F-0282	200311150	Cypress Shadows	Lee	244	0	160	160
07/28/06	4-1-05-F-12330	20047920	Hamilton Place	Dade	10	0	50	50
07/28/06	4-1-04-F-7279	20041695	Raffia Preserve	Collier	131	0	119	119
08/15/06	41420-2006-I-0151	20031963	Naples Custom Homes	Collier	10	0	9	9
08/21/06	41420-2006-I-0540	20041813	ASGM Business Park	Dade	41	0	25	25
08/21/06	4-1-03-F-3127	19956797	Atlantic Civil Ag Permit Extension	Collier	981	0	1,553	1,553
09/12/06	41420-2006-F-0554	20057414	Miccosukee Government Complex	Dade	17	0	37	37

Table 3. Continued.

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
09/22/06	41420-2006-I-0355	20040047	Immokalee Seminole Reservation Road Improvements	Collier	17	0	35	35
10/05/06	41420-2006-I-0616	20065295	New Curve on Corkscrew Road	Lee	12	0	18	18
10/16/06	41420-2006-F-0667	199507483	Miromar Addition	Lee	366	0	390	390
10/18/06	41420-2007-F-0026	2004777	Treeline Preserve	Lee	97	0	95	95
10/25/06	41420-2006-F-0442	20047046	Koreshan Boulevard Extension	Lee	14	0	31	31
10/26/06	41420-2006-F-0787	200306755	Jetway Tradeport	Collier	38	0	52	52
10/26/06	41420-2006-I-0849	20055702	Marina Del Lago	Lee	49	0	36	36
10/27/06	41420-2006-I-0203	20057180	Living Word Family Church	Collier	18	0	35	35
10/27/06	41420-2006-I-0607	20064878	Seminole Reservation Access Road	Hendry	2	0	5	5
11/15/06	41420-2006-TA-0727	N/A	Liberty Landing	Collier	27	0	19	19
11/15/06	41420-2007-FA-0222	200412415	Barry Goldmeier 5th Avenue Estates	Dade	15	0	18	18
11/16/06	41420-2006-TA-0060	N/A	Collier County Elementary School K	Collier	26	0	17	17
12/05/06	41420-2006-FA-1179	20057179	The Roberts Group CPD	Lee	58	0	29	29
12/07/06	41420-2006-FA-0781	20041689	Cypress Landing	Collier	46	0	18	18
01/19/07	41420-2006-I-0871	20061359	Brighton Veterans Center	Glades	9	0	8	8
03/09/07	4-1-04-F-6112	20021683	Alico Airpark (Haul Ventures)	Collier	241	75	315	390

Table 3. Continued.

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
03/09/07	41420-2006-F-0850	200312445	Airport Interstate Commerce Park	Lee	323	0	371	371
04/13/07	41420-2007-TA-0618	NA	Collier County School Site J - Everglades Blvd.	Collier	39	0	56	56
02/21/03 03/9/05 03/02/07 05/03/07	4-1-01-F-607	200001926 (IP-SB)	Mirasol	Collier	773	940	182	1,122
03/09/07	41420-2007-TA-0623	NA	Abercia North	Collier	25	0	31	31
03/09/07	41420-2007-I-0581	1999-4313	Savanna Lakes	Lee	124	0	140	140
05/01/07	41420-2006-I-0992	20045223	Seminole Motocross	Hendry	58	5	19	23
06/19/07	41420-2007-I-0997	2006-2583	Caloosa Reserve	Collier	111	0	139	139
07/03/07	41420-2007-TA-0818	NA	Woodcrest Development	Collier	11	0	15	15
07/17/07	41420-2007-I-0330	2006-6377	Faith Landing	Collier	35	0	18	18
07/30/07	41420-2007-I-0866	2006-7022	Collier county School Site L	Collier	32	0	21	21
09/05/07	41420-2006-I-0051	2005-4186	Gulf Coast Landfill Expansion	Lee	123	0	65	65
06/14/04 03/21/05 08/24/07	4-1-04-F-5744	199603501 (IP-TWM)	Terafina	Collier	437	210	261	471
10/31/07	41420-2007-F-1035	2004-3931	Big Cypress Regional General Permit - 83	Hendry Broward	2,357	4,144	0	4,144
11/13/07	41420-2006-FA-1430	2005-782	Summit Lakes	Collier	139	0	134	134
9/8/2005 02/15/08	4-1-04-F-5260 and 41420-2008-F-0112	200106580	Parklands Collier	Collier	487	157	434	591

Table 3. Continued.

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
2/7/2008	41420-2007-FA-1120 41420-2007-I-0862	1993-0862	Poinciana Parkway	Polk	187	0	236	236
1/30/2008	41420-2008-FA-0009 41420-2008-I-003	2007-4884	I-75 from Corkscrew Road to Daniels Parkway	Lee	7	0	12	12
1/22/2008	41420-2008-FA-0021 41420-2008-I-005	2007-4503	I-75 from Collier County Line to South of Corkscrew Road	Lee	7	0	44	44
6/26/2008	41420-2007-FA-1150 41420-2007-F-1144	2007-2175	Immokalee Master Plan	Collier	506	0	1,015	1,015
7/2/2008	41420-2007-FA-0592 41420-2007-F-0491	2005-7439	Kaicasa	Collier	72	0	183	183
07/14/2008	41420-2008-I-0508	2005-6488	Amerimed Medical Center	Collier	19	0	14	14
04/28/2008	41420-2008-I-0313	2007-6414	Immokalee Rd Substation	Collier	1	0	1	1
07/14/2008	41420-2008-I-0509	2007-4314	Gridley Medical Building	Collier	4	0	2	2
7/23/2008	41420-2006-FA-0165 41420-2006-F-0846	2004-182	Premier Airport Park	Lee	180	0	211	211

Table 3. Continued.

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
09/04/2008	41420-2008-FA-0415 41420-2008-I-0211	1984-4913	Colonial Boulevard Widening	Lee	35	0	39	39
09/25/08	41420-2008-FA-0702 41420-2008-I-0806	1988-1061	Alligator Alley Commercial Center	Collier	41	0	18	18
12/17/2008	41420-2006-FA-0023 41420-2008-F -0018	1999-4926	Sembler Partnership McMullen Parcel	Collier	40	0	49	49
01/13/09	41420-2007-FA-1111 41420-2007-I-1083	2007-1264	Big Corkscrew Island Fire Control & Rescue	Collier	5	2	5	7
01/30/02 02/12/09	4-1-98-F-372 and 41420-2006-F-0267	199402492 (IP-ML)	Florida Rock Industries, Inc. (Fort Myers Mine #2)	Lee	2,913	1,959	0	1,960
2/26/2009	41420-2006-FA-0548 41420-2006-F-1011	2006-7018	Oil Well Road Widening	Collier	329	0	356	356
				Total:	**96,124**	**12,583**	**29,028**	**41,612**

Table 4. Land Held for Conservation within the Florida Panther Core Area.

	Acres	Primary Equivalent Factor	Primary Equivalent Acres
Primary	1,659,657	1.00	1,659,657
Dispersal	0	1.00	0
Secondary	308,623	0.69	212,950
Other	609,872	0.33	201,258
TOTAL	2,578,152	**TOTAL**	2,073,865

Table 5. Habitat suitability values for use in assessing habitat value to the Florida panther.

Land Cover Type	Value	Land Cover Type	Value	Land Cover Type	Value
Water	0	STA	4.5	Cypress swamp	9
Urban	0	Shrub swamp	5	Sand pine scrub	9
Coastal strand	1	Shrub and brush	5	Sandhill	9
Reservoir	1.5	Dry prairie	6	Hardwood-Pine forest	9
Mangrove swamp	2	Grassland/pasture	7	Pine forest	9
Salt marsh	2	Freshwater marsh	9	Xeric oak scrub	10
Exotic plants	3	Bottomland hardwood	9	Hardwood forest	10
Cropland	4	Bay swamp	9		
Orchards/groves	4	Hardwood swamp	9		

Table 6. Undeveloped Privately Owned Land within Florida Panther Core Area.

	Acres	Primary Equivalent Factor	Primary Equivalent Acres
Primary	610,935	1.00	610,935
Dispersal	27,883	1.00	27,883
Secondary	503,481	0.69	347,402
Other	655,996*	0.33	216,479
TOTAL	1,962,294	**TOTAL**	1,202,699

* About 819,995 acres are at-risk in the other zone with about 80 percent with resource value. Total acres of at-risk privately owned lands are 1,962,294 acres.

Table 7. Landscape Compensation Multipliers.

Zone of Impacted Lands	Zone of Compensation Lands	Multiplier
Primary	Secondary	1.45
Secondary	Primary	0.69
Other	Secondary	0.48
Other	Primary	0.33

Table 8. Radio-collared Panthers Recorded within 5 miles of the Oil Well Road Project Site.

Panther	Count	Sex	Years	Death Cause - Year
FP 4	3	M	1982-1985	Vehicle - 1985
FP 5	138	F	1982	Unknown
FP10	29	M	1986-1987	Intraspecific Agression-1987
FP11	253	F	1986-2001	Intraspecific Agression-2001
FP12	304	M	1986-1994	Intraspecific Agression-1994
FP13	4	M	1986-1987	Vehicle-1987
FP19	693	F	1987-1997	Aortic Aneurysm-1997
FP25	38	M	1988	Intraspecific Agression-1988
FP29	9	M	1989-1992	Psuedorabies-1992
FP30	46	M	1989-1990	Intraspecific Agression-1990
FP31	582	F	1989-1994	Vehicle-1994
FP32	102	F	1989-2002	Unknown
FP34	28	M	1990-1993	Esophageal Puncture-1993
FP43	7	M	1990-1991	Intraspecific Agression-1991
FP45	39	M	1991-1998	Intraspecific Agression-1998
FP47	29	M	1992-1993	Intraspecific Agression-1993
FP48	107	F	1992-2006	Unknown
FP51	149	M	1992-1998	Vehicle-1998
FP52	81	F	1992-1995	Vehicle-1995
FP53	5	M	1993	Intraspecific Agression-1993
FP54	21	M	1993	Unknown
FP57	17	F	1995	Unknown
FP59	446	M	1996-2004	Intraspecific Agression-2004
FP60	52	M	1996-2004	Removed from Wild-2004
FP63	5	M	1997-2000	Vehicular Trauma/Drowning-2000
FP64	3	M	1997-1999	Intraspecific Agression-1999
FP65	1	M	1997-present	Alive
FP66	150	F	1997-present	Unknown
FP75	6	F	1999-present	Unknown
FP78	1	F	1999-2002	Intraspecific Agression-2002
FP83	1	F	2000-present	Unknown
FP97	49	M	2001	Intraspecific Agression-2001
FP98	9	M	2001-2002	Vehicle-2002
FP99	37	M	2001-2002	Vehicle-2002
FP105	60	F	2001-2002	Unknown
FP106	214	F	2001-2003	Vehicle-2003
FP107	43	F	2001	Unknown
FP113	161	F	2002-present	Alive
FP119	3	M	2003-present	Alive
FP131	241	M	2004-2008	Pnuemonia-2008
FP135	90	M	2004-2006	Intraspecific Agression/Euthanized-2006
FP140	1	F	2005-present	Alive
FP143	3	M	2006-present	Alive
FP154	69	M	2007-present	Alive
TX102	1	F	1995	Vehicle-1995
TX104	6	F	1995-1998	Gunshot-1998
TX106	7	F	1995-2003	Removed from Wild-2003

Table 9. Panther-Vehicle Collisions within the Oil Well Road widening Action Area as of December 5, 2008.

ID	Distance from Project	Roadway	Year	Sex	Result
UCFP04-(G80-4)	10.4 Miles Southeast	SR 29 JUST N SR 84	1979	F	DEATH
UCFP05-(G80-15)	4.3 Miles East	SR 29 NEAR SUNNILAND	1980	M	DEATH
UCFP06-(G81-19)	19.5 Miles South	SR 29 NEAR COPELAND	1981	F	DEATH
FP01	9.8 Miles South	SR 84 18 MM	1983	M	DEATH
UCFP12-(G84-26)	9.80000019073486 Miles South	SR 84 16 MM	1984	F	DEATH
UCFP13-(G85-BNZ)	9.8 Miles South	SR 84 MM16	1985	F	DEATH
FP04	9.8 Miles South	SR 84 17 MM	1985	M	DEATH
NONE	22.1 Miles Southwest	CR 951 2 M N US 41	1985	F	INJURY
FP07	14.4 Miles South	SR 29 4 MI S SR 84	1985	M	DEATH
UCFP15	9.8 Miles South	SR 84 16.5 MM	1986	F	DEATH
FP20	5.6 Miles East	CR 858 .8 M E SR 29	1987	M	INJURY
FP13	4.8 Miles Southeast	SR 29 SUNNILAND	1987	M	DEATH
UCFP18-(RK-850)	15.6 Miles Northwest	CR 850 1.5 M S SR 80	1989	M	DEATH
FP37	9.9 Miles Southeast	SR 29 .5 M N I-75	1990	M	DEATH
UCFP20-(FP11'S)	5.5 Mile Southeast	SR 29 PISTOL POND BRIDGE	1991	F	DEATH
UCFP21-(FP19'S)	4.7 Miles Southeast	SR 29 SUNNILAND	1992	F	DEATH
FP50	10.3 Miles Northeast	CR 846 5 M E OF IMMOKALEE	1993	M	DEATH
UCFP23-(FP52'S)	10 Miles Northeast	3 M N ON COUNTY LINE ROAD	1994	M	DEATH
FP31	4.7 Miles Southeast	SR 29 SUNNILAND	1994	F	DEATH
FP52	9.4 Miles Northeast	CR 846 NEAR DUPREE ROAD	1995	F	DEATH
UCFP29	21.6 Miles North	5.5 M E SR 29 ON CR 832	1996	M	DEATH
UCFP31	10.6 Miles Northeast	CR 846 1.5 M W CR 858	1997	U	DEATH
UCFP25	16.3 Miles Northeast	CR 846 3 M E CR 858	1998	F	DEATH
FP51	6.7 Miles Southeast	SR 29 @ BEAR ISLAND GRADE	1998	M	DEATH
UCFP27	14 Miles East	FARM ROAD E HENDRY PRISON	1999	F	DEATH
FP80	22.2 Miles East	200 FT. W SWAMP SAFARI, BCSIR	2000	F	DEATH
K76-(FP66)	2.9 Miles East	1 MI W SR 29, ON CR 858	2000	M	DEATH
UCFP34	15.3 Miles Northeast	CR846 2 MILES E COUNTY LINE	2000	M	DEATH

Table 9. Continued

ID	Distance from Project	Roadway	Year	Sex	Result
UCFP35	8.7 Miles North	CR846 2 MILES E IMMOKALEE	2000	M	DEATH
UCFP36	14.2 Miles Northeast	CR 846 E IMMOK. NEAR POWERLINE	2000	F	DEATH
UCFP37	9.7 Miles Northeast	4.5 MI E SR29 ON CR846	2000	F	DEATH
UCFP39	20.4 Miles South	SR 29 1/2 MI N OF JEROME	2001	F	DEATH
UCFP40	20.5 Miles South	SR 29 1/2 MI N OF JEROME	2001	M	DEATH
UCFP41	4.6 Miles East	SR 29 SUNNILAND, NEAR MINE RD	2001	M	DEATH
UCFP42	15.7 Miles Northeast	CR846, 1 MILE EAST POWERLINE	2001	F	DEATH
UCFP43	15.9 Miles Northeast	CR846 1 MILE EAST OF POWERLINE	2001	M	DEATH
UCFP46	16.7 Miles South	1/2 MI N OF DEEP LAKE, COLLIER	2002	M	DEATH
FP98	5 Miles Southeast	1 KM N PISTOL POND, SR 29	2002	M	DEATH
UCFP48	10.5 Miles Northeast	CR846 5-6 MI E IMMOKALEE	2002	F	DEATH
UCFP49 (K98)	9 Miles North	CR846 3-4 MI E IMMOKALEE	2002	F	DEATH
FP99	11.7 Miles West	CR846 1/4 MI N COLLIER FAIRGRN	2002	M	DEATH
UCFP50 (K33)	7 Miles Northwest	CR846 3.4 MI E EVERGLADES BLVD	2003	M	DEATH
FP106	4.7 Miles East	SR29 AT SUNNILAND MINE ENTRANCE	2003	F	DEATH
UCFP53	4.7 Miles Northeast	SR29, 1.4 MI N CR858, COLLIER	2003	F	DEATH
UCFP54	4.9 Miles Northeast	SR29, 1.7 MI N CR858, COLLIER	2003	M	DEATH
UCFP58	6.6 Miles Northwest	CR846 3/4 MILES E OF EVERGLADS B.	2003	F	DEATH
UCFP59	3.1 Miles East	CR 858, 1.2 miles west of SR 29	2003	F	DEATH
UCFP60	23.6 Miles Southwest	US41, ~ 1 MI EAST OF CR92	2003	M	DEATH
UCFP61	17.5 Miles Northeast	CR833, 1.7 MI N CR846 INTERSECTION	2003	F	DEATH
UCFP63	17.5 Miles Southwest	I-75, MM99 EASTBOUND LANE	2004	M	DEATH
UCFP65	6.5 Miles Southeast	SR29, 200 YD N BEAR ISLAND GRADE	2004	M	DEATH
UCFP66	13.2 Miles Southwest	I-75, MM93 0.5 MI W EVERGLADES BLVD	2004	M	DEATH
K94	16.5 Miles Southwest	I-75, NEAR MM98 EASTBOUND LANE	2004	M	DEATH
UCFP69	5.3 Miles Northeast	SR 29 2.5 miles N of CR 858	2004	F	DEATH
UCFP70	6.1 Miles Northeast	SR 29 at Owl Hammock Curve	2004	F	DEATH
K128	21.3 Miles North	CR 832 1 mile east of RR grade	2004	M	DEATH

Table 9. Continued.

ID	Distance from Project	Roadway	Year	Sex	Result
UCFP72	19.4 Miles South	SR 29 near Jerome	2005	M	DEATH
UCFP73	21.6 Miles Southwest	CR951 S of Rattlesnake Hammock Road	2005	M	DEATH
UCFP75	6.1 Miles Northeast	SR 29 at Owl Hammock Curve	2005	M	DEATH
K153	20.2 Miles Southwest	CR951, 1.2 M south of Davis Blvd.	2005	M	DEATH
UCFP76	23.7 Miles Southwest	US 41, 1.4 M east of CR 951	2005	M	DEATH
K49	22.3 Miles South	SR 29 1 mi N Wagon Wheel Road	2005	F	DEATH
UCFP78	11.7 Miles Northeast	CR846 1 mi W of CR858	2006	M	DEATH
UCFP79	11.9 Miles West	CR846 2 mi N of CR858 - near Collier fair	2006	F	DEATH
UCFP85	24.3 Miles Northeast	CR 832 3 mi east of OK Slough SF	2006	M	DEATH
UCFP87	20.7 Miles Northwest	Corkscrew Rd. near Alico, Lee County	2006	M	DEATH
UCFP88	23.7 Miles Southwest	US 41 between Manatee Rd and CR951	2006	F	DEATH
UCFP89	11.1 Miles Northeast	County Line Road, Collier/Hendry	2006	M	DEATH
UCFP90	21.3 Miles North	CR 832 1mile W of Forestry Tower	2007	F	DEATH
UCFP91	21.4 Miles North	CR832 Hendry Co., 100' west of Keri Tower Rd. Trail	2007	M	DEATH
UCFP97	20.4 Miles Northwest	Corkscrew Rd. near Alico	2007	F	DEATH
UCFP94	16.7 Miles Southwest	I-75 2 mi E of toll booth MM98, Collier County	2007	M	DEATH
UCFP98	21.9 Miles South	SR29 at Jerome wildlife crossing	2007	M	DEATH
UCFP100	6.6 Miles Northeast	SR 29 3 mi S of Immokalee	2007	M	DEATH
K199	21.5 Miles North	CR832 0.6 mi W of Forestry tower	2007	F	DEATH
UCFP102	11.3 Miles Southeast	I-75, 1.5 miles east of SR29	2007	M	DEATH
UCFP103	19.0 Miles West	Pine Ridge Road, half-way between CR951 and Logan Blvd.	2008	M	DEATH
UCFP108	7.0 Miles Northwest	Imokalee Road 1.7 Miles E of Oil Grade Road	2008	F	DEATH
UCFP111	4.7 Miles Northeast	SR29 approx. 2.4 km N of Oil Well Rd.	2008	F	DEATH
UCFP113	23.7 Miles West	Alico Road, Lee County	2008	M	DEATH
UCFP114	0.7 Miles East	CR858 (Oil Well Rd), Collier County; 1 mile east of Camp Keais Rd	2008	F	DEATH

Table 9. Continued.

ID	Distance from Project	Roadway	Year	Sex	Result
UCFP115	24.0 Miles North	CR832, east of the Okaloacoochee Slough State Forest	2009	M	DEATH
K235	10.4 Miles South	Eastbound exit ramp, I-75/SR29	2009	M	DEATH
UCFP116	7.0 Miles North	SR29 3mi S of Immokalee	2009	F	DEATH

Table 10. County and State Acquisitions within the Action Area (Acres).

Year	County	State
2003	2,041	552
2004	229	283
2005	241	166
2006	28	0
2007	384	0
Totals	**2,923**	**1,001**

Table 11. Panther Habitat Units – Oil Well Road Widening and South Grove Lakes Parcel, and Compensation Parcel.

Oil Well Road and South Grove Parcel

		Project Lands within Primary Zone 216.5 acres				Project Lands within Secondary Zone 306.4 acres			
		Current		With Project		Current		With Project	
Land Cover Type	*Score*	Acres	PHUs	Acres	PHUs	Acres	PHUs	Acres	PHUs
Urban (roadway pavement)	0	52.3	0	175.8	0	108	0	255.0	0
Open Water	0	23.3	0	40.7	0	10.7	0	51.4	0
Exotic Plants	3	5.7	17.1	0	0	5.7	17.1	0	0
Cropland	4	113.4	453.6	0	0	48.7	220.8	0	0
Grove	4	3.3	13.2	0	0	31.6	244.0	0	0
Shrub/Brush	5	0.3	1.5	0	0	39.9	199.5	0	0
Shrub Swamp	5	0.9	4.5	0	0	0.1	0.5	0	0
Grassland Pasture	7	0	0	0	0	5.3	37.1	0	0
Cypress Swamp	9	8.9	80.1	0	0	0.9	8.1	0	0
Hardwood Swamp	7	0.2	1.4	0	0	0	0	0	0
Hardwood-Pine Forest	9	3.3	29.7	0	0	7.4	66.6	0	0
Pine Forest	9	4.6	41.4	0	0	11.6	104.4	0	0
Hardwood Forest	9	0.3	2.7	0	0	0	0	0	0
	TOTAL	**216.5**	**645.2**	**216.5**	**0**	**306.4**	**898.1**	**306.4**	**0**

Total PHUs Impacted in Primary Zone =645.2 PHUs x 2.5 base ratio x 1landscape multiplier = 1,613.0 PHUs
Total PHUs Impacted in Secondary Zone = 898.1 x 2.5 base ration 0.69 landscape multiplier = 1,549.2 PHUs
Total PHUs Impacted = Total PHUs Impacted in Primary Zone + Total PHUs Impacted in Secondary Zone = 1,613.0 PHUs + 1,549.2 PHUs = 3,162.2 PHUs

Table 11. Continued.

Compensation parcel (all located in Primary Zone)

		Project Lands within Primary Zone 363.7 acres			
		Pre-Restoration		Post Restoration	
Land Cover Type	*Score*	Acres	PHUs	Acres	PHUs
Water	0	8.9	0	8.9	0
Exotic Plants	3	3.1	9.3	0	0
Freshwater Marsh	9	232.5	2,092.5	232.5	2,092.5
Hardwood-Pine Forest	9	119.2	1,072.8	122.3	1100.7
	TOTAL	**363.7**	**3,174.6**	**363.7**	**3,193.2**

Total PHUs Available in Compensation Parcel = [(Total PHUs Post Restoraton –Total PHUs Pre-Restoration)/2] + Total PHUs Pre-Restoration = [(3193.2 PHUs-3174.6 PHUs / 2] + 3,174.6 PHUs = 3,183.9 PHUs

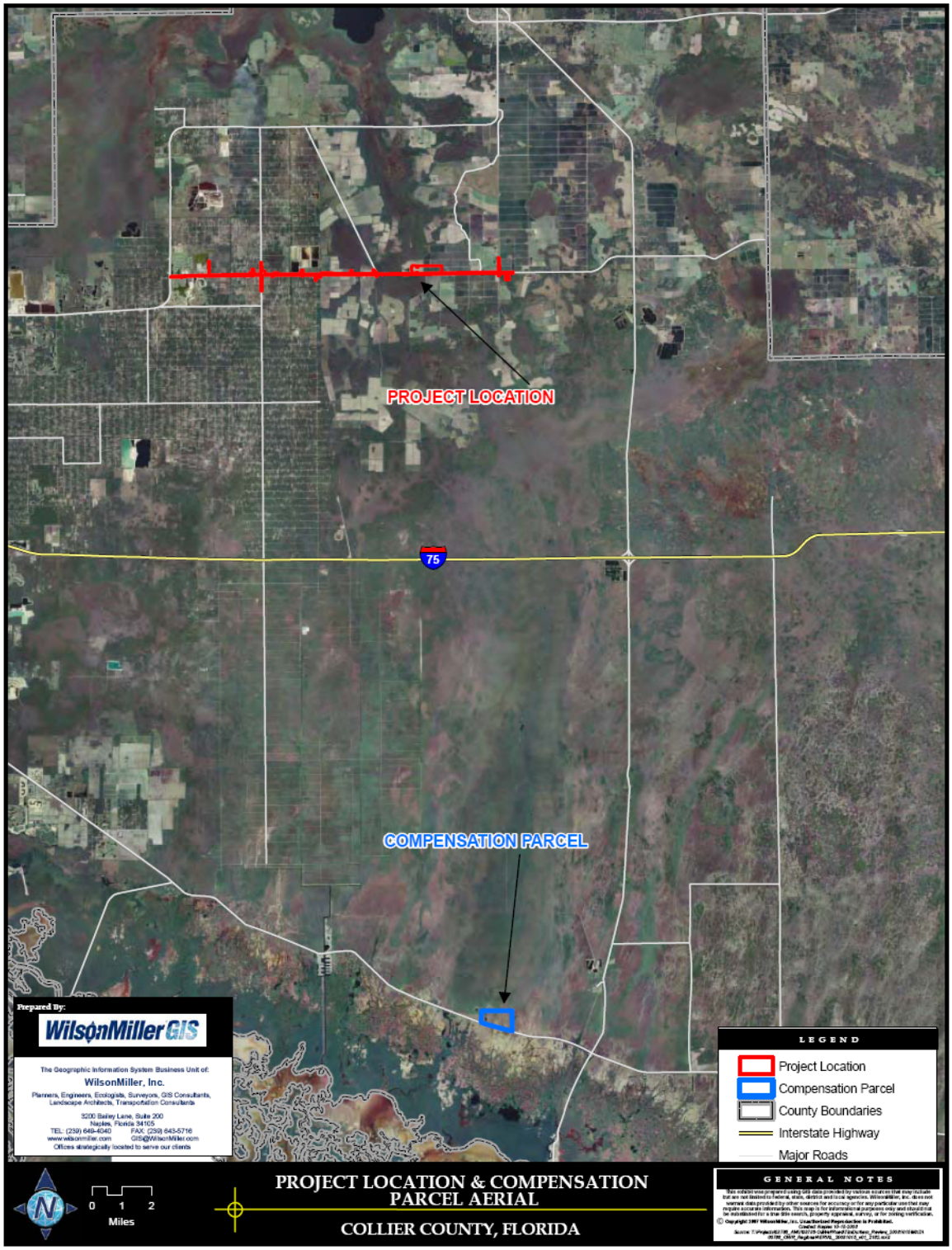


Figure 1. Location map of the Oil Well Road project site and the proposed panther habitat compensation parcel.

Figure 2. Location map of the South Grove Lake project site.

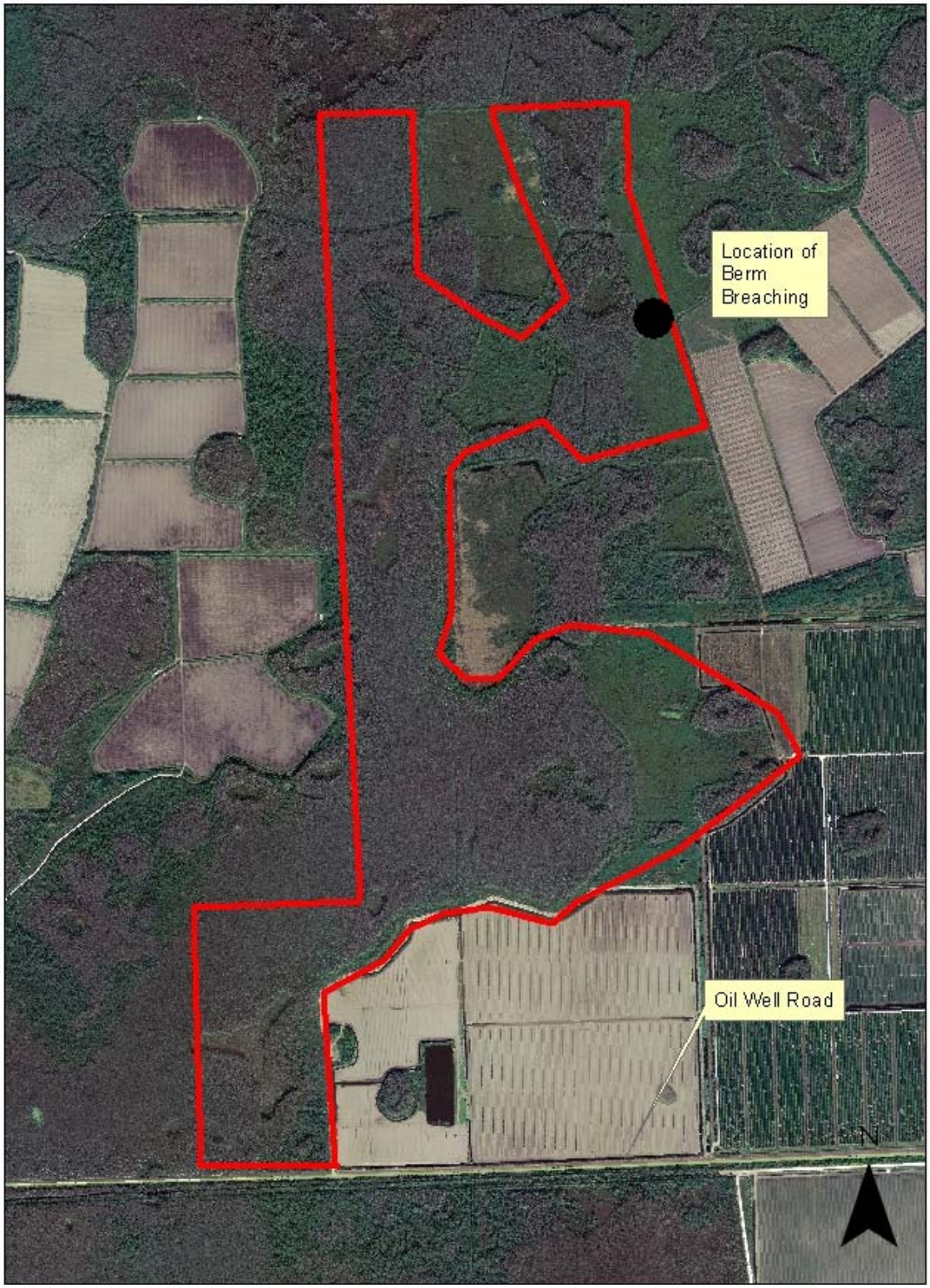


Figure 3. Location map of proposed wetland mitigation site located within Camp Keais Strand.

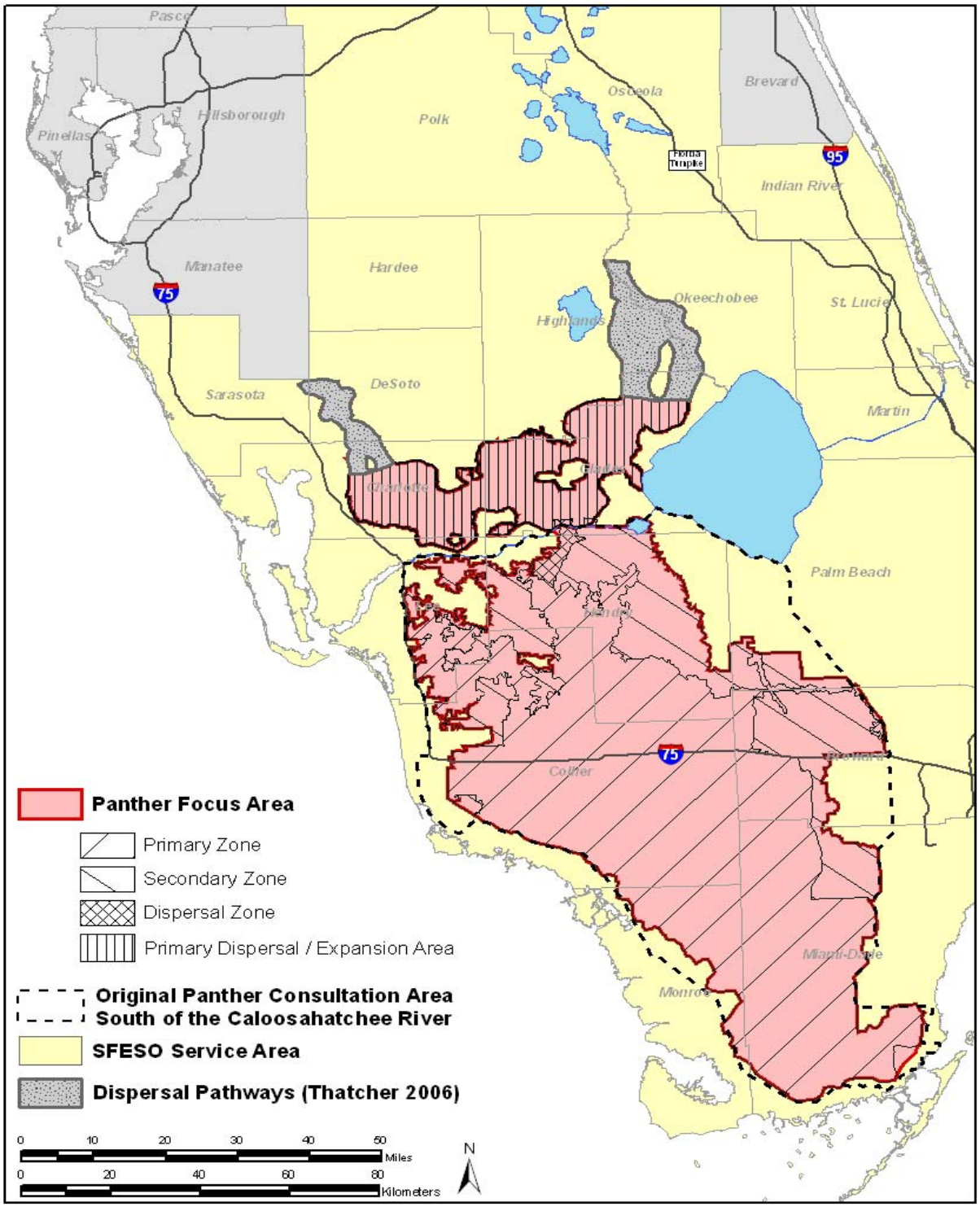


Figure 4. Florida Panther Focus Area and Original Panther Consultation Area.

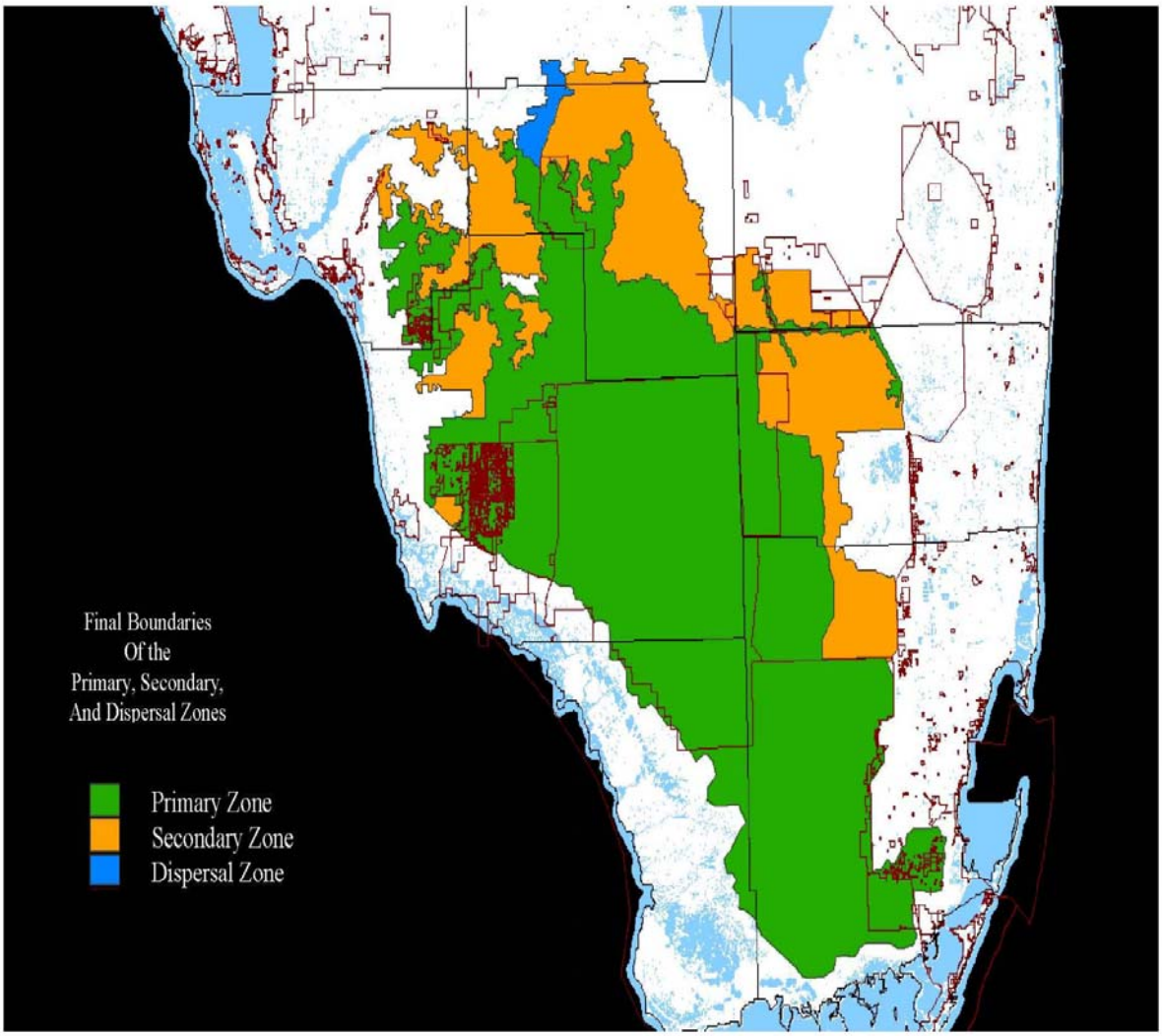


Figure 5. Primary, Secondary, and Dispersal Zones Kautz et al. (2006).

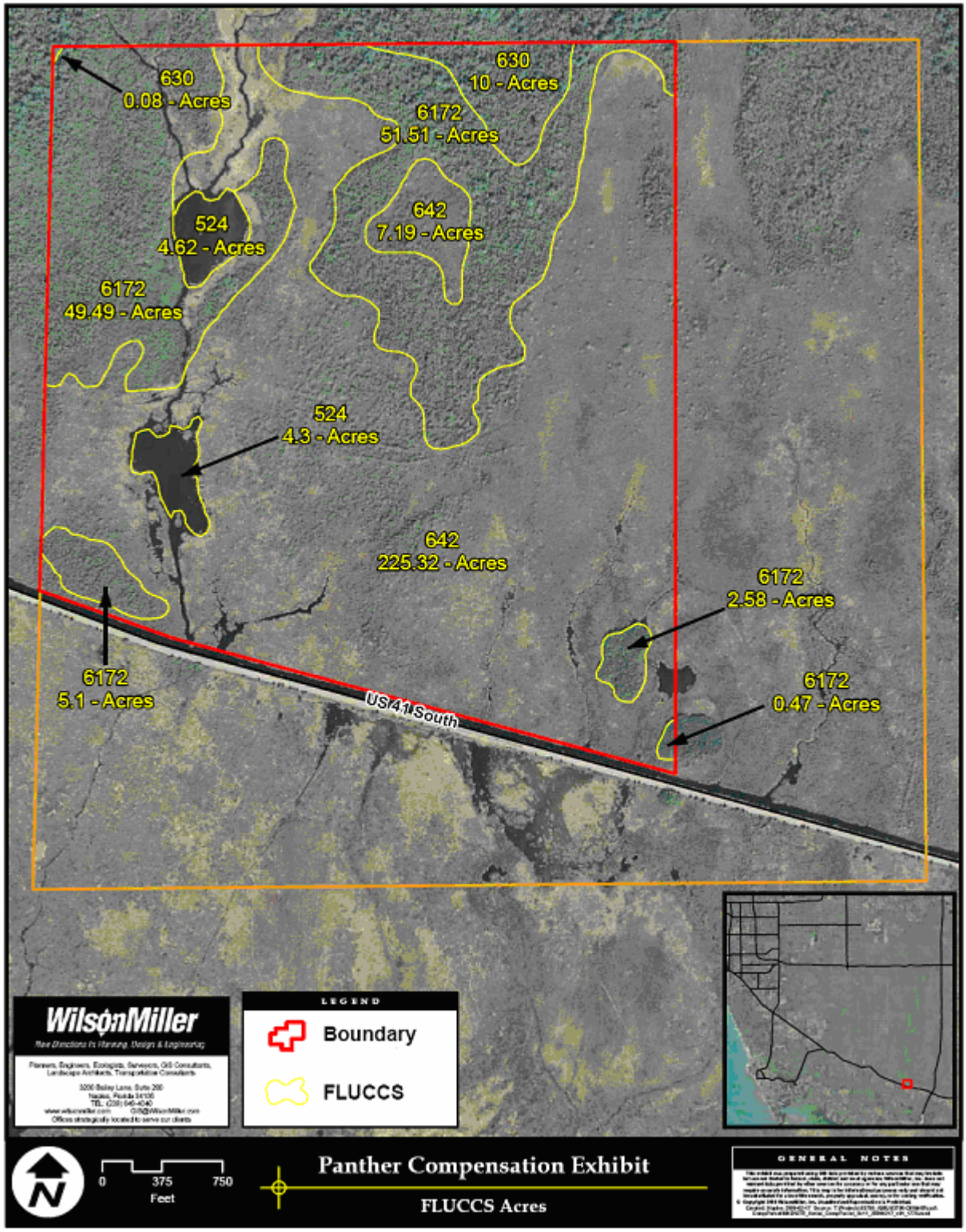


Figure 6. The proposed 363.7-acre off-site panther compensation site located north of U.S. Highway 41 and west of State Road 29.

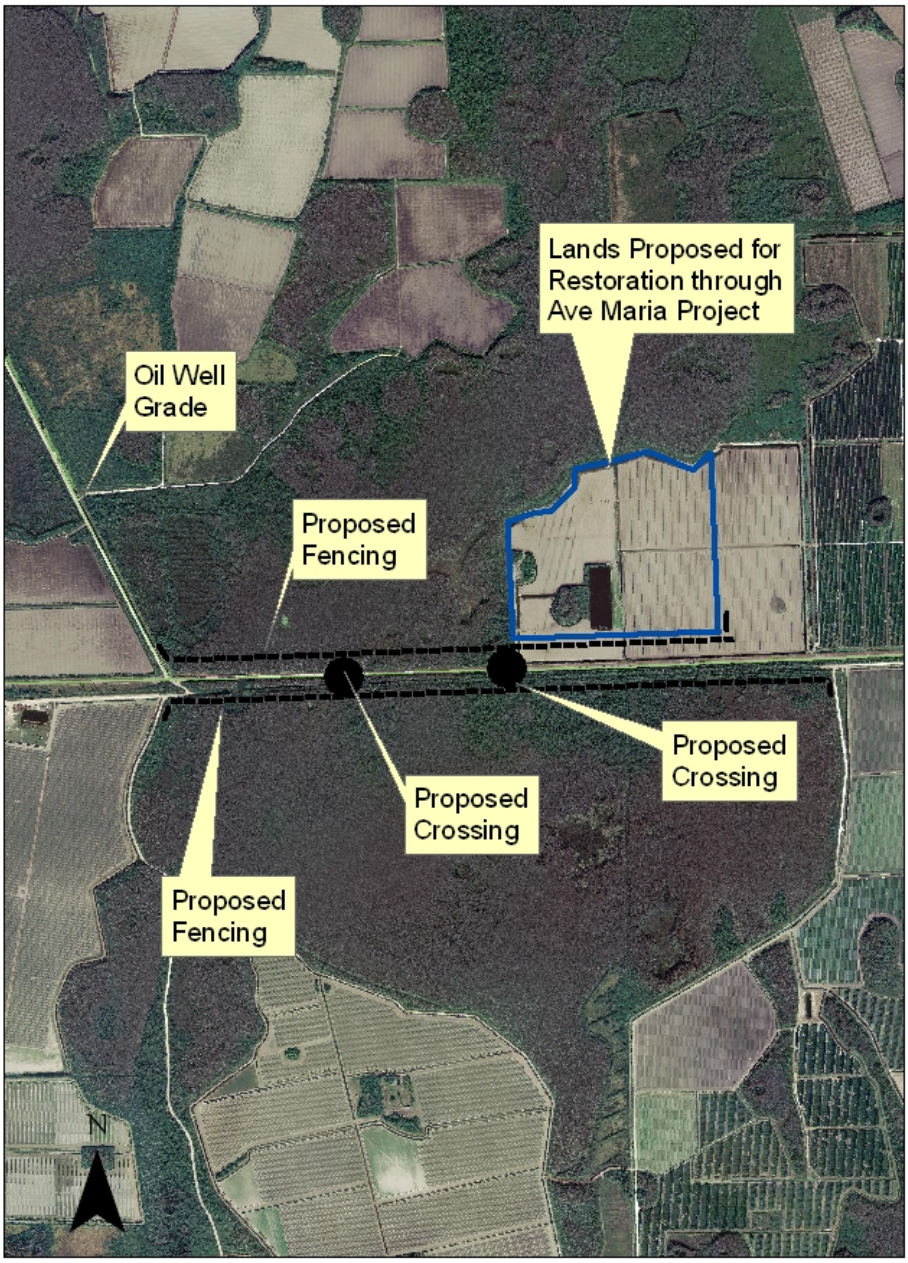


Figure 7. Locations of wildlife crossings and fencing proposed in conjunction with Oil Well Road widening.

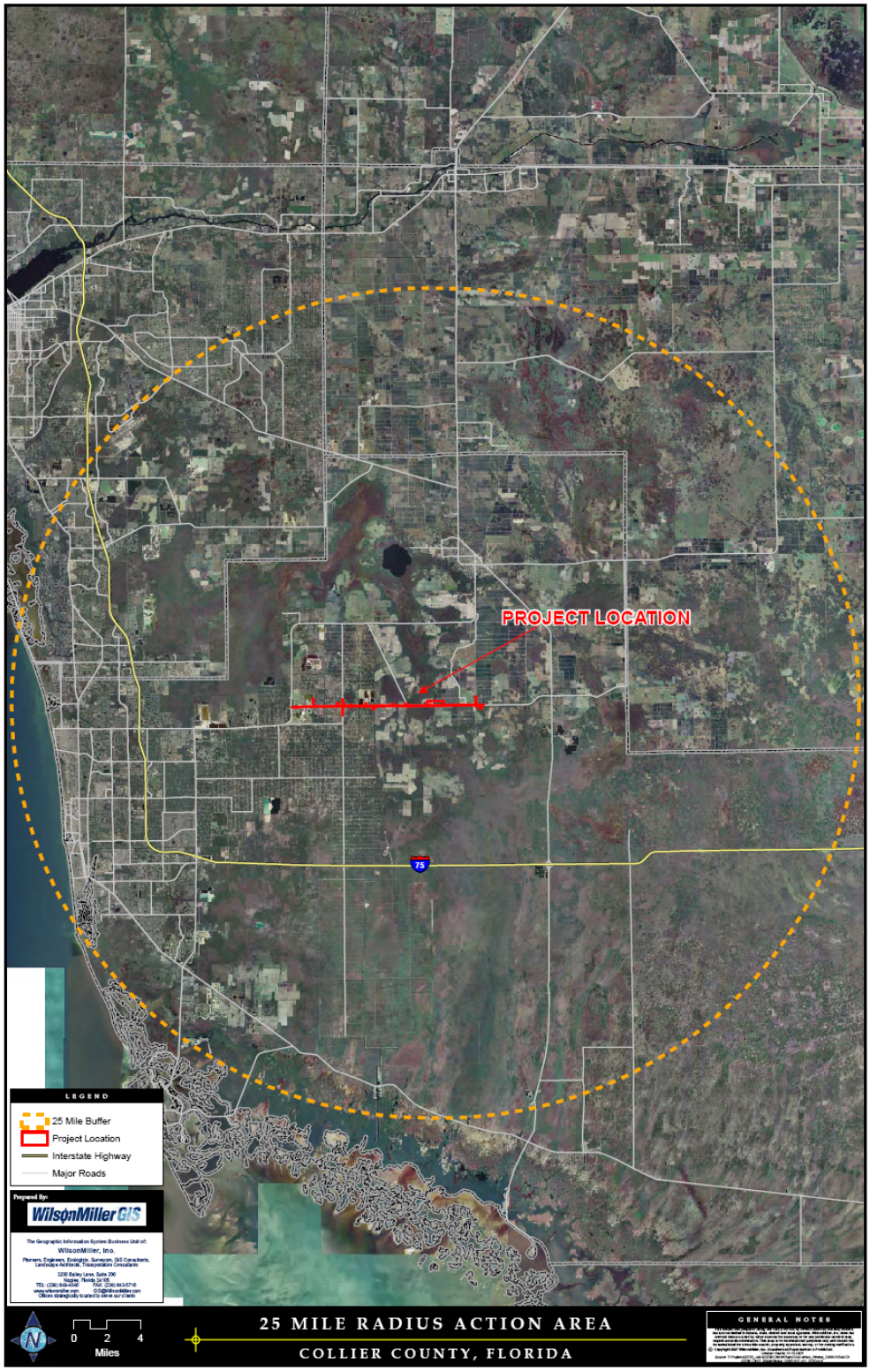


Figure 8. Regional aerial map showing 25-mile action area for the Oil Well Road Widening Project.

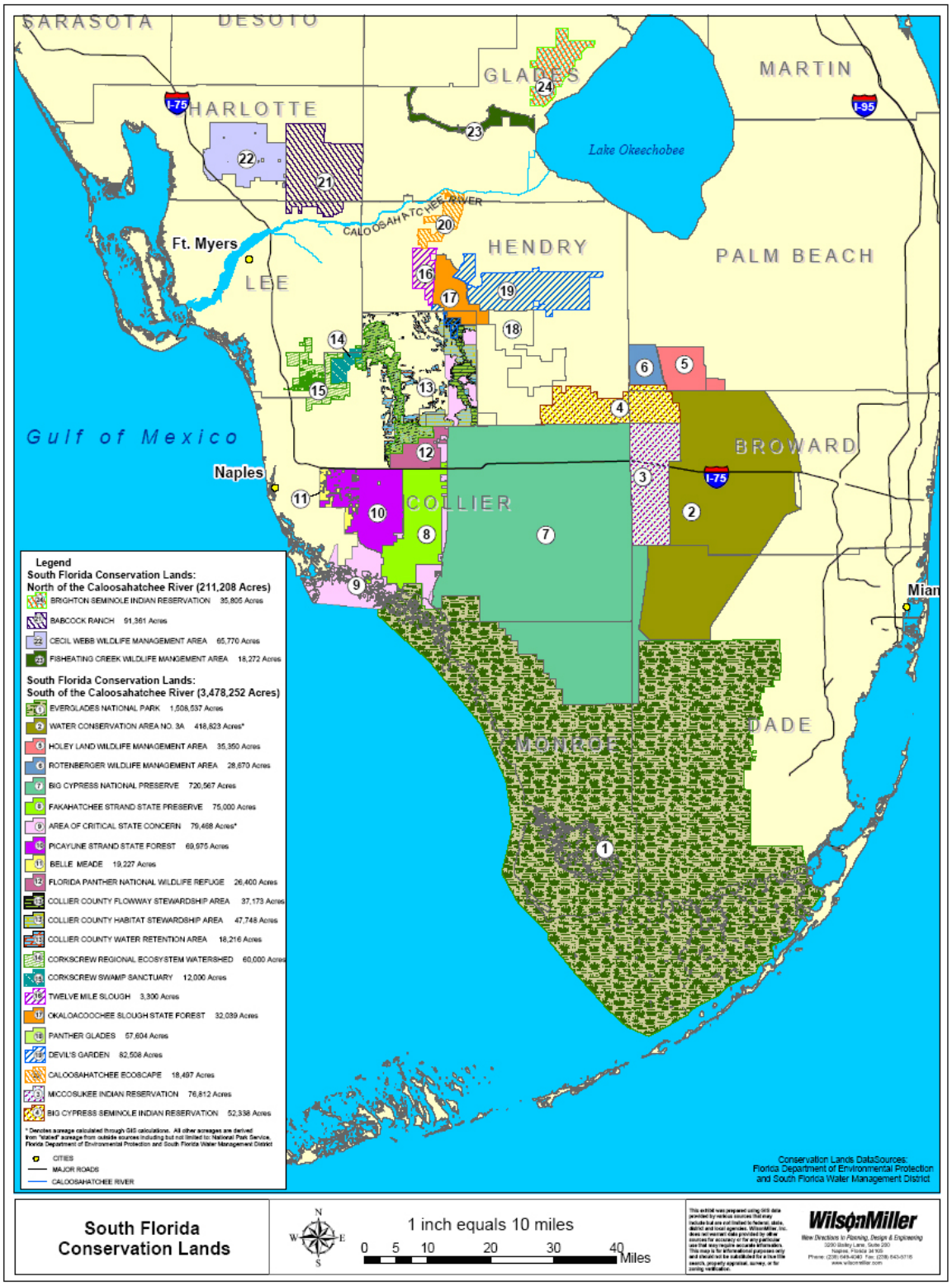


Figure 9. Southwest Florida conservation lands.

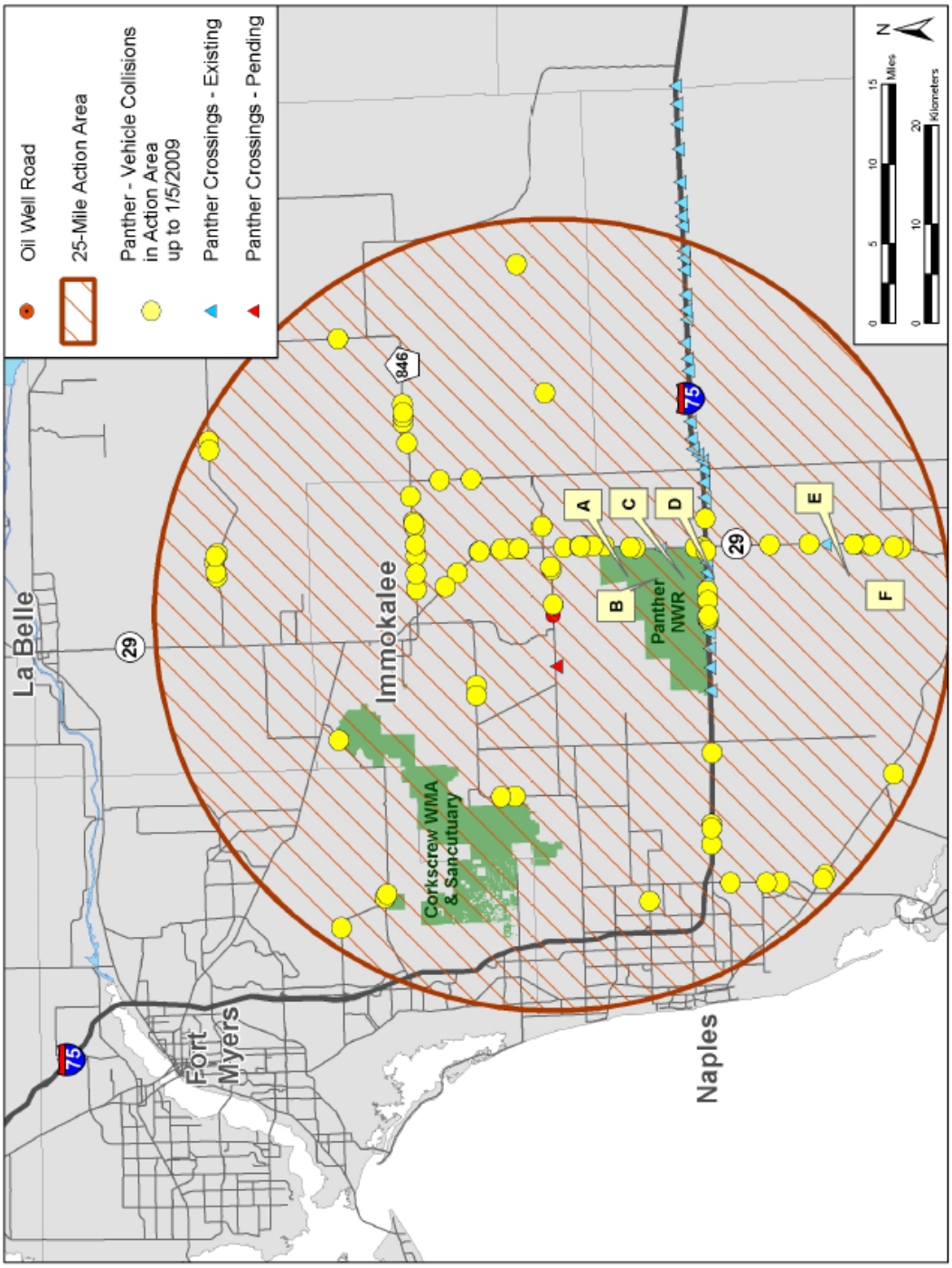


Figure 10. Panther – Vehicle Collisions and Panther Crossings within Action Area.

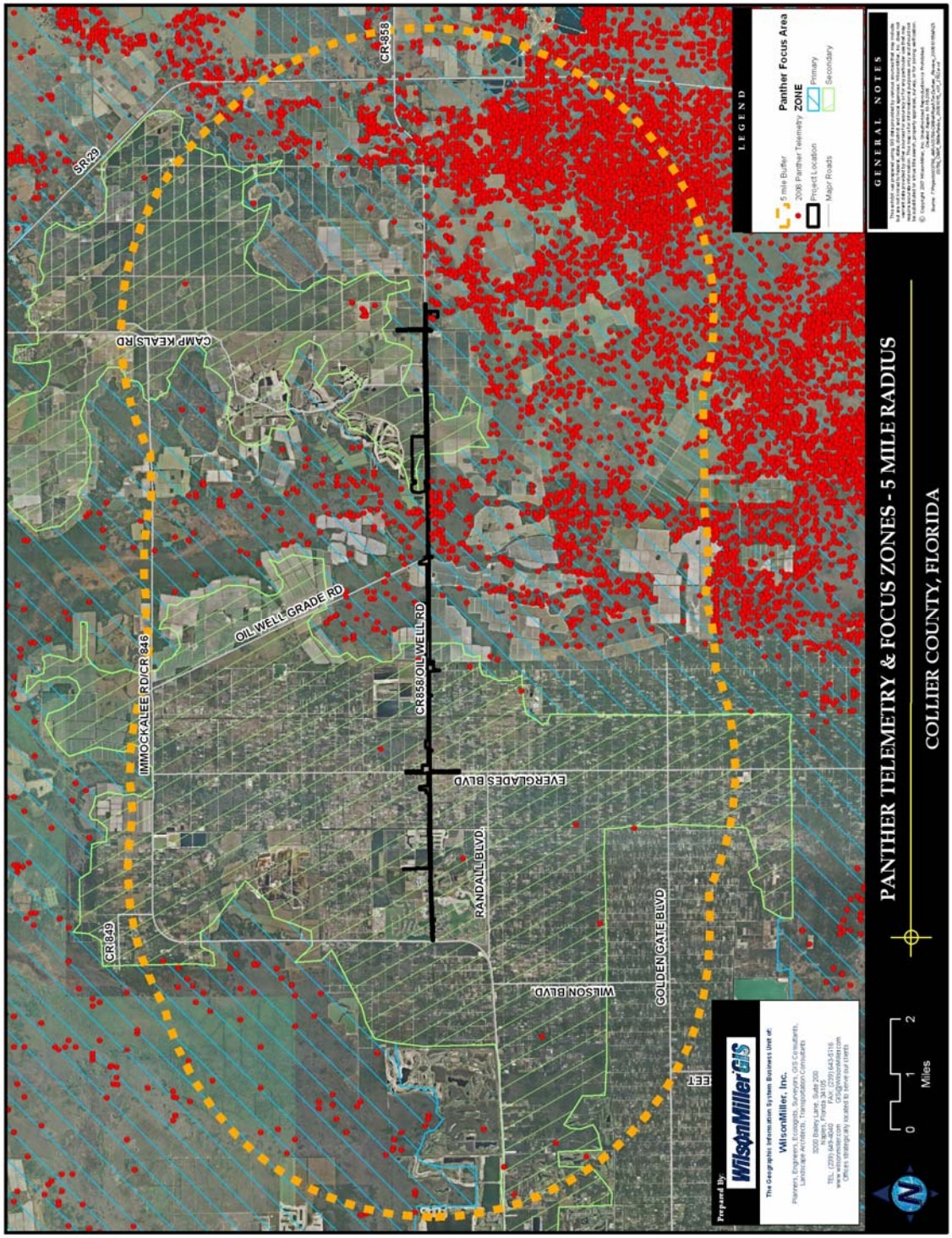


Figure 11. Telemetry locations of panther activity within 5-mile radius of the Oil Well Road widening project.

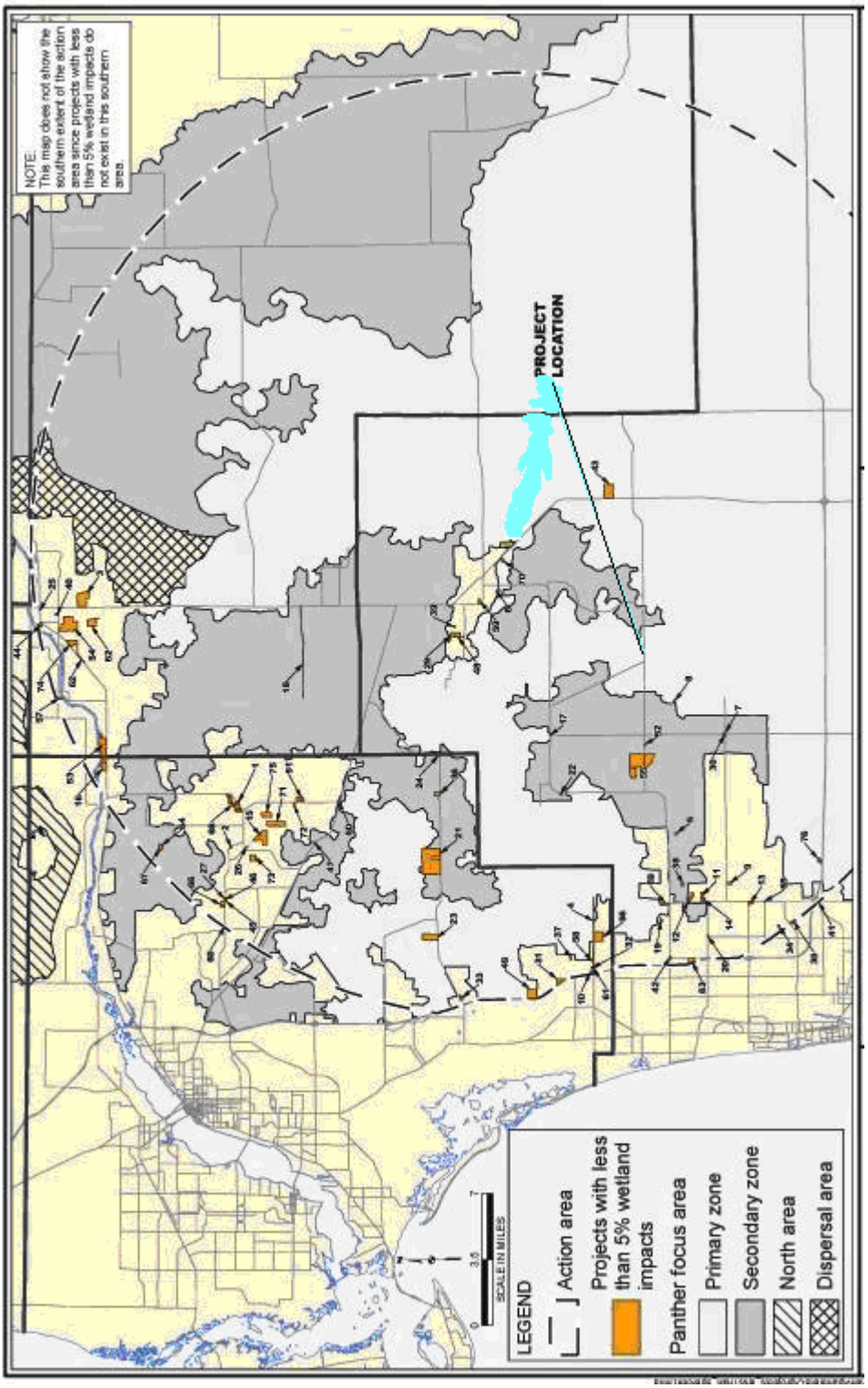


Figure 12. Projects in cumulative impact analysis.

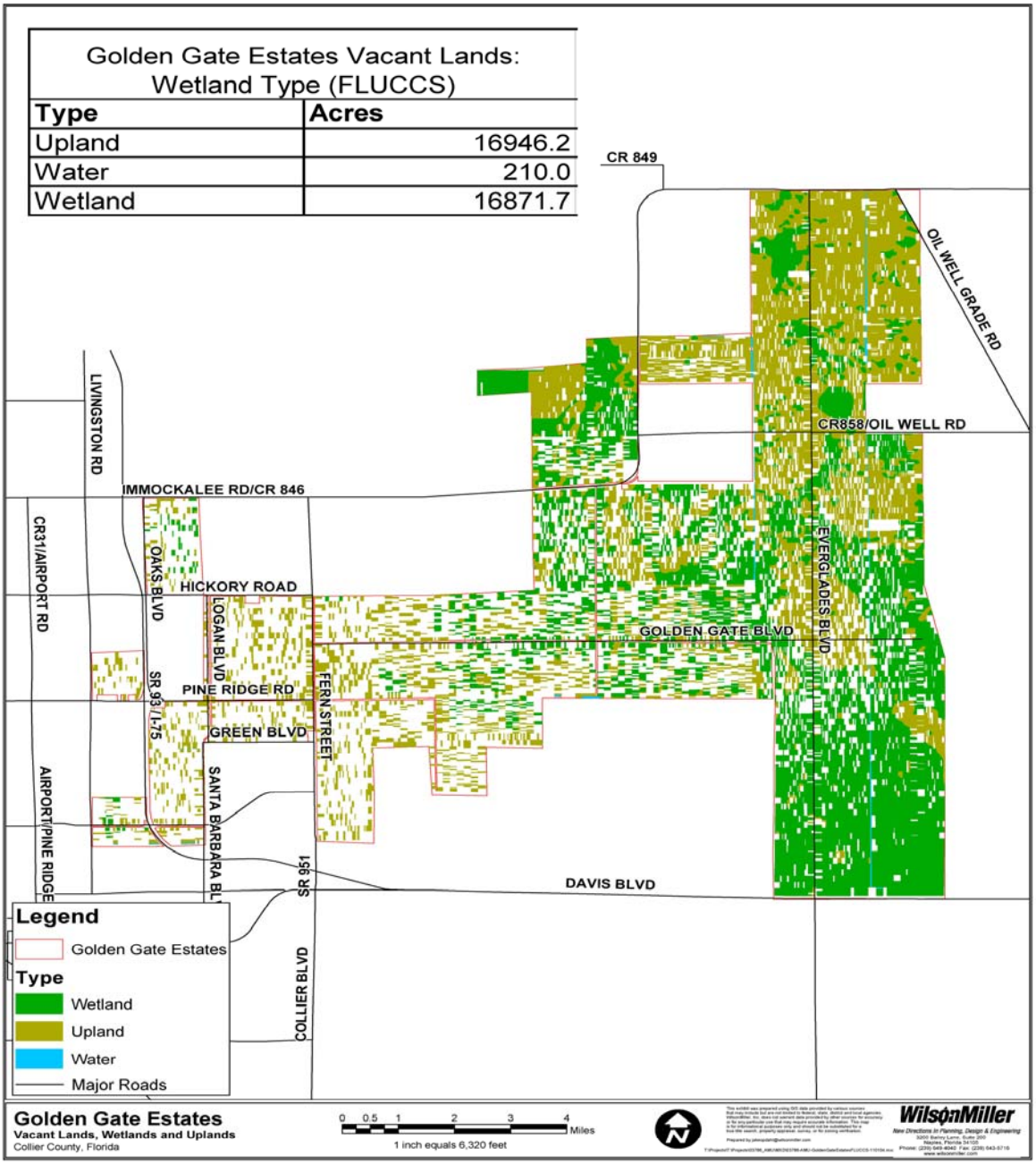


Figure 13. Northern Golden Gate Estates vacant lots (2004).

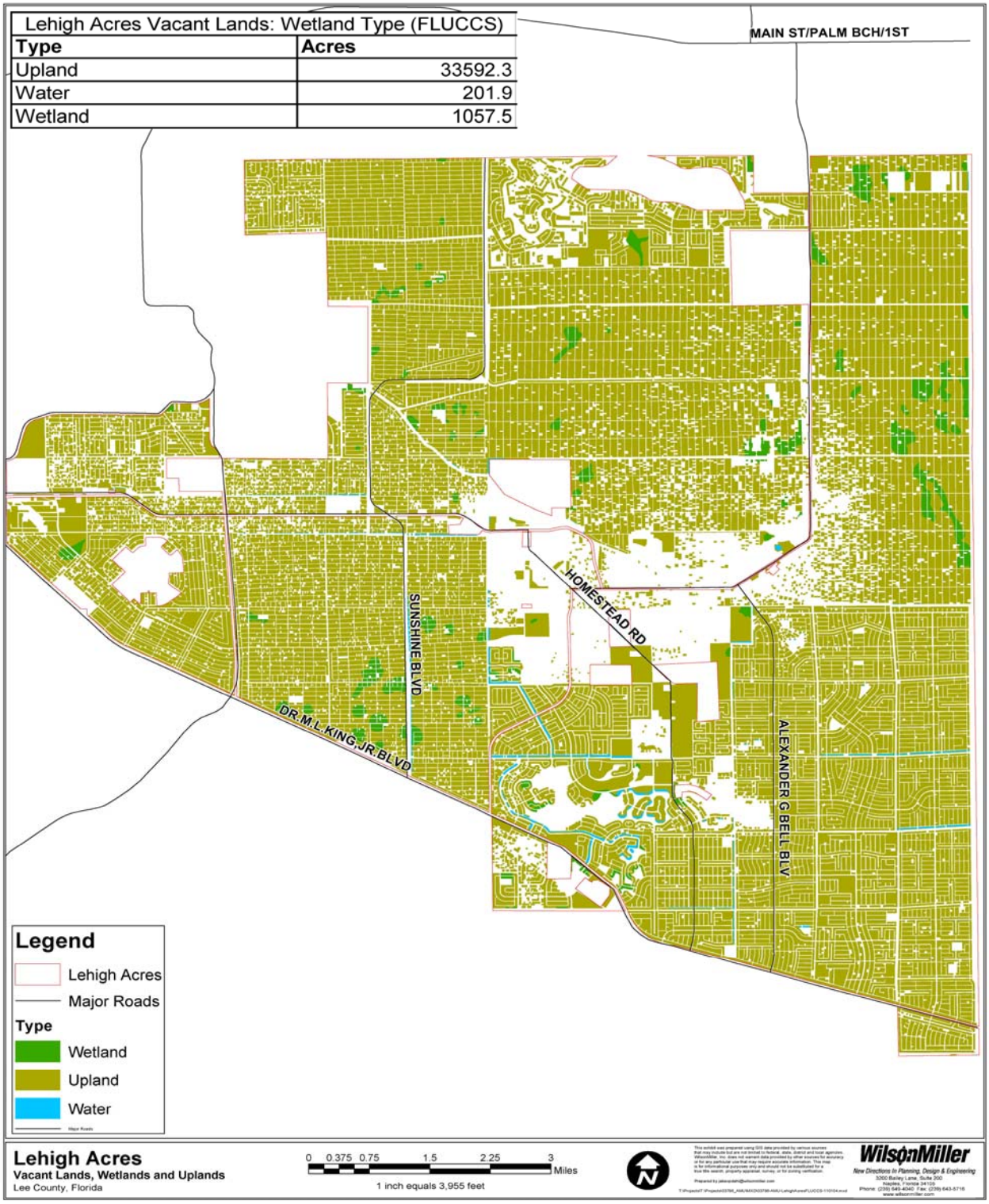
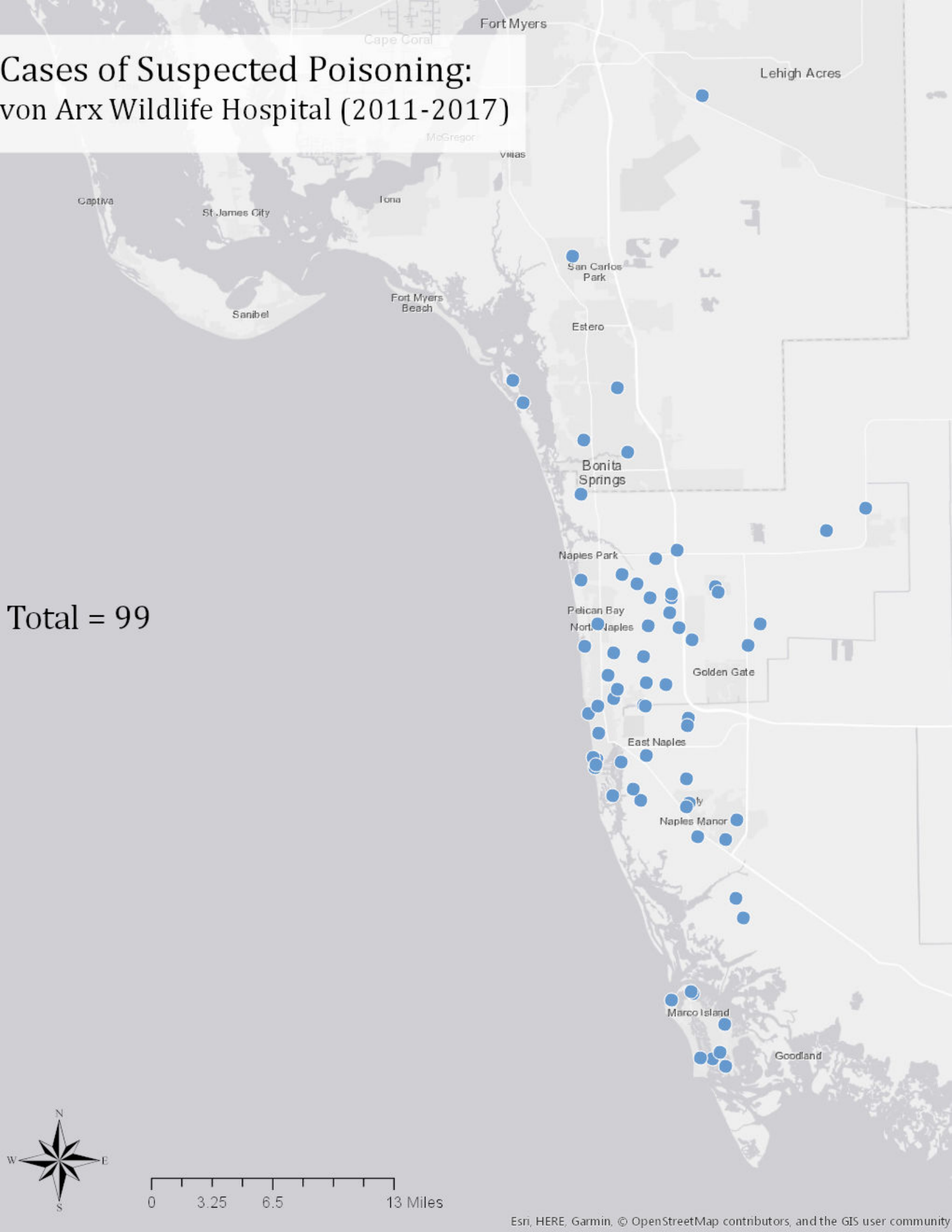


Figure 14. Lehigh Acres vacant lands (2002).

Cases of Suspected Poisoning:
von Arx Wildlife Hospital (2011-2017)



Total = 99

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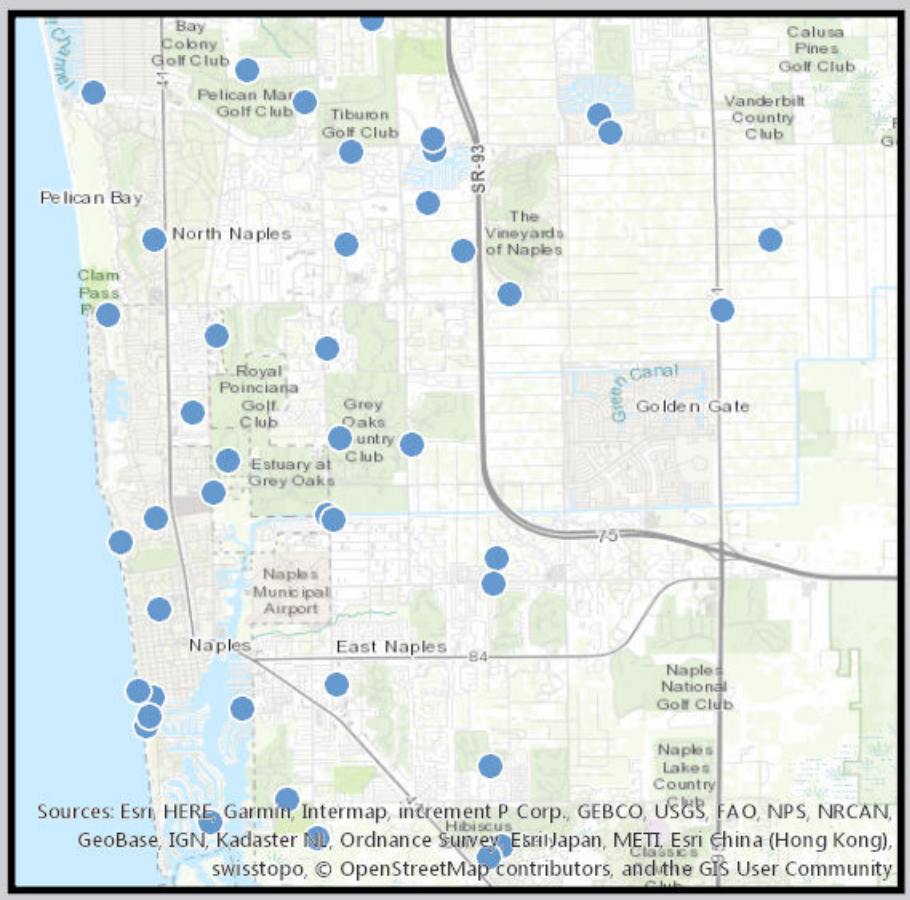
Cases of Suspected Poisoning:
von Arx Wildlife Hospital (2011-2017)

Total = 99



From:	Cassler, Constance
To:	Mitch Hutchcraft; Dell, David; Tawes, Robert; Clements, E. Carter Chandler; Mcdonald, Kenneth; Christian Spilker; Hinzman, Roxanna; dksutton@alicoinc.com; Mott, Vicki V; Johnson, Bruce; Tom Jones; Turner, Andrew; Arnold, Jack; Ziewitz, Jerry; Kelso, Charles; Peters, Kristen E; Tewis, Robert M SAJ
Subject:	Questions biologists have identified while drafting BO sections
Date:	Friday, February 15, 2019 8:33:19 AM
Attachments:	20190215_BO information needs_ask ECPO.docx

Good Morning,

I'm attaching a list of questions we have come up with in the course of drafting the BO. It would really help us out if ECPO could answer these questions. We can talk about them at 9:00.

Thank you,

Connie

Constance L. Cassler, Ph.D.
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Questions to ask ECPO related to information needs for the BO – February 15, 2019

1. How many agricultural fields in the HCP area are flooded to prevent weed growth during the non-growing season? Can we have a map and acreages for each field? This relates to red knot use of the HCP area.
2. Can we have an updated HCP map that removes Ave Maria footprint and the Ave Maria mitigation footprint so we can use it for BO purposes and an updated land use table that has the same Ave Maria acreages removed?
3. Are anticoagulant rodenticides used currently in HCP area? Do you plan to allow new developments to use them? We wrote a jeopardy BO to the EPA in the 1990s for this group of pesticides. FWC indicates evidence of health problems related to these chemicals is currently evident in panthers and other species.
4. Can we have a better explanation of the oil/gas exploration? For example, are there landowners that never intend to explore for oil and gas? Also, if there are landowners that never intend to mine, where are their lands located. Any more specificity would be beneficial in drafting the BO.
5. Questions for burrowing owl:
   - Will surveys for burrowing owls be conducted in the Very Low Density Use Area prior to any construction, similar to in the Covered Activities Area?
   - Will the FDACS Agricultural Wildlife BMPs be followed (specifically avoiding contact with burrowing owls and burrows while using heavy equipment)?
6. Questions for sandhill crane:
   - Will surveys for crane nests be conducted prior to construction and what avoidance, minimization, or mitigation measures be used if nests are found within construction areas?
   - Will the FDACS Agricultural Wildlife BMPs be followed (specifically avoid heavy equipment operation (except prescribed burning and related activities) within 400 feet of active, known, and visibly apparent Florida Sandhill Crane nests from February to May.)?
7. Question for fox squirrels:
   - Will nest surveys be completed prior to construction, and is the 38 m buffer in the HCP what will be used if a nest is found?
   - Will the Conservation Measures listed in the BCFS Conservation Measures and Permitting Guidelines (FWC 2016) be followed?
8. Questions for gopher tortoise:
   - Will the FDACS Agricultural Wildlife BMPs be followed?

From: Cassler, Constance
To: Johnson, Bruce
Subject: Re: [EXTERNAL] Data request
Date: Wednesday, April 17, 2019 8:53:10 AM

OK, thanks.

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
office: 772-469-4243
fax: 772-562-4288
email: constance_cassler@fws.gov

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On Wed, Apr 17, 2019 at 8:34 AM Johnson, Bruce <Bruce.Johnson@stantec.com> wrote:

> Connie,
>
> Based on the visual appearance of your reply email, it looks like the Stantec logo was converted into two hypertext links (one was a PNG for the logo image, the other an active link to our corporate homepage). I have not seen this before with other emails I've sent, so I assume it's just an email software hiccup.
>
> I'll check with our IT people, but you can simply ignore it. Please let me know if it happens again on this reply.
>
> Thanks,
>
> Bruce
>
> **Bruce Johnson, Ph.D.**
>
> Senior Scientist, Environmental Services

Direct: (407) 710-3379

Mobile: (386) 527-8333

Stantec Consulting Services Inc.

300 Primera Blvd., Suite 300

Lake Mary, FL 32746-2145 US

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From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Wednesday, April 17, 2019 8:20 AM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>
Subject: Re: [EXTERNAL] Data request

Hi Bruce,

What is the winmail.dat file attached to this email?

Connie

Constance L. Cassler, Ph.D.

Supervisory Fish and Wildlife Biologist

U.S. Fish and Wildlife Service

1339 20th Street

Vero Beach, Florida 32960

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On Tue, Apr 16, 2019 at 4:46 PM Johnson, Bruce <Bruce.Johnson@stantec.com> wrote:

> David,
>
> Per our conversation this morning, we are requesting the input data and assumptions that were used by AECOM to run the FDOT District One Regional Planning Model (D1RPM). In essence, we request everything that would be needed to reconstruct/deconstruct what was modeled, in order to achieve (validate) the model output results:
>
> * All D1RPM model files for the baseline conditions and the two alternatives (No Action and Issuance of ITPs)
> * Any spreadsheet files developed to interpolate/extrapolate TAZ socioeconomic (SE) land use data for the two alternatives

* Any GIS files used/developed that may have been used to quantify the SE data into the appropriate TAZs
* Any written documentation as to what modifications, if any were made to the TAZs, centroid connectors, network files, etc.
* Any supporting materials (input or output figures or tables) that clarify modeling approaches, inputs, and/or outputs

Given the timeline for the section 7 process, we request that the contractor deliver the necessary information to the Service ASAP. If they are unclear about any aspect of this request, we can promptly arrange a conference call between the Service, AECOM, and our transportation planner.

Thanks,

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
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From: Cassler, Constance
To: Johnson, Bruce
Subject: Re: [EXTERNAL] Data request
Date: Tuesday, April 16, 2019 5:01:42 PM

Thanks Bruce. I will get this to AECOM

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
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1339 20th Street
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On Tue, Apr 16, 2019 at 4:46 PM Johnson, Bruce <Bruce.Johnson@stantec.com> wrote:

> David,
>
> Per our conversation this morning, we are requesting the input data and assumptions that were used by AECOM to run the FDOT District One Regional Planning Model (D1RPM). In essence, we request everything that would be needed to reconstruct/deconstruct what was modeled, in order to achieve (validate) the model output results:
>
> * All D1RPM model files for the baseline conditions and the two alternatives (No Action and Issuance of ITPs)
> * Any spreadsheet files developed to interpolate/extrapolate TAZ socioeconomic (SE) land use data for the two alternatives
> * Any GIS files used/developed that may have been used to quantify the SE data into the appropriate TAZs
> * Any written documentation as to what modifications, if any were made to the TAZs, centroid connectors, network files, etc.
> * Any supporting materials (input or output figures or tables) that clarify modeling approaches, inputs, and/or outputs
>
> Given the timeline for the section 7 process, we request that the contractor deliver the necessary information to the Service ASAP. If they are unclear about any aspect of this request, we can promptly arrange a conference call between the Service, AECOM, and our

transportation planner.

Thanks,

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
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From:	Cassler, Constance
To:	Johnson, Bruce
Cc:	Dell, David; Tawes, Robert; Hinzman, Roxanna; Christian Spilker; Turner, Andrew; Clements, E. Carter Chandler; Ziewitz, Jerry; Tewis, Robert M SAJ; Kelso, Charles; Mcdonald, Kenneth
Subject:	Re: [EXTERNAL] Data request
Date:	Friday, April 26, 2019 4:03:23 PM

Thank you!

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
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On Fri, Apr 26, 2019 at 4:02 PM Johnson, Bruce <Bruce.Johnson@stantec.com> wrote:

> Connie,
>
> Thank you for coordinating the data delivery. We also appreciate and understand AECOM's summary of the process.
>
> We will review the data as quickly as practicable, and will coordinate with the Service when our review has concluded.
>
> Enjoy the weekend!
>
> **Bruce Johnson, Ph.D.**
>
> Senior Scientist, Environmental Services

Direct: (407) 710-3379

Mobile: (386) 527-8333

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From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Friday, April 26, 2019 3:15 PM
To: David Dell <david_dell@fws.gov>; Robert Tawes <Robert_Tawes@fws.gov>; Roxanna Hinzman <roxanna_hinzman@fws.gov>; Christian Spilker <CSpilker@collierenterprises.com>; Turner, Andrew <aturner@hunton.com>; Clements, E. Carter Chandler <eclements@hunton.com>; Jerry Ziewitz <jerry_ziewitz@fws.gov>; Tewis, Robert M SAJ <Robert.M.Tewis@usace.army.mil>; Johnson, Bruce <Bruce.Johnson@stantec.com>
Cc: Charles Kelso <charles_kelso@fws.gov>; Kenneth Mcdonald <kenneth_mcdonald@fws.gov>
Subject: Fwd: [EXTERNAL] Data request

Hi,

I'm forwarding the link to the information AECOM sent to respond to ECPO's questions about the traffic analysis. Please share with anyone else at ECPO that needs to see it.

Have a good weekend,

Connie

Constance L. Cassler, Ph.D.

Supervisory Fish and Wildlife Biologist

U.S. Fish and Wildlife Service

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---------- Forwarded message ---------
From: **Purcell, Adam** <adam.purcell@aecom.com>
Date: Fri, Apr 26, 2019 at 3:00 PM
Subject: RE: [EXTERNAL] Data request
To: Cassler, Constance <constance_cassler@fws.gov>, Cherney, Laura <Laura.Cherney@aecom.com>
Cc: Kenneth Mcdonald <kenneth_mcdonald@fws.gov>, Charles Kelso

<charles_kelso@fws.gov>, Samuels, Kelley <Kelley.Samuels@aecom.com>

All,

We have collected the data supporting our travel demand modeling efforts for Eastern Collier. That information can be downloaded through the link provided below. Please let me know if you have any additional questions.

Download link
https://we.tl/t-BVnKZ1qLab

1 file
Eastern Collier Modeling Files.zip

1 file, 51.7 MB in total · Will be deleted on 24 May, 2019

From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Thursday, April 18, 2019 8:05 AM
To: Cherney, Laura <Laura.Cherney@aecom.com>
Cc: Purcell, Adam <adam.purcell@aecom.com>; Kenneth Mcdonald <kenneth_mcdonald@fws.gov>; Charles Kelso <charles_kelso@fws.gov>; Samuels, Kelley <Kelley.Samuels@aecom.com>
Subject: Re: [EXTERNAL] Data request

Thank you Laura. I appreciate the great summary.

Connie

Constance L. Cassler, Ph.D.

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On Wed, Apr 17, 2019 at 7:51 PM Cherney, Laura <Laura.Cherney@aecom.com> wrote:

> Hi Connie,
>
> In response to your request below, AECOM's modeling team will compile the data used to support the modeling effort presented in the EIS. We anticipate that we will have the files together by the end of next week.
>
> As a friendly reminder to the context of the traffic modeling prepared for the EIS, the modeling effort was completed on an extremely compressed timeline, and was based on a

generalization of possible future condition. In an ideal situation, a detailed description of the timing and location of proposed development would have allowed AECOM to conduct a detailed analysis to identify allowable development based on a detailed review of the comprehensive plan and land development code.

However, since that information was not available (and to accommodate the compressed project timeline and budget), AECOM proposed an alternative modeling process by which development estimates would be based on observed densities in Ave Maria. Therefore, the results provided a very generalized estimate of future traffic conditions. If moving forward, the traffic analysis methodology is revisited, a detailed plan for development would allow future traffic conditions to be more accurately modeled.

Hope that helps. Please let me know if you have any questions.

Thanks,

Laura

From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Tuesday, April 16, 2019 5:09 PM
To: Cherney, Laura <Laura.Cherney@aecom.com>
Cc: Purcell, Adam <adam.purcell@aecom.com>; Kenneth Mcdonald <kenneth_mcdonald@fws.gov>; Charles Kelso <charles_kelso@fws.gov>
Subject: Fwd: [EXTERNAL] Data request

Hi Laura,

The traffic modeling you did for the EIS is also being used as the basis for the BO. We want to make sure that our analyses are on solid ground and have agreed to share them with the applicants. We already shared the table you produced and the summary of assumptions that was in the EIS. The applicants also have the EIS and appendices. See the message I'm forwarding from the applicant's consultant. It lists what they are asking for.

I would like to talk to you as early as possible tomorrow morning to discuss if this is information that would be part of our Admin Record and should be supplied to us as part of the Scope, or if this is above and beyond and will cost extra to provide. Please let me know if/when you are available tomorrow morning, or suggest an alternate time. Of course, we are on a short time frame as usual, and I'm sorry for the short notice.

Connie

Constance L. Cassler, Ph.D.

Supervisory Fish and Wildlife Biologist

U.S. Fish and Wildlife Service

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---------- Forwarded message ---------
From: **Johnson, Bruce** <Bruce.Johnson@stantec.com>
Date: Tue, Apr 16, 2019 at 4:46 PM

Subject: [EXTERNAL] Data request
To: Dell, David (david_dell@fws.gov) <david_dell@fws.gov>
Cc: Constance L. Cassler, Ph.D. <constance_cassler@fws.gov>

David,

Per our conversation this morning, we are requesting the input data and assumptions that were used by AECOM to run the FDOT District One Regional Planning Model (D1RPM). In essence, we request everything that would be needed to reconstruct/deconstruct what was modeled, in order to achieve (validate) the model output results:

* All D1RPM model files for the baseline conditions and the two alternatives (No Action and Issuance of ITPs)
* Any spreadsheet files developed to interpolate/extrapolate TAZ socioeconomic (SE) land use data for the two alternatives
* Any GIS files used/developed that may have been used to quantify the SE data into the appropriate TAZs
* Any written documentation as to what modifications, if any were made to the TAZs, centroid connectors, network files, etc.
* Any supporting materials (input or output figures or tables) that clarify modeling approaches, inputs, and/or outputs

Given the timeline for the section 7 process, we request that the contractor deliver the necessary information to the Service ASAP. If they are unclear about any aspect of this request, we can promptly arrange a conference call between the Service, AECOM, and our transportation planner.

Thanks,

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

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Lake Mary, FL 32746-2145 US

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From: Cassler, Constance
To: Johnson, Bruce
Subject: Re: [EXTERNAL] FW: Data request
Date: Thursday, February 28, 2019 4:09:22 PM
Attachments: Caracara mitigation from 20180831_Letter_ServicetoCorps_AveMaria.pdf

---

Hi Bruce,

I have what you have plus there were some caracara mitigation areas in SSA6. See the attachment.

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
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On Thu, Feb 28, 2019 at 3:16 PM Johnson, Bruce <Bruce.Johnson@stantec.com> wrote:

> Connie,
>
> When I sent the GIS file of the HCP without Ave Maria on 2/19, I assumed that the Service already had the GIS files for the associated mitigation in SSAs 1, 2, 3, 4, and 6.
>
> I still think that is correct, but I wanted to make sure that when we removed Ave Maria for your Biological Opinion analyses, the Service is only removing SSAs 1-4 and the 1,656 acres within SSA 6 that were used as mitigation for Ave Maria (see 20180831 Ave Maria Biological Opinion, page 8). Only 1,656 acres of SSA 6 were used as federal mitigation, not the entire 9,911 acres that were set aside for the local RLSP entitlement process. Please make sure that the Biological Opinion analyses are consistent with this. I'm attaching Figure 5 from the 20180831 Bi-Op as an illustration.
>
> If you have any questions, please call me at your convenience.

Thanks,

Bruce Johnson, Ph.D.

Senior Scientist, Environmental Services

Direct: (407) 710-3379

Mobile: (386) 527-8333

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From: Johnson, Bruce
Sent: Tuesday, February 19, 2019 6:55 PM
To: 'constance_cassler@fws.gov' <constance_cassler@fws.gov>
Subject: Data request

Hi Connie,

Per our phone discussion, please find attached two files for use by FWS staff:

1. A GIS geodatabase file of the HCP Area, with the 5,027-acre Ave Maria DRI removed; and
2. A spreadsheet breaking down the CLC land cover within that area (146,752 acres).

Please let us know if you require anything else to continue with the analyses.

Best Regards,

Bruce Johnson, Ph.D.

Senior Scientist, Environmental Services

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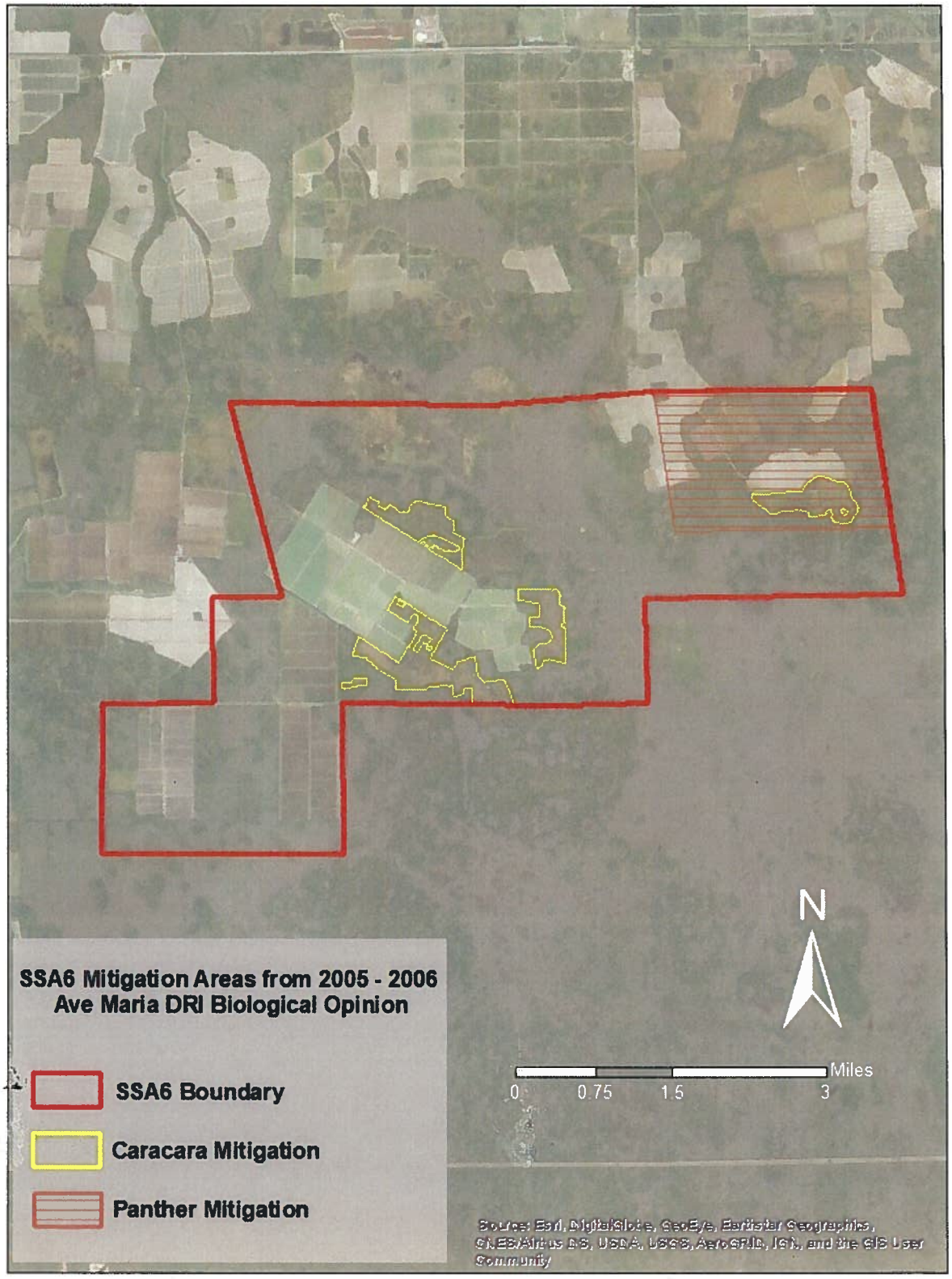

Figure 7. Caracara mitigation areas within SSA6.

From: Cassler, Constance
To: Johnson, Bruce
Cc: Dell, David; Kelso, Charles
Subject: Re: [EXTERNAL] HCP files
Date: Monday, March 25, 2019 2:46:53 PM

Thanks Bruce!

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
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On Mon, Mar 25, 2019 at 9:11 AM Johnson, Bruce <Bruce.Johnson@stantec.com> wrote:

> All,
>
> Thanks to Chuck's assistance with the file transfers, all of the updated HCP document files were uploaded a few moments ago. The upload contains the following files:
>
> - A fully revised HCP document in PDF format
> - The HCP document in Word format (without most table/figures); for Service use with commenting
> - Appendix A to the HCP
> - Appendix B to the HCP
>
> Please check the TOC functionality in the Word document. Some members of our team could use the TOC links by using the Ctrl-Click command, while for others the links were not active. If the links are not working properly, please advise us and we will resubmit.
>
> Thanks,

Bruce Johnson, Ph.D.

Senior Scientist, Environmental Services

Direct: (407) 710-3379

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From: Cassler, Constance
To: Tom Jones
Subject: Re: [EXTERNAL] Immokalee Sand Mine
Date: Thursday, January 31, 2019 10:48:07 AM

Hi Tom,

I'll take a quick look to confirm and get back to you. Is a return email sufficient?

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
1339 20th Street
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office: 772-469-4243
fax: 772-562-4288
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On Thu, Jan 31, 2019 at 9:01 AM Tom Jones <TJones@barroncollier.com> wrote:

> Connie,
>
> This is to follow-up on FWS's biological opinion on the Immokalee sand mine 404 permit.
>
> During early discussions on the sand mine project, questions were raised whether the Immokalee 404 permit and the ECPO HCP would use the same 764.1 acre parcel for mitigation. FWS's March 26, 2018 biological opinion for the Immokalee sand mine project addressed this issue as follows:
>
> "On February 16, 2017, the Service requested, via email to the Consultant, additional

> information regarding the status of the Project's proposed off-site compensation parcel related to Applicant's participation in the HCP, currently in the process of review and revision. The Service stated that the proposed off-site compensation parcel is located within the HCP boundary and designated as a HCP preserve area. While the Project site is outside the HCP boundary, use of the identified parcel as mitigation should be reviewed by the HCP Development Team.
>
> * * *
>
> In a series of communications between the Service, the Consultant, and the HCP Development Team, it was determined that using HCP preserve land for Project compensation would be consistent with the HCP plan provided either: (1) additional preserve acreage is added to the HCP preserve to make up for the acreage used by the Project; or (2) the amount of acreage designated for "covered activities" is reduced so the remaining HCP preserve areas provide adequate mitigation."

Use of the 764.1 acre parcel for mitigation has been resolved through adjustments to the HCP boundary that removed this parcel from the HCP area. The April 2018 revised HCP reflects the removal of the 764.1 acre compensation parcel from the HCP boundary. Accordingly, the 764.1 acre compensation parcel is no longer being used as mitigation under the HCP, and is only being used as mitigation for the Immokalee sand mine. I would like to note that changes to the southern boundary of the HCP not only removed the 764.1 acre parcel from the HCP boundary, but also added new areas to the HCP's preservation area. As currently configured, the HCP generates a surplus of mitigation credits.

We request that you write back confirming that there is no overlap in mitigation between the Immokalee sand mine project and the HCP, and that the parcel has been removed from the HCP preservation area.

Thank you for your assistance,

Tom

From: Cassler, Constance
To: Tom Jones
Cc: Stephen J. Fleming (Stephen.J.Fleming@usace.army.mil); Hamlin, Dennis J
Subject: Re: [EXTERNAL] Immokalee Sand Mine
Date: Thursday, January 31, 2019 11:47:43 AM

Hi Tom,

I reviewed the location of the off-site mitigation for the Immokalee Sand Mine project compared to the most recent preserve areas outlined for the Eastern Collier Multiple-species HCP. The off-site mitigation area for the sand mine is no longer part of the preserve areas identified for the HCP, so there is no overlap. I'm glad this was clarified in the mapping for the HCP.

Thank you,

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
office: 772-469-4243
fax: 772-562-4288
email: constance_cassler@fws.gov

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On Thu, Jan 31, 2019 at 9:01 AM Tom Jones <TJones@barroncollier.com> wrote:

> Connie,
>
> This is to follow-up on FWS's biological opinion on the Immokalee sand mine 404 permit.
>
> During early discussions on the sand mine project, questions were raised whether the Immokalee 404 permit and the ECPO HCP would use the same 764.1 acre parcel for mitigation. FWS's March 26, 2018 biological opinion for the Immokalee sand mine project

addressed this issue as follows:

> "On February 16, 2017, the Service requested, via email to the Consultant, additional information regarding the status of the Project's proposed off-site compensation parcel related to Applicant's participation in the HCP, currently in the process of review and revision. The Service stated that the proposed off-site compensation parcel is located within the HCP boundary and designated as a HCP preserve area. While the Project site is outside the HCP boundary, use of the identified parcel as mitigation should be reviewed by the HCP Development Team.
>
> * * *
>
> In a series of communications between the Service, the Consultant, and the HCP Development Team, it was determined that using HCP preserve land for Project compensation would be consistent with the HCP plan provided either: (1) additional preserve acreage is added to the HCP preserve to make up for the acreage used by the Project; or (2) the amount of acreage designated for "covered activities" is reduced so the remaining HCP preserve areas provide adequate mitigation."

Use of the 764.1 acre parcel for mitigation has been resolved through adjustments to the HCP boundary that removed this parcel from the HCP area. The April 2018 revised HCP reflects the removal of the 764.1 acre compensation parcel from the HCP boundary. Accordingly, the 764.1 acre compensation parcel is no longer being used as mitigation under the HCP, and is only being used as mitigation for the Immokalee sand mine. I would like to note that changes to the southern boundary of the HCP not only removed the 764.1 acre parcel from the HCP boundary, but also added new areas to the HCP's preservation area. As currently configured, the HCP generates a surplus of mitigation credits.

We request that you write back confirming that there is no overlap in mitigation between the Immokalee sand mine project and the HCP, and that the parcel has been removed from the HCP preservation area.

Thank you for your assistance,

Tom

From:	Cassler, Constance
To:	Johnson, Bruce
Cc:	Dell, David; Ziewitz, Jerry; Tawes, Robert; Christian Spilker (CSpilker@collierenterprises.com); Andrew Turner (aturner@hunton.com); Clements, E. Carter Chandler (eclements@hunton.com)
Subject:	Re: [EXTERNAL] Outline of proposed traffic approach
Date:	Thursday, May 9, 2019 8:01:24 AM
Importance:	High

Bruce,

Thank you for sending this. I'm unsure since you sent this if ECPO still intends to comment on the traffic model. We would love ECPO's feedback. Please let me know if we can still expect it.

Thank you,

Connie

Constance L. Cassler, Ph.D.
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On Wed, May 8, 2019 at 2:07 PM Johnson, Bruce <Bruce.Johnson@stantec.com> wrote:

> David and Jerry,
>
> Please find attached ECPO's outline of a proposed traffic approach to the section 7 analysis. We look forward to discussing the outline with you after you have reviewed it.
>
> Regards,
>
> **Bruce Johnson, Ph.D.**
>
> Senior Scientist, Environmental Services

Direct: (407) 710-3379

Mobile: (386) 527-8333

Stantec Consulting Services Inc.

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Lake Mary, FL 32746-2145 US

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From:	Cassler, Constance
To:	Johnson, Bruce
Cc:	Dell, David; Ziewitz, Jerry; Tawes, Robert; Christian Spilker (CSpilker@collierenterprises.com); Andrew Turner (aturner@hunton.com); Clements, E. Carter Chandler (eclements@hunton.com)
Subject:	Re: [EXTERNAL] Outline of proposed traffic approach
Date:	Thursday, May 9, 2019 8:30:01 AM

Thank you.

Constance L. Cassler, Ph.D.
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On Thu, May 9, 2019 at 8:28 AM Johnson, Bruce <Bruce.Johnson@stantec.com> wrote:

> Connie,
>
> Yes, we are in the process of evaluating the traffic modeling and will provide feedback to the Service as soon as possible. It appears that we now have all of the required data inputs from AECOM after the second data delivery, but we will let you know immediately if anything else arises. We will also try to pin down the timeline for completing our review of the modeling, after the initial model runs are complete.
>
> Thanks,
>
> **Bruce Johnson, Ph.D.**
>
> Senior Scientist, Environmental Services
>
> Direct: (407) 710-3379
>
> Mobile: (386) 527-8333

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From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Thursday, May 09, 2019 8:01 AM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>
Cc: Dell, David (david_dell@fws.gov) <david_dell@fws.gov>; Ziewitz, Jerry <jerry_ziewitz@fws.gov>; Robert Tawes <Robert_Tawes@fws.gov>; Christian Spilker (CSpilker@collierenterprises.com) <CSpilker@collierenterprises.com>; Andrew Turner (aturner@hunton.com) <aturner@hunton.com>; Clements, E. Carter Chandler (eclements@hunton.com) <eclements@hunton.com>
Subject: Re: [EXTERNAL] Outline of proposed traffic approach

Bruce,

Thank you for sending this. I'm unsure since you sent this if ECPO still intends to comment on the traffic model. We would love ECPO's feedback. Please let me know if we can still expect it.

Thank you,

Connie

Constance L. Cassler, Ph.D.

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On Wed, May 8, 2019 at 2:07 PM Johnson, Bruce <Bruce.Johnson@stantec.com> wrote:

> David and Jerry,
>
> Please find attached ECPO's outline of a proposed traffic approach to the section 7 analysis. We look forward to discussing the outline with you after you have reviewed it.

Regards,

Bruce Johnson, Ph.D.

Senior Scientist, Environmental Services

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From: Cassler, Constance
To: Johnson, Bruce
Subject: Re: [EXTERNAL] RE: GIS layer for Lands Eligible for Inclusion in HCP
Date: Tuesday, February 26, 2019 9:13:08 AM

Thanks Bruce. We'll check it and let you know.

Connie

Constance L. Cassler, Ph.D.
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On Mon, Feb 25, 2019 at 5:16 PM Johnson, Bruce <Bruce.Johnson@stantec.com> wrote:

> Connie,
>
> One of our analysts was able to export the “Eligible for Inclusion” features right away. Although it was checked by a second Stantec GIS analyst, please have your GIS folks run a check to see that it is matching up with their GIS data and Figure 2-1 from the HCP document.
>
> If your GIS analyst notes any discrepancies, please contact me and we will rectify any issues.
>
> **Bruce Johnson, Ph.D.**
>
> Senior Scientist, Environmental Services
>
> Direct: (407) 710-3379
>
> Mobile: (386) 527-8333

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From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Monday, February 25, 2019 4:29 PM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>
Subject: Re: [EXTERNAL] RE: GIS layer for Lands Eligible for Inclusion in HCP

Thanks for the help. If I can get someone to do a reasonable job of cleaning up what we have tomorrow I will let you know. I'm trying to get the information to the biologists so they have all they need to finish their BO sections. I'll shoot you an email before I leave tomorrow letting you know if we still need help.

Thanks,

Connie

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On Mon, Feb 25, 2019 at 4:24 PM Johnson, Bruce <Bruce.Johnson@stantec.com> wrote:

> Hi Connie,
>
> I'll forward your request to James Hale, our GIS Manager. I suspect that our analysts could pull from property appraiser parcel boundaries or some other data to clip the roads off those properties.
>
> We'll get back with you ASAP. I'll be seeing James on Wednesday, and we should be able to kick something out within 48 hours. Will that timeframe be OK?
>
> **Bruce Johnson, Ph.D.**
>
> Senior Scientist, Environmental Services

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From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Monday, February 25, 2019 4:17 PM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>
Subject: GIS layer for Lands Eligible for Inclusion in HCP

Hi Bruce,

For the BO we had promised to consider Lands Eligible for Inclusion in HCP in our analysis so that it would be easy to include them if landowners chose to join the HCP at a later date. I'm hoping you have a GIS layer you can send us so we get the property boundaries right. We have an old one that has a lot of roads attached to the properties. It would take us a long time to clean that up.

Please let me know,

Connie

Constance L. Cassler, Ph.D.

Supervisory Fish and Wildlife Biologist

U.S. Fish and Wildlife Service

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From: Cassler, Constance
To: Johnson, Bruce
Cc: Kelso, Charles; Dell, David
Subject: Re: [EXTERNAL] RE: Hogan Island Quarry off-site mitigation
Date: Friday, March 15, 2019 10:59:52 AM

Sorry I forgot that in my hurry to get it to you. The orange is the off-site mitigation area which looks to be outside of the mine project (grey on the HCP maps). This looks to be labelled as preserve on the HCP map. The green is within the mine footprint (grey area) and isn't a concern.

Connie

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On Fri, Mar 15, 2019 at 10:54 AM Johnson, Bruce <Bruce.Johnson@stantec.com> wrote:

> Hi Connie,
>
> Thanks for the screenshot; I will track that down as well. Can you tell me what the colors indicate (orange fill versus light green fill)?
>
> **Bruce Johnson, Ph.D.**
>
> Senior Scientist, Environmental Services
>
> Direct: (407) 710-3379
>
> Mobile: (386) 527-8333

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From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Friday, March 15, 2019 10:45 AM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>
Cc: Charles Kelso <charles_kelso@fws.gov>; David Dell <david_dell@fws.gov>
Subject: Hogan Island Quarry off-site mitigation

Hi Bruce,

I'm attaching a GIS map of the other project. It appears to be off-site mitigation for the Hogan Island Quarry.

Connie

Constance L. Cassler, Ph.D.

Supervisory Fish and Wildlife Biologist

U.S. Fish and Wildlife Service

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From: Cassler, Constance
To: Johnson, Bruce
Subject: Re: [EXTERNAL] RE: Last call for species data the Applicants don"t have
Date: Friday, February 22, 2019 4:38:46 PM

Thanks Bruce. That's very helpful.

Connie

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On Fri, Feb 22, 2019 at 3:08 PM Johnson, Bruce <Bruce.Johnson@stantec.com> wrote:

> Connie,
>
> Please see the two attached KMZ files for the red knot occurrences from eBird. I digitized these myself in Google Earth, and used the eBird data source that you provided to me the other day:
>
> https://ebird.org/map/redkno?neg=true&env.minX=&env.minY=&env.maxX=&env.maxY=&zh=false&gp=false&ev=Z&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2019
>
> The 2017 data point is within the Camp Keais Stand flowway that is designated as Preservation under the HCP. I think the eBird GPS location data point was generalized from the CBC travels that day. The photo appears to show more open/disturbed cover, but I located the KMZ point where eBird showed it. There's nothing in the data entry to state whether the birds were observed in a farm field, the clearing north of the data point, the forest trail, etc. Your folks will have to make some assumptions for their analysis.
>
> For the 2016 occurrence of three birds in the tomato field, I confirmed in Google Earth that the field was configured the same way in 2016 as it is now. The area of the digitized polygon (which includes the

field and the rim ditch around it) is estimated to be 74.7 acres.

Many thanks for your efforts to supply as much data as possible for our updated HCP document. If you think of anything else that we need to provide, just let us know.

Bruce Johnson, Ph.D.

Senior Scientist, Environmental Services

Direct: (407) 710-3379

Mobile: (386) 527-8333

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From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Friday, February 22, 2019 12:10 PM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>
Subject: Re: [EXTERNAL] RE: Last call for species data the Applicants don't have

We could use the acreage of the 2 fields where red knots have been observed if you can do it easily. Otherwise, we will figure it out.

I can't think of anything else.

Connie

Constance L. Cassler, Ph.D.

Supervisory Fish and Wildlife Biologist

U.S. Fish and Wildlife Service

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On Fri, Feb 22, 2019 at 10:44 AM Johnson, Bruce <Bruce.Johnson@stantec.com> wrote:

> Hi Connie,

Thank you for the additional information. Our GIS analysts are checking these data against what we already have in our system. We will update the occurrence data figures as necessary, and will do the same for the narrative.

Does Vero need any additional information from our team? We are working so hard on responses and revisions that I/we may have forgotten something.

Thanks,

Bruce Johnson, Ph.D.

Senior Scientist, Environmental Services

Direct: (407) 710-3379

Mobile: (386) 527-8333

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From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Friday, February 22, 2019 10:19 AM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>
Subject: Fwd: Last call for species data the Applicants don't have

Hi Bruce,

There is some scrub-jay information we are not sure you have. See the email I'm forwarding. I'll follow-up by forwarding another email where Liz has Immokalee information attached.

Connie

Constance L. Cassler, Ph.D.

Supervisory Fish and Wildlife Biologist

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---------- Forwarded message ---------
From: **Landrum, Elizabeth** <elizabeth_landrum@fws.gov>
Date: Fri, Feb 22, 2019 at 10:03 AM
Subject: Re: Last call for species data the Applicants don't have
To: Cassler, Constance <constance_cassler@fws.gov>

Connie,

The HCP doesn't mention anything beyond the 1992-93 scrub-jay survey data, which Dr. Bowman apparently told them was the only data available in that area. Since I attached the Immokalee GIS files to my last email, I have attached the Lake Trafford Pre-construction Survey report to this email.

The only other info I found was a handmarked map of scrub-jays in Immokalee (attached: 20070326_email_Rousso to HatcherR.jpg). I have no coordinates for the scrub-jay observations marked on the map, but they are in the same areas as the GIS locations I sent yesterday, and appear to correspond to some scrub habitat polygons (attached: seven "flahab1" GIS files).

Liz.

Elizabeth Landrum

Fish and Wildlife Biologist

US Fish and Wildlife Service

1339 20th Street

Vero Beach, FL 32960

Tel.: 772-469-4304

Fax: 772-562-4288

E-mail: elizabeth_landrum@fws.gov

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On Fri, Feb 22, 2019 at 8:11 AM Cassler, Constance <constance_cassler@fws.gov> wrote:

> Hi Liz,
>
> Can you please look at the HCP (\\IFW4FO-FLVEB620\Biologists\Trust Resources\HCP\County Collier\E Collier Multispecies HCP (2008FA0786)\HCP\Draft HCPs\20180822 Draft) on p 170 and 171 of the pdf and compare to what you have then send me anything different.
>
> Thank you,
>
> Connie
>
> Constance L. Cassler, Ph.D.
>
> Supervisory Fish and Wildlife Biologist
>
> U.S. Fish and Wildlife Service
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On Thu, Feb 21, 2019 at 6:35 PM Landrum, Elizabeth <elizabeth_landrum@fws.gov> wrote:

> Connie,
>
> You said Heather found scrub-jay info in the Lake Trafford survey, so I won't include that. I assume they also have the 1992-93 survey data. Was the applicant supplied with the Immokalee Development scrub-jay info? If not, I have attached the 12 GIS files, and in case the attachments mess up, the path to the two files is -
>
> L:\Trust Resources\HCP\County Collier\Immokalee\GIS
>
> \Immokalee_FSJ_03262007.shp and
> \Immokalee_FSJ_05102007.shp
>
> Liz.
>
> Elizabeth Landrum
>
> Fish and Wildlife Biologist
>
> US Fish and Wildlife Service
>
> 1339 20th Street
>
> Vero Beach, FL 32960

Tel.: 772-469-4304

Fax: 772-562-4288

E-mail: elizabeth_landrum@fws.gov

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to the Freedom of Information Act (FOIA) and may be disclosed to third parties.

On Thu, Feb 21, 2019 at 11:23 AM Cassler, Constance <constance_cassler@fws.gov> wrote:

> He Team,
>
> Last week, the Applicants requested any species data we have that they didn't present in their HCP. I have received info for some species and have passed it along to Bruce Johnson. If there is additional information please send it to me ASAP so I can send it to the applicants. If there is a reason we can't share it with them, please let me know that too.
>
> Thanks in advance,
>
> Connie
>
> Constance L. Cassler, Ph.D.
>
> Supervisory Fish and Wildlife Biologist
>
> U.S. Fish and Wildlife Service
>
> 1339 20th Street
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From:	Johnson, Bruce
To:	Cassler, Constance; Christian Spilker; Turner, Andrew
Cc:	Kelso, Charles; Dell, David; Hinzman, Roxanna; Williams, Larry O; Tawes, Robert; Ziewitz, Jerry; Mcdonald, Kenneth
Subject:	RE: [EXTERNAL] Traffic data files
Date:	Monday, May 6, 2019 3:46:42 PM
Importance:	High

Hi Connie,

Our thanks to you and AECOM for the data delivery. Our team will review the files and let you know if we have everything that we need. We also look forward to completing the review and discussing the results with the Service.

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

Stantec Consulting Services Inc.
300 Primera Blvd., Suite 300
Lake Mary, FL 32746-2145 US

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From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Monday, May 06, 2019 3:26 PM
To: Johnson, Bruce <Bruce.Johnson@stantec.com>; Christian Spilker <CSpilker@collierenterprises.com>; Turner, Andrew <aturner@hunton.com>
Cc: Charles Kelso <charles_kelso@fws.gov>; David Dell <david_dell@fws.gov>; Roxanna Hinzman <roxanna_hinzman@fws.gov>; Larry Williams <larry_williams@fws.gov>; Robert Tawes <Robert_Tawes@fws.gov>; Jerry Ziewitz <jerry_ziewitz@fws.gov>; Kenneth Mcdonald <kenneth_mcdonald@fws.gov>
Subject: Fwd: [EXTERNAL] Traffic data files

Hi Bruce,

AECOM sent the traffic model information you requested. Please let me know if you have any questions. We look forward to discussing the model with you when you are ready.

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist

U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
office: 772-469-4243
fax: 772-562-4288
email: constance_cassler@fws.gov

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---------- Forwarded message ---------
From: **Purcell, Adam** <adam.purcell@aecom.com>
Date: Mon, May 6, 2019 at 11:12 AM
Subject: RE: [EXTERNAL] Traffic data files
To: Cassler, Constance <constance_cassler@fws.gov>, Cherney, Laura <Laura.Cherney@aecom.com>, Samuels, Kelley <Kelley.Samuels@aecom.com>
Cc: Charles Kelso <charles_kelso@fws.gov>, Kenneth Mcdonald <kenneth_mcdonald@fws.gov>, David Dell <david_dell@fws.gov>

Connie,

Good morning. I was able to collect the additional base information requested by Stantec. I've provided a link through which the D1RPM files can be accessed.

Download link
https://we.tl/t-ol8IWSmc5K

1 file
D1RPM_v1.0.2.zip

1 file, 64.8 MB in

total · Will be deleted on 3 June, 2019

Adam Purcell, AICP
Project Planner, Surface Transportation Planning
D 1-813-675-6812
adam.purcell@aecom.com
AECOM
7650 West Courtney Campbell Causeway, Tampa, Florida 33607
T 1-813-286-1711 F 1-813-286-6587
www.aecom.com

Twitter I Facebook I LinkedIn I Google+

From: Cassler, Constance <constance_cassler@fws.gov>
Sent: Friday, May 03, 2019 8:20 AM
To: Cherney, Laura <Laura.Cherney@aecom.com>; Purcell, Adam <adam.purcell@aecom.com>; Samuels, Kelley <Kelley.Samuels@aecom.com>
Cc: Charles Kelso <charles_kelso@fws.gov>; Kenneth Mcdonald <kenneth_mcdonald@fws.gov>; David Dell <david_dell@fws.gov>
Subject: Fwd: [EXTERNAL] Traffic data files

Hi Laura,

ECPO reviewed the traffic model information you sent and are asking for information they didn't find in what you sent us. Can you please let us know if what you sent is all the information you have, or if you have what ECPO is requesting and can send it to us. Of course, time is of the essence.

Thanks in advance,

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
office: 772-469-4243
fax: 772-562-4288

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From: **Johnson, Bruce** <Bruce.Johnson@stantec.com>
Date: Fri, May 3, 2019 at 7:58 AM
Subject: [EXTERNAL] Traffic data files
To: Constance L. Cassler Ph. D. (constance_cassler@fws.gov) <constance_cassler@fws.gov>
Cc: Dell, David (david_dell@fws.gov) <david_dell@fws.gov>

Hi Connie,

We have reviewed the traffic modeling data that you forwarded to us and note that the only model input files provided are the socio-economic data files (ZONEDATA) for the two land use alternatives. In order to complete our review, we need to see all of the files contained in the model input directories used to perform the model runs. Please send us those files as soon as possible.

We are mindful of the tight schedule for completing various analyses, and want to avoid any delay. If you have any questions, please call me on my mobile.

Thanks,

Bruce Johnson, Ph.D.
Senior Scientist, Environmental Services

Direct: (407) 710-3379
Mobile: (386) 527-8333

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300 Primera Blvd., Suite 300
Lake Mary, FL 32746-2145 US

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From: Cassler, Constance
To: Christian Spilker
Subject: Re: Invitation: East Collier HCP Update Call @ Fri Apr 27, 2018 9am - 10am (EDT) (david_dell@fws.gov)
Date: Friday, April 27, 2018 8:34:16 AM
Attachments: 20100603_letter_Barron Collier to Service_ITP Apps and ECollier Multi Species HCP.pdf
Importance: High

Here is the attachment I forgot.

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
office: 772-469-4243
fax: 772-562-4288
email: constance_cassler@fws.gov

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On Fri, Apr 27, 2018 at 8:28 AM, Cassler, Constance <constance_cassler@fws.gov> wrote:

> Hi Christian,
>
> I'm attaching a copy of the permit application we have. It is from 2010. Please make sure all of the applicants that signed the application are still participating and if there are different ones, we will need their application.
>
> I haven't gone to our locked room to see if the old check is there or if you had Trish Adams shred it back around 2010. If we have the old check I can send it back to you or shred it. Just let me know what you prefer. We will need a new check, but wait until right before we send everything to the Regional Office in a couple of months.
>
> Connie
>
> Constance L. Cassler, Ph.D.
> Supervisory Fish and Wildlife Biologist
> U.S. Fish and Wildlife Service
> 1339 20th Street
> Vero Beach, Florida 32960
> office: 772-469-4243
> fax: 772-562-4288
> email: constance_cassler@fws.gov
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From: **Dell, David** <david_dell@fws.gov>
Date: Fri, Apr 27, 2018 at 7:55 AM
Subject: Re: Invitation: East Collier HCP Update Call @ Fri Apr 27, 2018 9am - 10am (EDT) (david_dell@fws.gov)
To: Robert Tawes <robert_tawes@fws.gov>
Cc: "Mitch Hutchcraft (mhutchcraft@cclpcitrus.com)" <mhutchcraft@cclpcitrus.com>, tjones@barroncollier.com, "Turner, Andrew" <aturner@hunton.com>, Charles Kelso <charles_kelso@fws.gov>, "Mott, Vicki" <vicki.mott@sol.doi.gov>, "Johnson, Bruce" <bruce.johnson@stantec.com>, Roxanna Hinzman <roxanna_hinzman@fws.gov>, Constance Cassler <constance_cassler@fws.gov>, Christian Spilker <cspilker@collierenterprises.com>

Everyone: Just wanted you to have this revised EIS process timeline. Hopefully this is clearer than the notes provided earlier. Talk to you soon.

David Dell
Southeast Region
HCP and Safe Harbors Coordinator
404/679-7313
fax: 7081
david_dell@fws.gov

NOTE: All email correspondence and attachments received from or sent to me are subject to the Freedom of Information Act (FOIA) and may be disclosed to third parties.

On Thu, Apr 19, 2018 at 8:21 AM, Robert Tawes <robert_tawes@fws.gov> wrote:

East Collier HCP Update Call **more details »**

General status update but also resolution on scope for EIS. 877/429-2163, 1151748#

When Fri Apr 27, 2018 9am – 10am Eastern Time

Video call https://hangouts.google.com/hangouts/_/doi.gov/aturner-robert

Calendar david_dell@fws.gov

Who
- robert_tawes@fws.gov - organizer
- mhutchcraft@cclpcitrus.com
- tjones@barroncollier.com
- aturner@hunton.com
- charles_kelso@fws.gov

- vicki.mott@sol.doi.gov
- bruce.johnson@stantec.com
- david_dell@fws.gov
- roxanna_hinzman@fws.gov
- constance_cassler@fws.gov
- cspilker@collierenterprises.com

Going? **Yes** - **Maybe** - **No** more options »

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BARRON COLLIER COMPANIES

June 3, 2010

Paul Souza, Field Supervisor
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, FL 32960-3559

Re: Eastern Collier Multi-Species Habitat Conservation Plan

Dear Mr. Souza:

Consistent with our ongoing discussions, we are pleased to submit the summary of the Eastern Collier Multiple Species Habitat Conservation Plan along with the following:

- Application fee – Check no. 2882 in the amount of $100.00
- Permit Applications for:
  - Alico, Inc.
  - Barron Collier Investment, LTD.
  - Collier Enterprises Management, Inc.
  - Consolidated Citrus
  - English Brothers
  - Half Circle Ranch, LLP
  - JB Ranch
  - Pacific Land, Ltd
  - Sunniland Family

We look forward to working with you and your staff, as well as other agencies and stakeholders, on this important project.

Should you have any questions or require further information, please feel free to contact me at (239) 262-2600.

Sincerely,

Tom Jones

Tom Jones, Authorized Agent
Barron Collier Companies

Enclosures

RECEIVED
JUN 04 2010
South Florida ES Office
Vero Beach, FL

FOSTER

MEH

EASTERN COLLIER MULTIPLE SPECIES HABITAT CONSERVATION PLAN

Prepared in support of an Incidental Take Permit under Section 10(a)(1)(B) of the Endangered Species Act

June 2010

OVERVIEW

The Eastern Collier County Multiple Species Habitat Conservation Plan (MSHCP) provides a detailed, long-term, science-based plan for the permanent protection of habitat for the endangered Florida panther (*Puma concolor coryi*) and other federally listed species within the proposed MSHCP area. Eastern Collier County encompasses a variety of land uses, including crop production, ranching, native vegetation communities, urban areas, and public lands. The ultimate planning goal for this region is to ensure a long-term compatible balance of conservation, sustainable agriculture, and economic development that contributes to the protection, survival and recovery of federally listed species.

In 2002, Collier County adopted an innovative Rural Land Stewardship Plan (RLSP) that resulted from an extraordinary collaboration between property owners, conservation organizations, and local and state government agencies. The RLSP created strong incentives for the permanent protection of environmentally sensitive lands, including prime panther habitats, in exchange for compact forms of residential and commercial development on lands with relatively low natural resource values. Since its implementation, the RLSP has already protected 56,000 acres of land that are utilized heavily by the Florida panther and the other species covered by this MSHCP.

Building upon this successful collaboration, a number of Eastern Collier property owners and leading conservation organizations created the Florida Panther Protection Program (FPPP)[1]. The FPPP integrates a variety of programs, studies, and strategies to enhance and fund a science-based program "to better protect and manage the Florida panther in southwest Florida." The program incorporates RLSP provisions related to panther habitat restoration and creation of additional panther movement corridors; suggests adjustments to panther-related aspects of the

[1] "The purpose of the Florida Panther Protection Program FPPP…is to facilitate the management and protection of panthers within the Enhanced Protection Area [i.e., RLSP/MSHCP area] by providing a contiguous range of preserved panther habitat in the Enhanced Protection Area to assist recovery through the use of buffering against panther-human interaction, locating and construction of panther crossings, and the protection, enhancement, restoration, including corridor enhancement or restoration, or acquisition of panther habitat demonstrated to be important to panther protection and management within the Enhanced Protection Area based upon a technical review and analysis of available data..." (excerpt from FPPP MOU between Rural Landowners and Conservation Organizations, June 2008)

RLSP; and creates a funding mechanism that is tied to generation and utilization of panther habitat mitigation.

The MSHCP furthers the goal of panther conservation, and conservation of other federally listed species, by working with USFWS to incorporate RLSP and FPPP program elements in a formal plan under Section 10 of the Endangered Species Act. At the conclusion of the MSHCP and associated NEPA process, an Implementing Agreement will be signed that specifies the rights and responsibilities of all parties to the MSHCP, and legally binds the parties to its provisions. The MSHCP provides a science-based, legally binding mechanism for the realization of Florida panther habitat conservation, conservation of other covered listed species, and sustainable regional planning.

INTRODUCTION

The proposed Eastern Collier Multiple Species Habitat Conservation Plan (herein "MSHCP") provides a long-range (50 year) conservation and land-use planning framework for approximately 177,000±[2] acres in southwest Florida. The MSHCP is required in support of the application for an Incidental Take Permit (ITP) under Section 10(a)(1)(B) of the Endangered Species Act. This document summarizes the main elements of the ITP application and MSHCP, including (but not limited to) the following:

- Basic applicant information;
- Location and extent of the MSHCP area;
- Relation of the MSHCP area to existing land use planning;
- Description of activities to be covered under the ITP and permit duration;
- Common and scientific names of listed species to be covered under the ITP;
- Major elements of the MSHCP, including:
    - The potential biological impact(s) that will likely result from the proposed taking of a species;

[2] For the purpose of this MSHCP summary document, acreages are best currently available estimates. Actual acreages will be ultimately determined during the ITP process.

  - Avoidance and minimization of biological impacts via the permanent protection of large blocks of habitat and environmental planning principles;
  - Steps the applicant will take to monitor, minimize, and mitigate unavoidable impacts to species;
  - The level and source of funding to implement such steps;
  - Alternatives to taking and why they were not pursued;
- General Considerations for the Implementing Agreement

The MSHCP arose from a collaborative effort between Eastern Collier property owners, conservation organizations, and wildlife agencies to meaningfully address long-term planning issues related to the Florida panther. The landscape-scale matrix of habitats that support the Florida panther also support several other federally listed species, therefore a multi-species approach was taken for the ITP and MSHCP.

Ultimately, the ITP and MSHCP allow participating property owners to plan and coordinate future actions within the MSHCP area, enabling more effective and integrated conservation planning, avoiding piecemeal development scenarios, supporting effective long-term cumulative impact analyses, and simplifying future individual consultations between USFWS and other federal agencies.

BASIC APPLICANT INFORMATION

The applicants for the ITP are the property owners known as the Eastern Collier Property Owners (ECPO) who are parties to the FPPP. ECPO collectively owns more than 85 percent of the land within the MSHCP area (Exhibit 1), in addition to other lands outside the MSHCP area in south and central Florida.

Over a decade ago, ECPO members spearheaded a long-term regional planning effort that resulted in the Collier County Rural Land Stewardship Program (RLSP). This innovative program created effective incentives to preserve large blocks of environmentally sensitive areas, in exchange for compact forms of rural development on previously disturbed lands with lower natural resource value. Since 2002, the RLSP has protected approximately 56,000 acres

of predominantly native habitats, interspersed with agricultural land uses, at no cost to the public. These protected areas support many of the listed species outlined later in this summary. One key hallmark of the RLSP was that property owners, conservation organizations, and government agencies effectively worked together to create and implement a long-term regional future land use plan with a strong conservation element.

ECPO members are currently collaborating with conservation organizations and wildlife agencies on the Florida Panther Protection Program (FPPP). The programmatic goal of the FPPP is to better protect, manage, and assist in the survival and recovery of the Florida panther, while balancing conservation efforts with property owner property rights.

LOCATION AND EXTENT OF THE MSHCP AREA

The MSHCP area is located in the northeast corner of Collier County, Florida and surrounds the town of Immokalee (Exhibit 1). The area subject to this MSHCP is approximately 177,000± acres. The MSHCP area also envelops 15,000± acres of public lands, functionally integrating these lands into a wider conservation plan.

As shown on Exhibit 1, the MSHCP borders the Florida Panther National Wildlife Refuge (FPNWR) and Big Cypress National Preserve (BCNP) to the south, public lands that support the core population area for the Florida panther. The MSHCP area also borders the Okaloacoochee Slough State Forest (OSSF) to the north and east, which is also heavily utilized by panthers and serves as part of a potential dispersal corridor to central Florida. To the west, the 13,000-acre Audubon Corkscrew Swamp Sanctuary harbors the largest breeding colony of endangered wood storks in south Florida. The MSHCP therefore occupies an area that, if properly planned and managed, can function as a landscape-scale habitat linkage in perpetuity. The avoidance, minimization, mitigation, and management actions proposed within the MSHCP and Implementation Agreement promote and maintain these linkages.

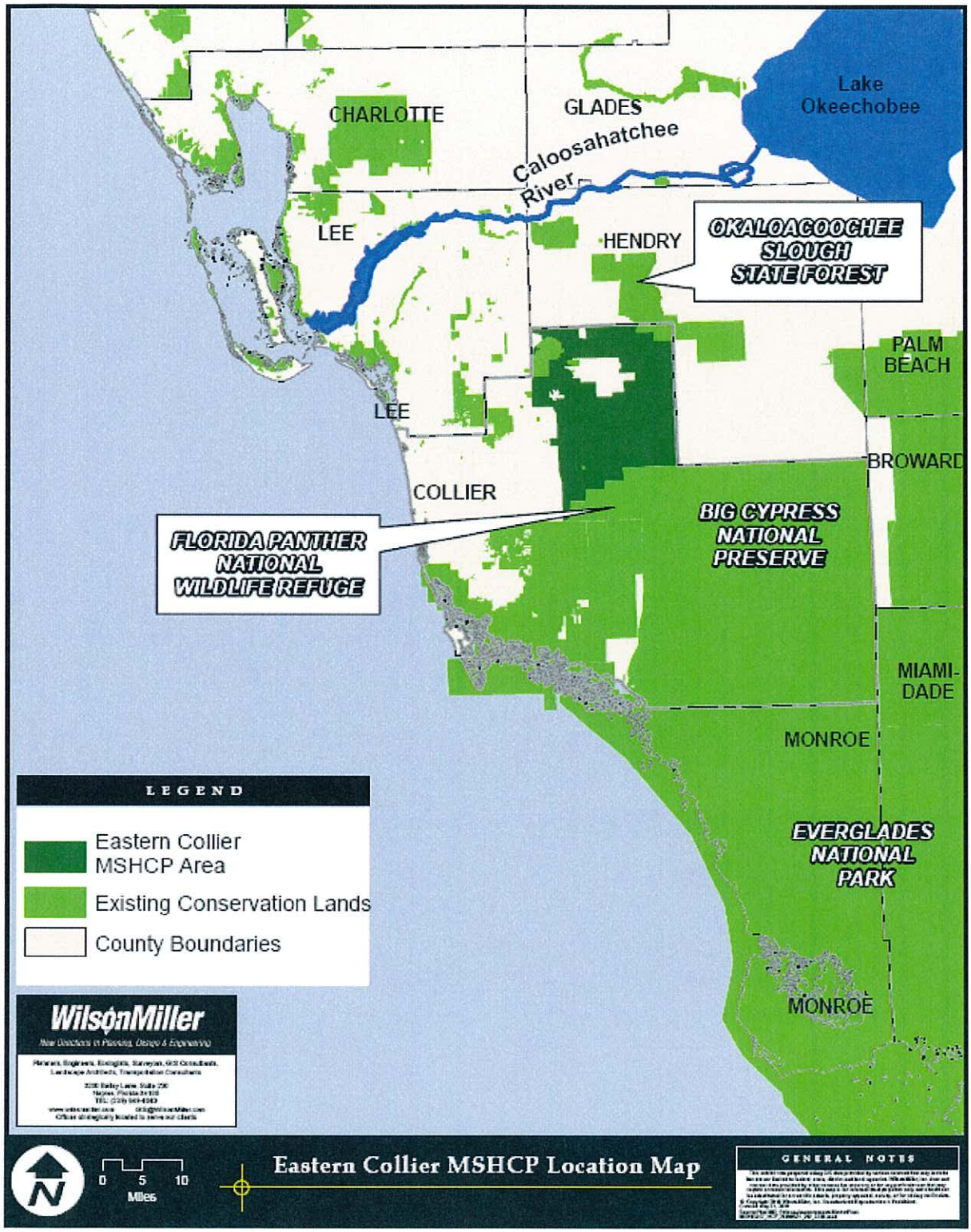

Exhibit 1. Location map for the Eastern Collier MSHCP.

RELATION OF THE MSHCP AREA TO EXISTING LAND USE PLANNING

The existing Collier County zoning within the MSHCP area stands at one dwelling unit per five-acre area, and thus defines the permitted alternative to the MSHCP (see "Alternatives" section). This underlying zoning can result in low-density growth patterns that fragment habitat, create inefficiencies in infrastructure and services, and generally complicate effective conservation actions. In 1999, ECPO members worked with local conservation organizations, Collier County, and state agencies to ultimately create the Collier County Rural Land Stewardship program (RLSP). The RLSP offers an alternative to existing zoning, at the option of the property owner, that provides for a more environmentally sensitive balance between conservation and development.

The RLSP creates incentives for property owners to permanently protect environmentally sensitive lands, in exchange for "stewardship credits" that allow compact development at higher densities than baseline zoning. Compact development at higher densities can only occur within areas that have been mapped as having lower natural resource values, and only via use of credits. Entry into the program is voluntary, to avoid "down-zoning" conflicts and other property rights issues, but the incentives were carefully designed to encourage property owner participation. The stewardship credit system was calibrated in a manner that required several acres of native habitat to be preserved in exchange for one acre of higher-density development (the exact ratio depends upon habitat quality and other environmental factors).

By design, implementation of the RLSP preserves the large regional wetland flow way systems and large blocks of interconnected upland and wetland native habitats that occur within the program area. Skeptics of the RLSP initially questioned whether the program would protect environmentally sensitive lands as planned. To date, approximately 56,000 acres have been preserved under the RLSP, including the vast majority of one regional flow way, and including 20,000 acres of high-value panther habitats directly adjacent to FPNWR and BCNP.

A recently completed five-year review of the RLSP concluded that the program was meeting the policy objectives it sought to achieve. One major review recommendation was that agricultural preservation should also be able to generate stewardship credits in order to preserve open space, sustainable agriculture, and the rural economy. The original RLSP concept, augmented

by the incentives for preserving agricultural lands, forms the basis for a long-term balance of land uses that underpin the MSHCP and Florida Panther Protection Plan (FPPP).
The MSHCP shares the same general boundaries as the RLSP area, with the exception of three parcels that are not voluntarily entered into the RLSP and are already engaged in the federal permit process and Section 7 consultations. These three parcels, Hogan Island Quarry, Immokalee Sand Mine and Lost Grove Mine, were therefore necessarily excluded from the MSHCP.

DESCRIPTION OF ACTIVITIES TO BE COVERED UNDER THE ITP; PERMIT DURATION

The major existing land uses / land cover within the MSHCP include agriculture, ranching, native vegetation communities, residential and commercial development, and earth mining. The goal of the RLSP and MSHCP is to ultimately create a balance between environmental preservation, listed species protection, sustainable agriculture, and economic development. The RLSP and MSHCP work in concert via a combination of economic incentives and regulatory mechanisms to achieve a balanced, sustainable future for the region.

The five-year review and modification of the RLSP, currently undergoing local and state approvals, resulted in a recommendation that residential and commercial development be capped at 45,000 acres within the RLSP area. In order to actually reach that development cap, the balance of the RLSP/MSHCP area (approximately 132,000 acres) would be permanently protected in order to generate sufficient stewardship credits. Protected lands would include the regional wetland flow way systems, large interconnected blocks of native habitat that support the Florida panther and other listed species, agricultural fields, and cattle ranches. This landscape-scale matrix of native habitats and agricultural uses currently supports the covered species listed in Table 1 (see next section).

The requested term of the Incidental Take Permit (ITP) is 50 years. This timeframe allows for planning, permitting and completion of contemplated or foreseeable development within the MSHCP, and for implementation of conservation actions that benefit covered species. The permit holders would be ECPO members. Other entities within the MSHCP area that propose to

undertake covered activities could be accommodated via a certificate of inclusion, if acceptable to USFWS.

Plan-wide activities covered by the ITP include those activities that have occurred historically throughout the MSHCP area and are planned to continue. The plan-wide activities generally include:

- Crop production (e.g. row crops, citrus, sod farms, specialty crops, greenhouse crops, landscaping nurseries, silviculture, etc.);
- Ranching and grazing (improved pastures, unimproved pastures, free-range grazing);
- Earth mining;
- Infrastructure repair and maintenance (repair and maintenance of farm roads, trails, utility lines, berms, canals and other rural infrastructure);
- Oil and gas exploration and production;
- Recreation (hunting, fishing, ORV operation, etc.);
- Passive recreation (hiking, biking, equestrian activities, bird-watching, etc.).
- Residential and commercial development (single and multiunit residential, commercial space, infrastructure and support facilities, etc.)
- Transportation of people, goods and services (locally, regionally, intrastate, interstate)

Open-space areas within the MSHCP will include the lands set aside for protection under the RLSP. If the 45,000 acre development cap is reached, permanent open-space areas will occupy 132,000± acres. The open-space areas will include native vegetation communities, agriculture, and range land uses, providing a landscape-scale matrix of native habitats and agriculture that can support covered species. Collectively, these open-space areas comprise an extensive interconnected network of habitats that currently support covered species and facilitate their movement throughout the landscape.

Residential and commercial development would be limited by the RLSP and MSHCP to those areas with low natural resource value, and would be capped at a maximum of 45,000 acres. Development is directed to those areas that have been previously disturbed by agricultural and/or earth mining activities, where environmental impacts from development are minimized. The RLSP prescribes compact, mixed-use forms of development that are characterized by a

balanced mix of residential units, stores, office space, etc. These communities allow residents to meet most of their daily needs within the community itself, reducing traffic on the larger transportation network and reducing traffic-related impacts to wildlife and habitat fragmentation. The long-range planning and compact forms of development within the RLSP area allow for the efficient planning of regional transportation networks that minimize overall environmental impacts.

COMMON AND SCIENTIFIC NAMES OF SPECIES TO BE COVERED UNDER THE ITP

The federally listed species to be covered under the ITP (herein "covered species") are listed in Table 1. The primary focal species for the MSHCP is the Florida panther (*Puma concolor coryi*). Due to the panther's habitat preferences and wide-ranging movements, the Florida panther serves as an "umbrella species" for many of the other covered species listed in Table 1. Many of the habitats required by other covered species occur as patches or inclusions within the landscape-scale matrix of habitats protected by this MSHCP.

In addition to the covered species, the MSHCP will benefit numerous species listed by the state of Florida (e.g., wading birds, Florida black bear, Big Cypress fox squirrel, etc.) and various game and non-game species that are not listed by state or federal agencies.

Table 1: Covered species for the Eastern Collier MSHCP.

COMMON NAME	SCIENTIFIC NAME	FEDERAL STATUS[1]
BIRDS		
Florida scrub jay	*Aphelocoma coerulescens*	T
Northern crested caracara	*Caracara cheriway*	T
Wood stork	*Mycteria americana*	E
Red-cockaded woodpecker	*Picoides borealis*	E
Everglade snail kite	*Rostrhamus sociabilis plumbeus*	E
REPTILES		
American alligator	*Alligator mississippiensis*	T(S/A)

Eastern indigo snake	*Drymarchon corais couperi*	T
Gopher tortoise	*Gopherus polyphemus*	SR
MAMMALS		
Florida bonneted bat	*Eumops floridanus*	C
Florida panther	*Puma concolor coryi*	E

[1] Federal status abbreviations: T -Threatened; T(S/A) – Threatened (Similarity of Appearance);
E – Endangered; C- Candidate species for federal listing;
SR – currently under status review for listing

MAJOR ELEMENTS OF THE MSHCP

This section summarizes the potential biological impact(s) that will likely result from the proposed taking of covered species under the ITP, along with design considerations and activities that will minimize and/or mitigate for impacts. In general, incidental take resulting from project impacts will be offset by one or more of the following mechanisms:

- Extensive land preservation (via federal conservation easements or equivalent mechanisms);
- Additional panther habitat mitigation (25% additional mitigation beyond that required by standard USFWS panther habitat functional analysis);
- Funding for panther/wildlife crossings on existing and/or new roads;
- Funding for panther-habitat land acquisition;
- Management of preserved lands (species-specific or multispecies oriented);
- Ecological restoration;
- Funding for scientific studies of covered species (e.g., northern crested caracara)

The potential impacts resulting from proposed activities and minimization/mitigation measures for each covered species are briefly summarized below.

Florida Panther

The potential direct and indirect impacts to panther from proposed activities include habitat loss, traffic-related mortalities, light and noise emanating from developed areas, and potential conflicts between panthers and humans or livestock. The MSHCP, in concert with the RLSP and FPPP, incorporates planning and design features to minimize and/or mitigate for these potential impacts. This MSHCP serves as the major instrument for implementing the programmatic goals of the FPPP.

Habitat loss throughout the panther's current range has been cited as the most significant issue relative to the current panther population's continued viability. A related issue is the degree of habitat fragmentation that may occur over the long term. Central to the issue of habitat loss is a clear definition and delineation of what constitutes panther habitat. The MSHCP will be based

upon the best scientific data available at the time of application submittal, including (but not limited to) published information from the USFWS Florida Panther Subteam (2002); a scientific literature review funded by the Florida Fish and Wildlife Conservation Commission (Beier et al., 2003); the "How Much is Enough?" journal article (Kautz et al., 2006); and a comparative study of panther habitat selection via GPS and VHF telemetry methods (Land et al., 2008).

"Biological goals" constitute the broad guiding principles for designing and implementing a habitat conservation plan. Under this MSHCP, the biological goals for the Florida panther are:

- Preservation of large, interconnected blocks of panther habitat within the RLSP, to be placed under phased federal easements;
- Creation, enhancement, and preservation of panther movement corridors between FPNWR and the Okaloacoochee Slough, and between Corkscrew Marsh and Okaloacoochee Slough State Forest, to be placed under phased federal easements;
- Preservation of approximately 40,000 acres of agricultural areas to maintain landscape linkages and buffers throughout the RLSP;
- Restoration activities;
- Avoidance and minimization of impacts to panther habitat by directing development activities to previously cleared areas;
- Avoidance and minimization of harm that could result from inappropriately designed and/or constructed transportation projects;
- Mitigation for potential impacts to panther via the design and construction of fenced wildlife crossings, land management practices, etc.

The sheer scale of habitat preservation for the Florida panther ultimately includes a wide range and extent of habitats for the other federally listed species covered under the MSHCP. The primary biological goal for the other covered species is therefore large-scale preservation of the landscape matrix of native habitats and agricultural lands that support these covered species.

The MSHCP addresses potential impacts from panther habitat loss via several mechanisms. The primary mechanism is avoidance and minimization of potential impacts to panther habitat patches that are associated with documented and/or likely panther utilization. The MSHCP incorporates the 45,000 acre cap on future development related to the RLSP and FPPP, directing future development to previously-disturbed agricultural and other open areas that

generally contain small, isolated forested patches that provide minimal support for panthers. Secondly, the MSHCP preserves the vast interconnected patches of upland and hardwood forests that are utilized heavily by panthers, along with native herbaceous communities and agricultural lands that occur within this landscape matrix.

Additionally, the MSHCP adopts the RLSP and FPPP strategy for preserving large blocks of agricultural lands on the eastern portions of the MSHCP area. This preservation maintains a vital panther corridor, the Okaloacoochee Slough, which serves as occupied habitat and facilitates movement of panthers throughout eastern Collier County and Hendry County. The agricultural preservation also provides a major buffer to this corridor, ensuring its continued function at plan completion.

Under the MSHCP, mitigation lands will be permanently protected via a phased recordation of federal conservation easements or equivalent legal mechanisms. Phased recordation will occur in conjunction with each individual action covered under the ITP, as part of the federal permit process for each action. This general process also applies to the other covered species included under the ITP.

Where unavoidable impacts to panther habitat do occur, mitigation will be calculated using current USFWS methodologies and will be satisfied primarily via land preservation and land management activities. Other mitigation options can include panther habitat restoration, acquisition of additional panther habitat, buffering of panther habitats against panther-human interactions, and the locating and construction of panther crossings and fencing along local road segments.

Panther habitat restoration includes activities related to increasing the functional quality of existing habitat (e.g. enhancing prey base capacity); increasing the acreage of habitat; improving connectivity between habitat patches; or all three. Examples of panther habitat restoration include control of exotic plant species that can adversely affect prey base populations; controlled burns to increase prey base carrying capacity; and afforestation activities to expand forested habitat area and/or functional wildlife corridors.

The MSHCP incorporates the RLSP mechanisms for re-establishing or enhancing of two panther corridors between FPNWR and the Okaloacoochee Slough, and between Corkscrew Marsh and the Okaloacoochee Slough State Forest. These corridors have been identified via panther telemetry data and least-cost path (LCP) analyses, and will facilitate the safe long-distance movement of panthers between large habitat blocks.

Acquisition of additional panther habitat may be used to offset impacts to potential habitat, where such acquisition provides a preferred alternative to habitat restoration or other mitigation measures.

Buffering of potential panther habitat against panther-human interactions may include a variety of measures that include: master planning to minimize the development-habitat interface; concentration of intensive land uses in the core of the development and less intensive uses near the development periphery; the use of lakes, berms, landscaping or other features to create barriers to interactions; and the use of directional lighting and similar designs to minimize light and noise effects.

Mitigation of traffic-related potential impacts within the MSHCP can be accomplished via the study, locating, design, and/or construction of panther crossings and fencing. Panther crossings have been used successfully throughout southwest Florida and are highly effective in safely conveying panthers underneath highways. The Florida Fish and Wildlife Conservation Commission (FWC) has conducted several GIS-based least-cost-path (LCP) studies to identify potential panther movement corridors within the MSHCP. A comparison of the LCP study results with telemetry and field tracking data indicate that the LCP pathways accurately identify locations for future panther crossings.

Other Mammals

Other than the Florida panther, there are currently no federally listed mammalian species that occur within the MSHCP area. One species, the Florida bonneted bat (*Eumops floridanus*), is currently a candidate species for listing. According to the USFWS species assessment form, the Florida bonneted bat has been documented in Fakahatchee Strand State Preserve (FSSP) and Big Cypress National Preserve (BCNP), directly south of the MSHCP area.

The ecology of the Florida bonneted bat is not well known, but the species assessment indicates that wetlands and open water are the prime foraging areas for this species. The bats roost primarily in tree cavities, and the availability of roosting trees is thought to be a limiting factor for this species. The MSHCP directly addresses these two major issues (foraging areas and roosting sites) via the extensive preservation of the regional wetland flow way systems, preservation of large forest patches, and generally directing development to previously disturbed sites that lack extensive wetlands or forest patches.

Incidental take of this species under the ITP is expected to be rare to non-existent. There are currently no documented occurrences of the Florida bonneted bat within the MSHCP, and future development activities avoid or minimize potential impacts to suitable habitat as noted above. The preservation of extensive wetland systems and forested roosting habitats mitigate for potential impacts to this species.

In unlikely instances where a potential impact to this species may occur, management activities can maintain roosting sites for the bats by avoiding removal of cavity trees within forested areas. The bats have been documented to utilize bat houses, which provide another management option if a colony is documented. By preserving extensive forested areas and prime foraging areas, the MSHCP directly provides conservation benefits to this candidate species.

Birds

Five federally listed bird species occur within the MSHCP area (Table 1). A brief summary for each species is provided below, regarding habitat requirements, potential biological impacts of future activities, and minimization and/or mitigation of potential impacts.

The wood stork (*Mycteria americana*) inhabits cypress swamps, freshwater marshes, and other wetland communities that occur within the MSHCP. The major nesting site for wood storks in South Florida is the Audubon Corkscrew Swamp Sanctuary, a 13,000-acre refuge that directly adjoins the northwestern boundary of the MSHCP area. Cypress swamps constitute the primary nesting areas for inland wood stork colonies, and much of the MSHCP occurs within the core foraging areas of the Corkscrew colonies.

Wood storks have specialized habitat requirements due to their feeding methods, requiring shallow wetlands that can concentrate prey (mainly small fish) during alternating periods of flooding and falling water levels. Breeding success is tied to the availability and concentration of food sources throughout the nesting season. Because these wading birds feed by feel (tacto-location), ideal foraging conditions occur in wetlands with water depths of 10-25 centimeters, a lack of dense herbaceous vegetation, and a concentration of prey. Historic drainage changes in south Florida over the last several decades have decreased the extent of wetlands that fulfill these optimal conditions.

The MSHCP addresses potential impacts to wood storks via several mechanisms. The primary mechanism involves extensive preservation of the regional wetland flow way systems, other large cypress swamps (strands), and associated herbaceous wetlands that wood storks utilize for roosting, nesting, and foraging. Secondly, the MSHCP results in avoidance and/or minimization of habitat impacts, by directing future development to previously disturbed sites that lack the extensive shallow wetlands or cypress swamps that constitute wood stork habitat. Depending upon the specific project impacts, additional mitigation efforts may assist wood stork recovery through wetland enhancement and restoration. Wetland enhancement options include control of exotic invasive species; control of shrubby or woody plant species in foraging areas; and engineering of wetland hydrology to mimic optimal foraging conditions during the nesting season. Wetland creation for wood stork habitat, similar to successful efforts at the nearby Panther Island Mitigation Bank, is also an option.

The Everglade snail kite (*Rostrhamus sociabilis plumbeus*) is also a wetland-dependent bird, but requires deep freshwater marshes and open water for its foraging habitat. The snail kite subsists almost entirely on apple snails (*Pomacea paludosa*) that are found in deep, long-hydroperiod marshes. These birds visually search for apple snails, and the optimal marsh vegetation structure is relatively open, with pockets of open water. Dense herbaceous or woody vegetation inhibits apple snail proliferation and foraging success. Short-stature wetland trees, shrubs, and herbaceous vegetation may be used for nesting, with over 90 percent of nests occurring in willows.

Potential impacts to the Everglade snail kite, and measures to assist in recovery, are generally similar to those described above for wood stork. The primary mechanism involves extensive preservation of the regional wetland flow way systems that snail kites utilize for foraging. Secondly, the MSHCP promotes avoidance and/or minimization of habitat impacts, by directing future development to previously disturbed sites that lack the extensive deep-water wetlands that constitute snail kite habitat. Depending upon the specific project impacts, additional mitigation efforts may assist snail kite recovery through wetland creation, enhancement and restoration. Wetland enhancement options include control of exotic invasive species; control of shrubby or woody plant species in foraging areas; and engineering of wetland hydrology to mimic productive deep-water apple-snail habitat. Mitigation efforts that maintain and/or restore water quality in deep-water marshes can promote apple snail abundance and increases snail kite visual foraging success.

The Florida population of the northern crested caracara (*Caracara cheriway*) historically utilized native dry and wet prairie areas containing cabbage palms, the tree that it nests in almost exclusively. Although large areas of wet and dry prairie were historically converted to agricultural land uses, caracaras also thrive in areas where improved pastures and ranchlands comprise a large proportion of land use (provided cabbage palms are also present). Caracaras prefer the short vegetation structure of prairies and pastures, due to its tendency to walk while foraging for food, and do not utilize areas with tall or dense vegetation. Wetlands within or near these open areas appear to be an essential habitat component. Caracaras are highly opportunistic in their feeding habits, eating carrion and a wide variety of live prey. The major threat to caracara population trends in Florida is habitat loss, which may be either due to land use conversions or simple changes in land management.

The RLSP has already assisted in the recovery of the caracara in south Florida. Prior to the RLSP, the known caracara breeding range extended to the northern boundary of the MSHCP area and only one confirmed breeding pair had been documented. The incentives within the RLSP led to the documenting of at least six breeding caracara pairs, extended the known breeding range by 15 miles, incentivized the restoration of caracara habitat, and increased property owner knowledge of caracara ecology and habitat management. A "gathering area" of juvenile caracaras has also been documented within the MSHCP area.

The potential impacts to caracara within the MSHCP relate primarily to potential habitat loss due to conversion of agricultural lands to development. Caracara "habitat loss" can result from direct land use conversions, but it can also result temporally due to agricultural cropping cycles, fallowing of fields, overgrowth of herbaceous or shrubby vegetation, loss of cabbage palm trees, etc. The MSHCP addresses potential impacts from caracara habitat loss via several mechanisms. Most significantly, the preservation of agricultural areas under the revised RLSP will protect wide expanses of pastures, wet prairies and dry prairies used for ranching, which constitute prime habitats for the birds. Secondly, many areas within the 56,000 acres already protected under the RLSP are known to contain breeding pairs and stable caracara home ranges. Preserving large areas of agriculture, ranchlands, and wetlands provides extensive open areas for caracara. Depending upon the specific project impacts, mitigating for impacts to caracara habitat may also include creation or restoration of caracara habitat that mimics the caracara's preferred habitats (dry or wet prairies, pastures, etc.), and includes long-term land management to maintain the presence of short-stature vegetation and cabbage palms; habitat management agreements; and/or payments to a caracara recovery fund for scientific study, land acquisition, and/or land management.

The red-cockaded woodpecker (RCW) occurs in southwest Florida as a support population for this endangered species, not a recovery population. No RCW clusters are documented within the MSHCP area, and the nearest clusters are located in the BCNP to the south. RCWs inhabit old-stand pine flatwoods or pine-dominated pine/hardwood forests with relatively low stand densities and low or sparse understory vegetation. Nest cavities are almost always excavated in older, living pines. The open understory appears essential for RCW habitation, as they will abandon otherwise suitable habitat if the understory approaches cavity height.

Potential impacts to RCW in the MSHCP area appear to be unlikely, given the lack of colonies within the area. However, RCWs may occur incidentally in the area and are therefore included in the ITP and MSHCP. Although unlikely to occur in the MSHCP area, one primary conservation mechanism is avoidance and minimization of potential impacts to RCW potential habitat patches, by directing future development to previously-disturbed agricultural and other open areas unsuitable for RCW habitation. Additionally, large expanses of potential RCW habitat are already protected under the RLSP implementation. Restoration activities within

FPNWR may result in RCW re-colonization that could be supported by restoration activities within the MSHCP area.

The Florida scrub jay (*Aphelocoma coerulescens*), is included in the MSHCP only because a small isolated group exists within the Immokalee urban area that is surrounded by the MSHCP area (Exhibit 1). Florida scrub jays possess extremely specific habitat requirements, preferring xeric oak scrub communities that occur on excessively drained and well-drained soils, experience frequent fire, and contain open sandy areas. The scrub jays within Immokalee inhabit scrubby flatwoods and more mesic oak scrub communities that are sub-optimal habitat, and the group is effectively isolated from other scrub jay populations by a distance of 20 kilometers or more.

Small patches (0-5 acres) of remnant oak scrub habitat exist within the MSHCP north and west of Immokalee. These patches are surrounded by agricultural land uses, have not experienced frequent fire, and are severely degraded in terms of potential habitat quality. A scrub jay pair requires a minimum territory area equaling approximately 12 acres of suitable habitat. These habitat conditions do not exist within the MSHCP area.

Potential impacts to Florida scrub jay are unlikely within the MSHCP, due to the lack of suitable habitat and corresponding lack of verified observations. However, due to the proximity of a group within the Immokalee urban area, and small remnants of degraded scrub oak habitat, a small possibility of incidental take exists. In the unlikely event that a transient occurrence of Florida scrub jay is observed and may be subject to incidental take, the permit holder may mitigate the action by attempting to rehabilitate scrub patches, contribute to the management of the scrub jay group within the Immokalee urban area, or contribute to scrub jay conservation efforts within the Lake Wales Ridge core population area in Glades or Highlands counties, the nearest core population to the MSHCP area.

Reptiles

Although three reptile species are listed in Table 1, the American alligator was included simply because it is on the USFWS federally listed species list for Collier County. The alligator is listed

as "Threatened (Similarity of Appearance)" primarily due to potential confusion with the endangered American crocodile, as their ranges overlap in extreme southern Florida. However, crocodiles inhabit coastal regions, and the nearest coastal environment is approximately 15 miles from the MSHCP. The taking of alligators is permitted under federal law (50 CFR Section 17.42) as regulated by the state of Florida, and the Florida Fish and Wildlife Conservation Commission (FWC) regulates hunting and trapping of alligators. No special provisions for alligator are envisioned in the MSHCP, although the preservation of large regional wetland flow ways protects alligator habitat on a large scale.

The Eastern indigo snake (*Drymarchon corais couperi*) utilizes a wide variety of upland and wetland habitats, including pine-palmetto flatwoods, dry prairies, oak hammocks, hydric pine flatwoods, etc. In upland habitats, eastern indigo snakes utilize underground refugia to regulate temperature and desiccation, most commonly inhabiting gopher tortoise (*Gopherus polyphemus*) burrows. Other refugia may include armadillo (*Dasypus novemcinctus*) burrows, tree hollows, rock piles, etc. Eastern indigo snakes also opportunistically utilize human-altered landscapes such as agricultural and residential areas.

Potential impacts to Eastern indigo snakes will generally correspond to the degree of impacts to native upland habitats and traffic-related impacts. The potential habitat impacts are addressed in the MSHCP through the extensive preservation of upland habitats via the RLSP. Large expanses of agricultural lands are also preserved in the RLSP, which also support indigo snakes. Traffic-related impacts can be minimized and/or mitigated by design and construction of roads that are permeable to herpetofauna. Finally, since Eastern indigo snakes are commensal species with gopher tortoises, conserving gopher tortoises and their habitats benefit the indigo snake. Thus, the most appropriate mitigation required for a specific incidental taking may also include the preservation, enhancement, restoration, and/or long-term management of gopher tortoise habitat. In addition to conservation of upland habitat, incentives for creating recipient gopher tortoise sites may be included within the MSHCP.

The gopher tortoise (*Gopherus polyphemus*) is currently under status review for federal listing. The protection of this species benefits a variety of commensal species that inhabit gopher tortoise burrows. Although the MSHCP does not currently address this species directly, it may be included in the MSHCP during the ITP application processing timeframe. As noted above,

conservation of gopher tortoise habitat will already be incorporated into the MSHCP in the course of conserving Eastern indigo snake habitat.

Alternatives to Taking and Why They Were Not Pursued

Three basic action alternatives are considered under the HCP for analysis purposes. These basic alternatives illustrate the likely cumulative impacts and overall long-term outcomes within the MSHCP area, and represent actual choices that property owners, regulatory agencies, and conservation organizations must consider in their evaluations.

The first basic alternative is the existing local zoning of one dwelling unit per five acres, without engaging the RLSP or MSHCP, carried forward to the extent allowed under law (i.e., a "no action" alternative). In this alternative, thousands of individual "ranchettes" could be constructed within the RLSP area, many without triggering a federal nexus through the 404 permitting program. Ranchettes would be distributed through the area in a low-density rural development pattern, and could easily be located within existing agricultural areas within the large blocks of interconnected habitat. This pattern of development could be highly disruptive to Florida panther habitat utilization and movement, as research shows panthers avoid landscapes where residential density exceeds certain thresholds. Road traffic in a diffuse development pattern also increases the distances that residents travel to meet daily needs, increasing the risks of wildlife road mortalities, and this development pattern provides no clear mechanism for mitigating traffic impacts. The cumulative impacts from this alternative are much more speculative than the other two alternatives, because no regional planning underlies the activity.

The second basic alternative is implementation of the RLSP, without a MSHCP component. In this alternative, the RLSP advances project by project, with the standard federal permitting process and Section 7 consultations. This alternative can result in beneficial outcomes that balance sustainable agriculture, residential and commercial development, and conservation. However, the process is less defined than the MSHCP alternative regarding the ultimate cumulative impacts, the ultimate sum total of conservation actions, and the overall integration of conservation actions. Without the MSHCP component, there is considerable additional uncertainty for property owners in terms of federal permitting and project approvals, potentially

leading to an incomplete execution of the RLSP and therefore incomplete protection of native forest habitats, wetlands, and agricultural areas within the RLSP area.

The third basic alternative is the RLSP with MSHCP and FPPP components. In this alternative, the property owners, regulatory agencies, and conservation organizations possess an integrated, clearly defined, incentive-driven plan for achieving a sustainable balance of land uses within the MSHCP area. Property owners possess incentives in the form of well-defined parameters under the ITP and a more predictable consultation process. USFWS and other federal regulators can consider the overall MSHCP rather than project-by-project consultations, and thereby more efficiently and accurately assess project impacts versus cumulative impacts. Conservation organizations are incentivized by well-defined conservation planning, species-specific recovery actions, and certainty regarding the ultimate balance of conservation, agriculture, and development within the MSHCP area. Under this scenario, the RLSP and FPPP achieve full implementation, generating an estimated $150 million for panther habitat management, restoration, fenced road crossings, land acquisition, etc.

While a panther-only HCP could be offered as an alternative, the lands dedicated to panther conservation would already provide protection to the other covered species (Table 1). Failure to include these covered species in a HCP would forfeit a valuable conservation opportunity, might require property owners to obtain project-specific takings authorizations in some instances, and could compromise the support of conservation organizations and the public.

The third (MSHCP) alternative provides the most predictability for future conditions, clearly specifies conservation goals, covers the full range of federally listed species resident in the area, and provides strong incentives for diverse parties to implement the plan in full.

General Considerations for the Implementing Agreement

The Implementing Agreement (IA) is a detailed legal contract that identifies the responsibilities for all parties under the MSHCP, and legally binds MSHCP participants to specific obligations. As the name implies, the IA governs the actual implementation of the MSHCP, and incorporates it by reference.

The IA for the Eastern Collier MSHCP will be drafted in consultation with USFWS. Detailed obligations of the permittee(s) and USFWS will be documented, along with details regarding the term of the ITP; funding mechanisms; monitoring and reporting requirements; consultations with other federal agencies; remedies and enforcement; adaptive management provisions to deal with unforeseen circumstances; etc.

The focal species for the MSHCP is the Florida panther, although multiple species are covered under the ITP and MSHCP. In general, the IA provisions for adaptive management, modifications, amendments etc. will be guided foremost by panther conservation needs. However, as noted in the MSHCP, the "umbrella species" role played by the Florida panther ensures that conservation actions on behalf of the panther will benefit multiple covered species as well.

Monitoring measures will be included within the MSHCP and IA. Compliance monitoring will document the implementation of specific provisions within the MSHCP and IA and ensure that the plan requirements are met. One example of compliance monitoring will be an inventory of land parcels preserved under the MSHCP and verification that federal easements have been recorded, which documents the major biological goal of habitat preservation.

"Effect and effectiveness" monitoring will verify progress in advancing the biological goals and objectives for the covered species. In the case of the elusive Florida panther, effects monitoring will rely heavily upon existing FWC and USFWS research programs, particularly FWC panther tracking via radiotelemetry and GPS technology. Monitoring protocols for other covered species will be developed in consultation with FWS as dictated by provisions within the MSHCP.

Department of the Interior
U.S. Fish and Wildlife Service

Expires: Nov. 30, 2010
OMB No. 1018-0094

Federal Fish and Wildlife Permit Application Form

Return to: U.S. Fish and Wildlife Service (USFWS)

Type of Activity: Native Endangered and Threatened Species – Incidental Take Permits Associated with a Habitat Conservation Plan (HCP)

Complete Sections A or B, and C, D, and E of this application. U.S. address may be required in Section C, see instructions for details.
See attached instruction pages for information on how to make your application complete and help avoid unnecessary delays.

A. Complete if applying as an individual

1.a. Last name	1.b. First name	1.c. Middle name or initial	1.d. Suffix

2. Date of birth (mm/dd/yyyy)	3. Social Security No.	4. Occupation	5. Affiliation/ Doing business as (see instructions)

6.a. Telephone number	6.b. Alternate telephone number	6.c. Fax number	6.d. E-mail address

B. Complete if applying on behalf of a business, corporation, public agency or institution

1.a. Name of business, agency, or institution	1.b. Doing business as (dba)
Alico, INc.	

2. Tax identification no.	3. Description of business, agency, or institution
59-0906081	Agricultural Operation - Citrus

4.a. Principal officer Last name	4.b. Principal officer First name	4.c. Principal officer Middle name/ initial	4.d. Suffix
Alexander	John	D.	

5. Principal officer title	6. Primary contact
President and Chief Executive Officer	Donald Schrotenboer

7.a. Business telephone number	7.b. Alternate telephone number	7.c. Business fax number	7.d. Business e-mail address
863-675-2966	863-673-4413	863-675-6928	drschrotenboer@alicoinc.com

C. All applicants complete address information

1.a. Physical address (Street address; Apartment #, Suite #, or Room #; no P.O. Boxes)
640 S. Main Street

1.b. City	1.c. State	1.d. Zip code/Postal code:	1.e. County/Province	1.f. Country
LaBelle	FL	33935	Hendry	USA

2.a. Mailing Address (include if different than physical address; include name of contact person if applicable)

2.b. City	2.c. State	2.d. Zip code/Postal code:	2.e. County/Province	2.f. Country

D. All applicants MUST complete

1. Attach check or money order payable to the U.S. FISH AND WILDLIFE SERVICE **in the amount indicated on page 2**. Federal, tribal, State, and local government agencies, and those acting on behalf of such agencies, are exempt from the processing fee – ***attach documentation of fee exempt status as outlined in instructions.*** (50 CFR 13.11(d))

2. Do you currently have or have you ever had any Federal Fish and Wildlife permits?
Yes ☐ If yes, list the number of the most current permit you have held or that you are applying to renew/re-issue: _____
No ☒

3. Certification: I hereby certify that I have read and am familiar with the regulations contained in ***Title 50, Part 13 of the Code of Federal Regulations*** and the other ***applicable parts in subchapter B of Chapter I of Title 50***, and I certify that the information submitted in this application for a permit is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to the criminal penalties of 18 U.S.C. 1001.

Signature (in blue ink) of applicant/person responsible for permit (No photocopied or stamped signatures) — Date of signature (mm/dd/yyyy): 5.26.2010

Please continue to next page

** See page 14 for additional instructions on completing the above form. See page 15 for information on the Paperwork Reduction Act, Privacy Act, and Freedom of Information Act aspects of this application form.

Section E. **ALL APPLICANTS COMPLETE SECTION E.** Provide the information outlined in Section E. on the following pages. Be as complete and descriptive as possible. Please do not send pages that are over 8.5"X 11", videotapes, or DVDs.

INCIDENTAL TAKE PERMITS ASSOCIATED WITH A HABITAT CONSERVATION PLAN (HCP)

Have you obtained all required State, Federal or foreign government approval to conduct the activity you propose? Please be aware that there may be other requirements necessary to conduct this activity such as an import permit, collection permit, permission to work on Federal lands, Federal bird banding permit, Corps of Engineers permits, Environmental Protection Agency NPDES permits, State, county or local permits, etc.

☐ Yes. Provide a copy of the approval(s). List the State, Federal or foreign countries involved and type of document required. Include a copy of these documents with the application.

☐ I have applied. List the State, Federal or foreign countries involved and type of documents required. Provide the reasons why the permits have not been issued _____.

☒ Not required. ~~The proposed activity is not regulated.~~ Not required at this time. MSHCP precedes future activities.

Application Processing Fees

The application processing fee for a new Incidental Take permit, or to renew/re-issue an existing valid permit, is $100. If permit amendment is required at a time other than renewal/re-issuance, the processing fee is $50.

Check the appropriate box below and enclose check or money order payable to the *U.S. Fish and Wildlife Service* in the amount of

☒ $100 for a **new** permit

OR

☐ $100 to **renew/re-issue** my existing valid permit (with only *minor changes* such as updating my name and address) using my current application package on file.

OR

☐ $50 to make a **substantive amendment** (with *major changes*) to my existing valid permit [50 CFR 13.11(d)(2)].

If the information in your current application package on file has changed in a manner that triggers a major amendment or a change not otherwise specified in the permit, then you must apply for an amendment to your valid permit. For example, such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit. Please contact our Ecological Services Field Office located closest to your proposed activity for technical assistance in making this determination. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please check the **type of amendment** you are requesting --

☐ add species (specify) _____

☐ add a geographic area ☐ change in personnel

☐ other (specify) _____

If this application includes **transfer or succession** of a valid Incidental Take permit, please check the box below:

☐ Transfer or succession of a valid Incidental Take permit associated with a HCP using the current application package on file. No application fee is required.

Application Processing Time

To expedite a final decision on your application, you are urged to coordinate with us as soon as possible for guidance in assembling a complete application package. If you are renewing or amending a valid permit, your complete application package must be received at least 30 days prior to the expiration of the valid permit. This time period begins when we receive a complete permit application package and does not include any time required for requesting clarification or additional information about your application.

The time required to process an application for an Incidental Take permit will vary depending on the size, complexity, and impacts of the HCP involved. Procedurally, the most variable factor in application processing is the level of analysis required for the proposed HCP under the National Environmental Policy Act (e.g., whether an application requires preparation of an Environmental Impact Statement, Environmental Assessment, or whether a categorical exclusion applies), although other factors such as public controversy can also affect application processing times. The target processing timeline from when we receive a complete application package to our final decision on a permit application is: up to 3 months for low-effect HCPs, 4 to 6 months for HCPs with an Environmental Assessment, and up to 12 months for HCPs with a 90-day comment period and/or an Environmental Impact Statement. Although not mandated by law or regulation, these targets are adopted as U.S. Fish & Wildlife Service and National Marine Fisheries Service (NMFS/NOAA Fisheries) policy and all offices are expected to streamline their Incidental Take permit programs, and to meet these targets to the maximum extent practicable.

The information provided in your permit application will be used to evaluate your application for compliance with the Endangered Species Act, its implementing regulations (which may require a 30 day public comment period), and with U.S. Fish and Wildlife Service policy. Receipt and possession of a permit under the Endangered Species Act should be regarded as a privilege, as we must balance permit issuance with our duties to protect and recover listed species.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal, re-issuance or amendment.

If your activities may affect species under the authority of the National Marine Fisheries Service (NMFS/NOAA Fisheries), then you may need to obtain a separate permit from that agency. In addition we share jurisdiction with NMFS/NOAA Fisheries for sea turtles (e.g., we evaluate applications for permits to conduct activities impacting sea turtles on land, and NMFS/NOAA Fisheries evaluates applications for permits to conduct activities impacting sea turtles in the marine environment). To apply for a permit to conduct activities with sea turtles in the marine environment or other species under NMFS/NOAA Fisheries jurisdiction, please contact them via their permit web page at http://www.nmfs.noaa.gov/pr/permits/

We cannot issue an Incidental Take permit under Section 10(a)(2)(A)(i) of the Endangered Species Act unless you submit a conservation plan that specifies the impacts that are likely to result from the incidental take associated with your activity.

Our general permit regulations at 50 CFR 13.12(a)(9) allow us to collect such other information as we determine that is relevant to the processing of a permit application. Before you submit an application for an Incidental Take permit, we may require that you conduct biological surveys to determine which species and/or habitat would be impacted by the activities sought to be covered under the permit. Biological surveys provide information necessary to develop an adequate HCP, and to assess the biological impacts of the proposed activities. In addition, the information provided in a biological survey can reduce the applicant's risk of take under Section 9 of the Endangered Species Act by ensuring that affected species and/or habitat are identified and appropriately covered under the permit.

You are required to obtain a Scientific Purposes, Enhancement of Propagation or Survival permit (commonly called a Recovery permit) from us before engaging in any biological survey activities that would take listed species. Contact our Ecological Services Field Office closest to the location of your activity to obtain technical assistance in determining the need for both a biological survey and a Recovery permit for your survey activity. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

If a biological survey is required, you will need to send us your complete Recovery permit application package at least 3 months prior to commencement of survey activities to facilitate processing of your Recovery permit application. The Recovery permit application is designated as U.S. Fish & Wildlife Service form # 3-200-55 and can be found on our Endangered Species permit web page at http://www.fws.gov/forms/3-200-55.pdf.

We maintain a list of Recovery permittees (such as biological consultants) who have authorized the release of their contact information to third parties for conducting biological surveys on a contract basis. This list is provided to the public at the discretion of each U.S.

Fish and Wildlife Service Regional Office as time and workload allow. Please be aware that this list does not represent an endorsement by us of any particular permittee.

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If you are not applying as an individual but as a business, corporation, institution, or non-Federal public agency (block B. on page 1 of the application), the person to whom the permit will be issued (e.g., the landowner, president, director, executive director, or executive officer) is legally responsible for implementing the permit. Although other people under the direct control of the permittee (e.g., employees, contractors, consultants) receive third party take authorization in their capacity as designees of the permittee, the individual named as the permittee ultimately is legally responsible for the permit and any activities carried out under the permit except as otherwise limited in the case of permits issued to State or local government entities under 50 CFR 13.25(e).

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If you wish to coordinate the processing of this permit application through an **authorized agent**, and to have that agent represent you as the primary contact with us, check the box below. Sign (in blue ink) and date the authorization statement, and provide contact information for your authorized agent.

X I hereby authorize the following person to act as an authorized agent on my behalf in the processing of this permit application and to furnish, upon request, supplemental information in support of this permit application.

signature (in blue ink) 5.26.2010 date

Donald R. Schroeder
please print name legibly

Your Authorized Agent's Contact Information (please print legibly)

Name: Tom Jones

Address: 2600 Golden Gate Pkwy.

City: Naples State: FL Zip Code: 34105

Telephone: 239-262-2600

Fax: 239-261-1797

E-Mail: tjones@barroncollier.com

INCIDENTAL TAKE PERMIT APPLICATION INSTRUCTIONS

You have 4 options for providing the required information for an Incidental Take permit application. Choose only one option.

Incidental Take Permit Application: Option I. Renewal of a Valid Incidental Take Permit.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal.

Sign the following statement if you are applying to renew an existing valid Incidental Take permit. If you are proposing major changes to your Incidental Take permit, you must use Option II.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct and hereby request renewal of that permit.
>
> _____ _____
> signature (in blue ink) date
>
> _____
> please print name legibly
>
> * Please note: If you have signed the above statement, then your renewal request is complete. Please submit completed pages 1 through 5 of this application to our Regional Office (see attached list) covering the location of your proposed activity. Requests for renewals must be received no later than 30 days prior to permit expiration to ensure that your current permit remains in effect while we process your renewal request.

Incidental Take Permit Application: Option II. Amended Incidental Take Permit (with *major changes*)

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for amendment.

Sign the following statement if you are proposing to amend a valid Incidental Take permit by making major changes. Such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct, except for the changes listed below, and hereby request amendment of that permit.
>
> _____ _____
> signature (in blue ink) date
>
> _____
> please print name legibly

Provide a brief description of the changes to your valid permit (answer the appropriate questions for these changes under Incidental Take Permit Application Option III. below). Please submit completed pages 1 through 6 of this application form (along with the changed information relative to Option III. below) to our Regional Office (see attached list) covering the location of your proposed activity.

Incidental Take Permit Application: Option III. New Incidental Take Permit & Supplementary Information for Amendment of a Valid Permit (with *major changes*).

General permit regulations for the U.S. Fish & Wildlife Service can be found at 50 CFR 13. Regulations for an Incidental Take permit under the Endangered Species Act can be found at 50 CFR 17.22(b)(1) for endangered wildlife species and 50 CFR 17.32(b)(1) for threatened wildlife species.

Each landowner who wishes to be covered under a new or amended Incidental Take permit associated with an HCP must sign (in blue ink) and date the Incidental Take Permit Application Certification Notice at the end of this application, unless the landowner will be covered under this U.S. Fish & Wildlife Service Incidental Take permit via another vehicle, such as a certificate of inclusion (50 CFR 13.25(d)). Any change in the language of the Certification Notice must be reviewed by the Department of Interior, Office of the Solicitor and approved by the U.S. Fish & Wildlife Service. The same person who signs in box D. on page 1 of the application should sign the certification.

If the information in items A. - D. below is already provided in your final HCP (or Implementing Agreement, if applicable), then you do not have to provide it here. Instead, check the box below and use the spaces provided in items A. - D. to indicate the page numbers in your HCP or Implementing Agreement that provide the requested information.

☒ I am not providing the following information for items A. - D. as part of my Incidental Take permit application, because it is already provided in my final HCP or Implementing Agreement (copy attached or already submitted).

If the requested information in items A. - D. is not provided in your final HCP or final Implementing Agreement, or you are using Option II. to amend your existing valid Incidental Take permit, then attach separate pages for the missing information. In order to assist us in processing your request, please provide the item number (A. 1.a., etc.) of the required information before each of your responses. Thank you.

Please ensure that your final HCP and Implementing Agreement (if applicable) are attached if it has not been previously submitted.

If you have previously submitted a final draft HCP or Implementing Agreement, please indicate the document's date.

Date of final draft HCP TBD (MSHCP summary attached.)

Date of final draft Implementing Agreement TBD

Applications for an Incidental Take permit associated with an HCP must provide the following specific information (relevant to the activity) under items A.- D. below in addition to the general information on page 1 of this application.

A. Identify species and activity:

1. For a new Incidental Take permit:

   a. Provide the common and scientific names of the species being requested for coverage in the permit and their status (endangered (E), threatened (T), proposed endangered (PE), proposed threatened (PT), candidate for listing (C), or species likely to become a candidate (LC)).

   b. Provide the number, age, and sex of such species to the extent known

   c. Quantify the anticipated effects to their habitat.

   d. Describe the land use or water management activity sought to be authorized for each species.

2. For an amended Incidental Take permit:

   a. Identify the species to be added to your valid permit (provide both the scientific, to the most specific taxonomic level, and common names), as well as the species status (see 1.a.. above).

   b. Provide the number, age and sex of such species to the extent known.

   c. If any activities requested in this application differ from those authorized in your valid permit, then for each

species state the currently authorized activity, the requested new activity, and how the new activity will impact each species.

d. Identify each activity associated with your project that would result in the incidental take of each species.

e. Quantify any anticipated effects to the habitat of each added species.

f. Identify species to be deleted from your valid permit and the reason(s) for the deletion.

Page(s) & source document : _____

B. Identify location of the proposed activity:

1. Provide the name of the State, county, and specific location of the proposed activity site(s). Include a formal legal description, section/township/range information, county tax parcel number, local address, or any other identifying property designation that will precisely place the location of the proposed activity site(s). Attach a location map and plat of the project site clearly depicting the project boundaries and the footprint and location of all portions of the property that would be affected by your proposed activities.

2. Provide the total number of acres covered by the HCP 177,000+/-

   Is this the total acreage of the parcel? (circle one) (yes) no

3. Provide the approximate number of acres to be impacted 45,000

4. Provide the approximate number of acres to be protected 132,000

5. Provide a complete description, including timeframes, for implementation of proposed voluntary management activities to enhance, restore, or maintain habitat benefiting federally listed, proposed or candidate species, or other species likely to become candidates. Include schedules for implementing these activities.

Page(s) & source document: See attached MSHCP summary.

C. Describe the proposed activities in the conservation plan:
You must submit a Habitat Conservation Plan. We strongly encourage you to ensure that your HCP is consistent with the Habitat Conservation Planning Handbook, subsequent Handbook addendums, and current policies to minimize delays in evaluating your application. The Handbook and other HCP information is available on the U.S. Fish & Wildlife Service's Endangered Species web page at http://www.fws.gov/endangered/hcp/index.html

Provide a complete description of activity(ies) to be authorized or reference the applicable HCP or Implementing Agreement page numbers identifying the subject information.

The HCP must specify:

1. The impact that will likely result from the incidental taking. A discussion of the impact that will likely result from the incidental take should include quantification of any anticipated effects to the habitat of the species sought to be covered by the permit.

2. The steps that will be taken to minimize and mitigate such impacts, the funding that will be available to implement such steps, and the procedures to deal with unforeseen circumstances.

3. The steps that will be taken to monitor and report on such impacts, including a copy of the monitoring plan. We are authorized to require reports of activities conducted under a permit per the U.S. Fish & Wildlife Service's general permit regulations at 50 CFR 13.45.

4. Alternative actions to such incidental taking that have been considered and the reasons why these alternatives are not proposed for use.

5. The biological goals(s) and objectives for the HCP.

6. The duration requested for the proposed permit.

Page(s) & source document : See attached HCP summary.

D. Implementing Agreement

An Implementing Agreement

is ***is not*** (FWS *Regional Office* to circle one)

required as part of the permit application for a Habitat Conservation Plan.

This Implementing Agreement must be signed at finalization of the HCP. Are you willing to commit to an Implementing Agreement at finalization of the HCP?

☒ Yes, I am willing to commit to an Implementing Agreement. Please submit any unsigned, draft Implementing Agreement that you have prepared with our Field Office.

☐ No, I am not willing to commit to an Implementing Agreement.

Incidental Take Permit Application: Option IV. Permit Transfer or Succession of a Permit

Complete the following if you are applying for transfer of a valid Incidental Take permit to you or obtaining rights of succession of a valid Incidental Take permit. In addition, you and the current permit holder may also need to sign an Assumption Agreement. Please contact our Ecological Services Field Office nearest your activity to determine whether you and the current permit holder need to execute an Assumption Agreement. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please indicate the name of the HCP to be transferred or succeeded and indicate the document's date.

Name of HCP _____

Date of HCP _____

An Assumption Agreement

is ***is not*** (FWS Ecological Services *Field Office* to circle one)

required as part of the transfer or succession permit application for the HCP.

Incidental Take Permit Application

Certification Notice

The same person who signs in box D. on page 1 of the application should sign (in blue ink) the following certification.

By submitting this application and receiving an Incidental Take permit pursuant to Section 10(a)(1)(B) of the Endangered Species Act, I

DONALD R. SCHROTENBOER (print name(s)) attest that I/we own the lands indicated in this application, or have sufficient authority or rights over these lands to implement the measures of the Habitat Conservation Plan (and Implementing Agreement if applicable) covered by the Incidental Take permit. Further, upon receipt of the Incidental Take permit, I/we agree to conduct the activities as specified in the Habitat Conservation Plan (and Implementing Agreement if applicable) according to the terms and conditions of the Incidental Take permit and its supporting documents.

signature (in blue ink) — 5.26.2016 date

DONALD R. SCHROTENBOER
please print name legibly

signature (in blue ink) — date

please print name legibly

****

The public reporting burden for completing this application for an Incidental Take permit is estimated to be 3 hours, including time for reviewing instructions, gathering and maintaining application data, and completing and reviewing the forms. Comments regarding the burden estimate or any other aspect of the reporting requirement(s) should be directed to the U.S. Fish & Wildlife Service Information Collection Clearance Officer, MS 222 ARLSQ, U.S. Fish and Wildlife Service, Washington, DC 20240.

An agency may not conduct and a person is not required to respond to a collection of information unless a currently valid OMB control number is displayed.

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USFWS Regional Contacts for Native Endangered & Threatened Species Permits

Pacific Region (Region 1): HI, ID, OR, WA, American Samoa, Commonwealth of the Northern Mariana Islands, Guam, and the Pacific Trust Territories

U.S. Fish and Wildlife Service
Endangered Species Permit Office
911 NE 11th Avenue
Portland, Oregon 97232-4181

Web: http://www.fws.gov/pacific/ecoservices/endangered/index.html
Phone: (503) 231-2071
email: permitsR1ES@fws.gov
Fax: (503) 231-6243

California & Nevada Region (Region 8): CA and NV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
2800 Cottage Way, Suite W-2606
Sacramento, California 95825 -1846

Web: http://www.fws.gov/cno/es/recovery.html
Phone: (916) 414-6464
email: permitsCNES@fws.gov
Fax: (916) 414-6486

Southwest Region (Region 2): AZ, NM, OK, and TX

U.S. Fish and Wildlife Service
Endangered Species Permit Office
500 Gold Avenue S.W. (street address)
P.O. Box 1306 (mailing address)
Albuquerque, New Mexico 87103-1306

Web: http://www.fws.gov/southwest/es/EndangeredSpecies/
Phone: (505) 248-6633
email: permitsR2ES@fws.gov
Fax: (505) 248-6788

Midwest Region (Region 3): IA, IL, IN, MI, MN, MO, OH, and WI

U.S. Fish and Wildlife Service
Endangered Species Permit Office
B.H. Whipple Federal Building
One Federal Drive
Fort Snelling, Minnesota 55111-4056

Web: http://www.fws.gov/midwest/Endangered/
Phone: (612) 713-5343
email: permitsR3ES@fws.gov
Fax: (612) 713-5292

Southeast Region (Region 4): AL, AR, FL, GA, KY, LA, MS, NC, PR, SC, TN, and U.S. Virgin Islands

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1875 Century Blvd., Suite 200
Atlanta, Georgia 30345

Web: http://www.fws.gov/southeast/es/#
Phone: (404) 679-7313
email: permitsR4ES@fws.gov
Fax: (404) 679-7081

Northeast Region (Region 5): CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, and WV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
300 Westgate Center Drive
Hadley, MA 01035-9589

Web: http://www.fws.gov/northeast/endangered/
Phone: (413) 253-8615
email: permitsR5ES@fws.gov
Fax: (413) 253-8482

Mountain-Prairie Region (Region 6): CO, KS, MT, NE, ND, SD, UT, and WY

U.S. Fish and Wildlife Service
Endangered Species Permit Office
Denver Federal Center
P.O. Box 25486
Denver, Colorado 80225-0489

Web: http://www.fws.gov/mountain%2Dprairie/endspp/
Phone: (303) 236-7400
email: permitsR6ES@fws.gov
Fax: (303) 236-0027

Alaska Region (Region 7): AK

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1011 E. Tudor Road
Anchorage, Alaska 99503-6199

Web: http://alaska.fws.gov/fisheries/endangered/index.htm
Phone: (907) 786-3323
email: permitsR7ES@fws.gov
Fax: (907) 786-3350

PERMIT APPLICATION FORM INSTRUCTIONS

The following instructions pertain to the standard permit form 3-200 that must be completed as an application for a U.S. Fish and Wildlife Service or CITES permit. The General Permit Procedures in 50 CFR 13 address the permitting process. For simplicity, all licenses, permits, registrations, and certificates will be referred to as a permit.

GENERAL INSTRUCTIONS:

- Complete all blocks/lines/questions in Sections A or B, and C and D. Complete all of Section E.
- **An incomplete application may cause delays in processing or may be returned to the applicant. Be sure you are filling in the appropriate application form for the proposed activity.**
- Print clearly or type in the information. Illegible applications may cause delays.
- Sign the application in blue ink. Faxes or copies of the original signature will not be accepted.
- Mail the original application to the address at the top of page one of the application or if applicable on the attached address list.
- **Keep a copy of your completed application.**
- **Please plan ahead. Allow at least 60 days for your application to be processed. Some applications may take longer than 90 days to process. (50 CFR 13.11)**
- Applications are processed in the order they are received.
- Additional forms and instructions are available from http://permits.fws.gov/ .

COMPLETE EITHER SECTION A OR SECTION B:

Section A. **Complete if applying as an individual:**

- Enter the complete name of the responsible individual who will be the permittee if a permit is issued. Enter personal information that identifies the applicant. ***Fax and e-mail are not required if not available.***
- If you are applying on behalf of a client, the personal information must pertain to the client, and a document evidencing power of attorney must be included with the application.
- **Affiliation/ Doing business as (dba):** business, agency, organizational, or institutional affiliation *directly* related to the activity requested in the application (e.g., a taxidermist is an individual whose business can *directly* relate to the requested activity). The Division of Management Authority (DMA) will **not** accept *doing business as* affiliations for individuals.

Section B. **Complete if applying as a business, corporation, public agency, or institution:**

- Enter the complete name of the business, agency or institution that will be the permittee if a permit is issued. Give a brief description of the type of business the applicant is engaged in. Provide contact phone number(s) of the business.
- **Principal Officer** is the person in charge of the listed business, corporation, public agency, or institution. The principal officer is the person responsible for the application and any permitted activities. Often the principal officer is a Director or President. **Primary Contact** is the person at the business, corporation, public agency, or institution who will be available to answer questions about the application or permitted activities. Often this is the preparer of the application.

ALL APPLICANTS COMPLETE SECTION C:

- For all applications submitted to the Division of Management Authority (DMA) a physical U.S. address is **required.** Province and Country blocks are provided for those USFWS programs which use foreign addresses and are not required by DMA..
- **Mailing address** is address where communications from USFWS should be mailed if different than applicant's physical address.

ALL APPLICANTS COMPLETE SECTION D:

Section D.1 **Application processing fee:**

- An application processing fee is required at the time of application; unless exempted under 50 CFR13.11(d)(3). The application processing fee is assessed to partially cover the cost of processing a request. **The fee does not guarantee the issuance of a permit. Fees will not be refunded for applications that are approved, abandoned, or denied.** We may return fees for withdrawn applications prior to any significant processing occurring.
- **Documentation of fee exempt status is not required for Federal, tribal, State, or local government agencies; but must be supplied by those applicants acting on behalf of such agencies.** Those applicants acting on behalf of such agencies must submit a letter on agency letterhead and signed by the head of the unit of government for which the applicant is acting on behalf, confirming that the applicant will be carrying out the permitted activity for the agency.

Section D.2 **Federal Fish and Wildlife permits:**

- List the number(s) of your most current FWS or CITES permit or the number of the most recent permit if none are currently valid. If applying for re-issuance of a CITES permit, the original permit must be returned with this application.

Section D.3 **CERTIFICATION:**

- **The individual identified in Section A, the principal officer named in Section B, or person with a valid power of attorney (documentation must be included in the application) must sign and date the application in blue ink.** This signature binds the applicant to the statement of certification. This means that you certify that you have read and understand the regulations that apply to the permit. You also certify that everything included in the application is true to the best of your knowledge. Be sure to read the statement and re-read the application and your answers before signing.

Please continue to next page

APPLICATION FOR A FEDERAL FISH AND WILDLIFE PERMIT
Paperwork Reduction Act, Privacy Act, and Freedom of Information Act – Notices

In accordance with the Paperwork Reduction Act of 1995 (44 U.S.C. 3501, *et seq.*) and the Privacy Act of 1974 (5 U.S.C. 552a), please be advised:

1. The gathering of information on fish and wildlife is authorized by:
   (Authorizing statutes can be found at: http://www.gpoaccess.gov/cfr/index.html and http://www.fws.gov/permits/ltr/ltr.shtml.)

   a. Bald and Golden Eagle Protection Act (16 U.S.C. 668), 50 CFR 22;
   b. Endangered Species Act of 1973 (16 U.S.C. 1531-1544), 50CFR 17;
   c. Migratory Bird Treaty Act (16 U.S.C. 703-712), 50 CFR 21;
   d. Marine Mammal Protection Act of 1972 (16 U.S.C. 1361, *et. seq.*), 50 CFR 18;
   e. Wild Bird Conservation Act (16 U.S.C. 4901-4916), 50 CFR 15;
   f. Lacey Act: Injurious Wildlife (18 U.S.C. 42), 50 CFR 16;
   g. Convention on International Trade in Endangered Species of Wild Fauna and Flora (TIAS 8249), http://www.cites.org/ , 50 CFR 23;
   h. General Provisions, 50 CFR 10;
   i. General Permit Procedures, 50 CFR 13; and
   j. Wildlife Provisions (Import/export/transport), 50 CFR 14.

2. Information requested in this form is purely voluntary. However, submission of requested information is required in order to process applications for permits authorized under the above laws. Failure to provide all requested information may be sufficient cause for the U.S. Fish and Wildlife Service to deny the request. Response is not required unless a currently valid Office of Management and Budget (OMB) control number is displayed on form.

3. Certain applications for permits authorized under the Endangered Species Act of 1973 (16 U.S.C. 1539) and the Marine Mammal Protection Act of 1972 (16 U.S.C. 1374) will be published in the **Federal Register** as required by the two laws.

4. Disclosures outside the Department of the Interior may be made without the consent of an individual under the routine uses listed below, if the disclosure is compatible with the purposes for which the record was collected. (Ref. 68 FR 52611, September 4, 2003)

   a. Routine disclosure to subject matter experts, and Federal, tribal, State, local, and foreign agencies, for the purpose of obtaining advice relevant to making a decision on an application for a permit or when necessary to accomplish a FWS function related to this system of records.
   b. Routine disclosure to the public as a result of publishing **Federal Register** notices announcing the receipt of permit applications for public comment or notice of the decision on a permit application.
   c. Routine disclosure to Federal, tribal, State, local, or foreign wildlife and plant agencies for the exchange of information on permits granted or denied to assure compliance with all applicable permitting requirements.
   d. Routine disclosure to Captive-bred Wildlife registrants under the Endangered Species Act for the exchange of authorized species, and to share information on the captive breeding of these species.
   e. Routine disclosure to Federal, tribal, State, and local authorities who need to know who is permitted to receive and rehabilitate sick, orphaned, and injured birds under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act; federally permitted rehabilitators; individuals seeking a permitted rehabilitator with whom to place a bird in need of care; and licensed veterinarians who receive, treat, or diagnose sick, orphaned, and injured birds.
   f. Routine disclosure to the Department of Justice, or a court, adjudicative, or other administrative body or to a party in litigation before a court or adjudicative or administrative body, under certain circumstances.
   g. Routine disclosure to the appropriate Federal, tribal, State, local, or foreign governmental agency responsible for investigating, prosecuting, enforcing, or implementing statutes, rules, or licenses, when we become aware of a violation or potential violation of such statutes, rules, or licenses, or when we need to monitor activities associated with a permit or regulated use.
   h. Routine disclosure to a congressional office in response to an inquiry to the office by the individual to whom the record pertains.
   i. Routine disclosure to the General Accounting Office or Congress when the information is required for the evaluation of the permit programs.
   j. Routine disclosure to provide addresses obtained from the Internal Revenue Service to debt collection agencies for purposes of locating a debtor to collect or compromise a Federal claim against the debtor or to consumer reporting agencies to prepare a commercial credit report for use by the FWS.

5. For individuals, personal information such as home address and telephone number, financial data, and personal identifiers (social security number, birth date, etc.) will be removed prior to any release of the application.

6. The public reporting burden on the applicant for information collection varies depending on the activity for which a permit is requested. The relevant burden for an **Incidental Take** permit application is **3 hours**. This burden estimate includes time for reviewing instructions, gathering and maintaining data and completing and reviewing the form. You may direct comments regarding the burden estimate or any other aspect of the form to the Service Information Clearance Officer, U.S. Fish and Wildlife Service, Mail Stop 222, Arlington Square, U.S. Department of the Interior, 1849 C Street, NW, Washington D.C. 20240.

Freedom of Information Act – Notice

For organizations, businesses, or individuals operating as a business (i.e., permittees not covered by the Privacy Act), we request that you identify any information that should be considered privileged and confidential business information to allow the Service to meet its responsibilities under FOIA. Confidential business information must be clearly marked "Business Confidential" at the top of the letter or page and each succeeding page and must be accompanied by a non-confidential summary of the confidential information. The non-confidential summary and remaining documents may be made available to the public under FOIA [43 CFR 2.13(c)(4), 43 CFR 2.15(d)(1)(i)].

Department of the Interior
U.S. Fish and Wildlife Service

Federal Fish and Wildlife Permit Application Form

Expires Nov. 30, 2010
OMB No. 1018-0094

Return to: U.S. Fish and Wildlife Service (USFWS)

Type of Activity: Native Endangered and Threatened Species – Incidental Take Permits Associated with a Habitat Conservation Plan (HCP)

Complete Sections A or B, and C, D, and E of this application. U.S. address may be required in Section C, see instructions for details.
See attached instruction pages for information on how to make your application complete and help avoid unnecessary delays.

A.	**Complete if applying as an individual**		
1.a. Last name	1.b. First name	1.c. Middle name or initial	1.d. Suffix
2. Date of birth (mm/dd/yyyy)	3. Social Security No.	4. Occupation	5. Affiliation/ Doing business as (see instructions)
6.a. Telephone number	6.b. Alternate telephone number	6.c. Fax number	6.d. E-mail address

B.	**Complete if applying on behalf of a business, corporation, public agency or institution**		
1.a. Name of business, agency, or institution		1.b. Doing business as (dba)	
Barron Collier Investment, LTD		Barron Collier Companies	
2. Tax identification no.	3. Description of business, agency, or institution		
65-0630512	Agricultural Business		
4.a. Principal officer Last name	4.b. Principal officer First name	4.c. Principal officer Middle name/ initial	4.d. Suffix
Collier	Barron	G	III
5. Principal officer title		6. Primary contact	
General Partner		Tom Jones, Authorized Agent	
7.a. Business telephone number	7.b. Alternate telephone number	7.c. Business fax number	7.d. Business e-mail address
239-262-2600		239-261-1797	Tjones@barroncollier.com

C.	**All applicants complete address information**			
1.a. Physical address (Street address; Apartment #, Suite #, or Room #; no P.O. Boxes)				
2600 Golden Gate Parkway				
1.b. City	1.c. State	1.d. Zip code/Postal code:	1.e. County/Province	1.f. Country
Naples	FL	34105	Collier	USA
2.a. Mailing Address (include if different than physical address; include name of contact person if applicable)				
2600 Golden Gate Pkwy				
2.b. City	2.c. State	2.d. Zip code/Postal code:	2.e. County/Province	2.f. Country
Naples	FL	34105	Collier	USA

D. All applicants MUST complete

1. Attach check or money order payable to the U.S. FISH AND WILDLIFE SERVICE **in the amount indicated on page 2.** Federal, tribal, State, and local government agencies, and those acting on behalf of such agencies, are exempt from the processing fee – ***attach documentation of fee exempt status as outlined in instructions.*** (50 CFR 13.11(d))

2. Do you currently have or have you ever had any Federal Fish and Wildlife permits?
   Yes ☐ If yes, list the number of the most current permit you have held or that you are applying to renew/re-issue: _____
   No ☒

3. Certification: I hereby certify that I have read and am familiar with the regulations contained in ***Title 50, Part 13 of the Code of Federal Regulations*** and the other ***applicable parts in subchapter B of Chapter I of Title 50***, and I certify that the information submitted in this application for a permit is complete and accurate to the ~~best of my knowledge~~ and belief. I understand that any false statement herein may subject me to the criminal penalties of 18 U.S.C. 1001.

Baron G Collier III — 6-1-10

Signature (in blue ink) of applicant/person responsible for permit (No photocopied or stamped signatures) — Date of signature (mm/dd/yyyy)

Please continue to next page

** See page 14 for additional instructions on completing the above form. See page 15 for information on the Paperwork Reduction Act, Privacy Act, and Freedom of Information Act aspects of this application form.

Section E. **ALL APPLICANTS COMPLETE SECTION E.** Provide the information outlined in Section E. on the following pages. Be as complete and descriptive as possible. Please do not send pages that are over 8.5"X 11", videotapes, or DVDs.

INCIDENTAL TAKE PERMITS ASSOCIATED WITH A HABITAT CONSERVATION PLAN (HCP)

Have you obtained all required State, Federal or foreign government approval to conduct the activity you propose? Please be aware that there may be other requirements necessary to conduct this activity such as an import permit, collection permit, permission to work on Federal lands, Federal bird banding permit, Corps of Engineers permits, Environmental Protection Agency NPDES permits, State, county or local permits, etc.

☐ Yes. Provide a copy of the approval(s). List the State, Federal or foreign countries involved and type of document required. Include a copy of these documents with the application.

☐ I have applied. List the State, Federal or foreign countries involved and type of documents required. Provide the reasons why the permits have not been issued _____.

☒ Not required. ~~The proposed activity is not regulated.~~ Not required at this time. MSHCP precedes future activities.

Application Processing Fees

The application processing fee for a new Incidental Take permit, or to renew/re-issue an existing valid permit, is $100. If permit amendment is required at a time other than renewal/re-issuance, the processing fee is $50.

Check the appropriate box below and enclose check or money order payable to the *U.S. Fish and Wildlife Service* in the amount of

☒ $100 for a **new** permit

OR

☐ $100 to **renew/re-issue** my existing valid permit (with only *minor changes* such as updating my name and address) using my current application package on file.

OR

☐ $50 to make a **substantive amendment** (with *major changes*) to my existing valid permit [50 CFR 13.11(d)(2)].

If the information in your current application package on file has changed in a manner that triggers a major amendment or a change not otherwise specified in the permit, then you must apply for an amendment to your valid permit. For example, such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit. Please contact our Ecological Services Field Office located closest to your proposed activity for technical assistance in making this determination. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please check the **type of amendment** you are requesting --

☐ add species (specify) _____

☐ add a geographic area ☐ change in personnel

☐ other (specify) _____

If this application includes **transfer or succession** of a valid Incidental Take permit, please check the box below:

☐ Transfer or succession of a valid Incidental Take permit associated with a HCP using the current application package on file. No application fee is required.

Application Processing Time

To expedite a final decision on your application, you are urged to coordinate with us as soon as possible for guidance in assembling a complete application package. If you are renewing or amending a valid permit, your complete application package must be received at least 30 days prior to the expiration of the valid permit. This time period begins when we receive a complete permit application package and does not include any time required for requesting clarification or additional information about your application.

The time required to process an application for an Incidental Take permit will vary depending on the size, complexity, and impacts of the HCP involved. Procedurally, the most variable factor in application processing is the level of analysis required for the proposed HCP under the National Environmental Policy Act (e.g., whether an application requires preparation of an Environmental Impact Statement, Environmental Assessment, or whether a categorical exclusion applies), although other factors such as public controversy can also affect application processing times. The target processing timeline from when we receive a complete application package to our final decision on a permit application is: up to 3 months for low-effect HCPs, 4 to 6 months for HCPs with an Environmental Assessment, and up to 12 months for HCPs with a 90-day comment period and/or an Environmental Impact Statement. Although not mandated by law or regulation, these targets are adopted as U.S. Fish & Wildlife Service and National Marine Fisheries Service (NMFS/NOAA Fisheries) policy and all offices are expected to streamline their Incidental Take permit programs, and to meet these targets to the maximum extent practicable.

The information provided in your permit application will be used to evaluate your application for compliance with the Endangered Species Act, its implementing regulations (which may require a 30 day public comment period), and with U.S. Fish and Wildlife Service policy. Receipt and possession of a permit under the Endangered Species Act should be regarded as a privilege, as we must balance permit issuance with our duties to protect and recover listed species.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal, re-issuance or amendment.

If your activities may affect species under the authority of the National Marine Fisheries Service (NMFS/NOAA Fisheries), then you may need to obtain a separate permit from that agency. In addition we share jurisdiction with NMFS/NOAA Fisheries for sea turtles (e.g., we evaluate applications for permits to conduct activities impacting sea turtles on land, and NMFS/NOAA Fisheries evaluates applications for permits to conduct activities impacting sea turtles in the marine environment). To apply for a permit to conduct activities with sea turtles in the marine environment or other species under NMFS/NOAA Fisheries jurisdiction, please contact them via their permit web page at http://www.nmfs.noaa.gov/pr/permits/

We cannot issue an Incidental Take permit under Section 10(a)(2)(A)(i) of the Endangered Species Act unless you submit a conservation plan that specifies the impacts that are likely to result from the incidental take associated with your activity.

Our general permit regulations at 50 CFR 13.12(a)(9) allow us to collect such other information as we determine that is relevant to the processing of a permit application. Before you submit an application for an Incidental Take permit, we may require that you conduct biological surveys to determine which species and/or habitat would be impacted by the activities sought to be covered under the permit. Biological surveys provide information necessary to develop an adequate HCP, and to assess the biological impacts of the proposed activities. In addition, the information provided in a biological survey can reduce the applicant's risk of take under Section 9 of the Endangered Species Act by ensuring that affected species and/or habitat are identified and appropriately covered under the permit.

You are required to obtain a Scientific Purposes, Enhancement of Propagation or Survival permit (commonly called a Recovery permit) from us before engaging in any biological survey activities that would take listed species. Contact our Ecological Services Field Office closest to the location of your activity to obtain technical assistance in determining the need for both a biological survey and a Recovery permit for your survey activity. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

If a biological survey is required, you will need to send us your complete Recovery permit application package at least 3 months prior to commencement of survey activities to facilitate processing of your Recovery permit application. The Recovery permit application is designated as U.S. Fish & Wildlife Service form # 3-200-55 and can be found on our Endangered Species permit web page at http://www.fws.gov/forms/3-200-55.pdf.

We maintain a list of Recovery permittees (such as biological consultants) who have authorized the release of their contact information to third parties for conducting biological surveys on a contract basis. This list is provided to the public at the discretion of each U.S.

Fish and Wildlife Service Regional Office as time and workload allow. Please be aware that this list does not represent an endorsement by us of any particular permittee.

****

If you are not applying as an individual but as a business, corporation, institution, or non-Federal public agency (block B. on page 1 of the application), the person to whom the permit will be issued (e.g., the landowner, president, director, executive director, or executive officer) is legally responsible for implementing the permit. Although other people under the direct control of the permittee (e.g., employees, contractors, consultants) receive third party take authorization in their capacity as designees of the permittee, the individual named as the permittee ultimately is legally responsible for the permit and any activities carried out under the permit except as otherwise limited in the case of permits issued to State or local government entities under 50 CFR 13.25(e).

****

If you wish to coordinate the processing of this permit application through an authorized agent, and to have that agent represent you as the primary contact with us, check the box below. Sign (in blue ink) and date the authorization statement, and provide contact information for your authorized agent.

☒ I hereby authorize the following person to act as an authorized agent on my behalf in the processing of this permit application and to furnish, upon request, supplemental information in support of this permit application.

Barron G. Collier III — signature (in blue ink)

6-1-10 — date

Barron G. Collier, III

please print name legibly

Your Authorized Agent's Contact Information (please print legibly)

Name: Tom Jones

Address: 2600 Golden Gate Pkwy.

City: Naples State: FL Zip Code: 34105

Telephone: 239-262-2600

Fax: 239-261-1797

E-Mail: Tjones@barroncollier.com

INCIDENTAL TAKE PERMIT APPLICATION INSTRUCTIONS

You have 4 options for providing the required information for an Incidental Take permit application. Choose only one option.

Incidental Take Permit Application: Option I. Renewal of a Valid Incidental Take Permit.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal.

Sign the following statement if you are applying to renew an existing valid Incidental Take permit. If you are proposing major changes to your Incidental Take permit, you must use Option II.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct and hereby request renewal of that permit.
>
> _____ _____
> signature (in blue ink) date
>
> _____
> please print name legibly
>
> * Please note: If you have signed the above statement, then your renewal request is complete. Please submit completed pages 1 through 5 of this application to our Regional Office (see attached list) covering the location of your proposed activity. Requests for renewals must be received no later than 30 days prior to permit expiration to ensure that your current permit remains in effect while we process your renewal request.

Incidental Take Permit Application: Option II. Amended Incidental Take Permit (with *major changes*)

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for amendment.

Sign the following statement if you are proposing to amend a valid Incidental Take permit by making major changes. Such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct, except for the changes listed below, and hereby request amendment of that permit.
>
> _____ _____
> signature (in blue ink) date
>
> _____
> please print name legibly

Provide a brief description of the changes to your valid permit (answer the appropriate questions for these changes under Incidental Take Permit Application Option III. below). Please submit completed pages 1 through 6 of this application form (along with the changed information relative to Option III. below) to our Regional Office (see attached list) covering the location of your proposed activity.

Incidental Take Permit Application: Option III. New Incidental Take Permit & Supplementary Information for Amendment of a Valid Permit (with *major changes*).

General permit regulations for the U.S. Fish & Wildlife Service can be found at 50 CFR 13. Regulations for an Incidental Take permit under the Endangered Species Act can be found at 50 CFR 17.22(b)(1) for endangered wildlife species and 50 CFR 17.32(b)(1) for threatened wildlife species.

Each landowner who wishes to be covered under a new or amended Incidental Take permit associated with an HCP must sign (in blue ink) and date the Incidental Take Permit Application Certification Notice at the end of this application, unless the landowner will be covered under this U.S. Fish & Wildlife Service Incidental Take permit via another vehicle, such as a certificate of inclusion (50 CFR 13.25(d)). Any change in the language of the Certification Notice must be reviewed by the Department of Interior, Office of the Solicitor and approved by the U.S. Fish & Wildlife Service. The same person who signs in box D. on page 1 of the application should sign the certification.

If the information in items A. - D. below is already provided in your final HCP (or Implementing Agreement, if applicable), then you do not have to provide it here. Instead, check the box below and use the spaces provided in items A. - D. to indicate the page numbers in your HCP or Implementing Agreement that provide the requested information.

☒ I am not providing the following information for items A. - D. as part of my Incidental Take permit application, because it is already provided in my final HCP or Implementing Agreement (copy attached or already submitted).

If the requested information in items A. - D. is not provided in your final HCP or final Implementing Agreement, or you are using Option II. to amend your existing valid Incidental Take permit, then attach separate pages for the missing information. In order to assist us in processing your request, please provide the item number (A. 1.a., etc.) of the required information before each of your responses. Thank you.

Please ensure that your final HCP and Implementing Agreement (if applicable) are attached if it has not been previously submitted.

If you have previously submitted a final draft HCP or Implementing Agreement, please indicate the document's date.

Date of final draft HCP TBD (MSHCP summary attached.)

Date of final draft Implementing Agreement TBD

Applications for an Incidental Take permit associated with an HCP must provide the following specific information (relevant to the activity) under items A.- D. below in addition to the general information on page 1 of this application.

A. Identify species and activity:

1. For a new Incidental Take permit:

   a. Provide the common and scientific names of the species being requested for coverage in the permit and their status (endangered (E), threatened (T), proposed endangered (PE), proposed threatened (PT), candidate for listing (C), or species likely to become a candidate (LC)).

   b. Provide the number, age, and sex of such species to the extent known

   c. Quantify the anticipated effects to their habitat.

   d. Describe the land use or water management activity sought to be authorized for each species.

2. For an amended Incidental Take permit:

   a. Identify the species to be added to your valid permit (provide both the scientific, to the most specific taxonomic level, and common names), as well as the species status (see 1.a.. above).

   b. Provide the number, age and sex of such species to the extent known.

   c. If any activities requested in this application differ from those authorized in your valid permit, then for each

species state the currently authorized activity, the requested new activity, and how the new activity will impact each species.

d. Identify each activity associated with your project that would result in the incidental take of each species.

e. Quantify any anticipated effects to the habitat of each added species.

f. Identify species to be deleted from your valid permit and the reason(s) for the deletion.

Page(s) & source document : _____

B. Identify location of the proposed activity:

1. Provide the name of the State, county, and specific location of the proposed activity site(s). Include a formal legal description, section/township/range information, county tax parcel number, local address, or any other identifying property designation that will precisely place the location of the proposed activity site(s). Attach a location map and plat of the project site clearly depicting the project boundaries and the footprint and location of all portions of the property that would be affected by your proposed activities.

2. Provide the total number of acres covered by the HCP 177,000+/-

   Is this the total acreage of the parcel? (circle one) (yes) no

3. Provide the approximate number of acres to be impacted 45,000

4. Provide the approximate number of acres to be protected 132,000

5. Provide a complete description, including timeframes, for implementation of proposed voluntary management activities to enhance, restore, or maintain habitat benefiting federally listed, proposed or candidate species, or other species likely to become candidates. Include schedules for implementing these activities.

Page(s) & source document: See attached MSHCP summary.

C. Describe the proposed activities in the conservation plan:
You must submit a Habitat Conservation Plan. We strongly encourage you to ensure that your HCP is consistent with the Habitat Conservation Planning Handbook, subsequent Handbook addendums, and current policies to minimize delays in evaluating your application. The Handbook and other HCP information is available on the U.S. Fish & Wildlife Service's Endangered Species web page at http://www.fws.gov/endangered/hcp/index.html

Provide a complete description of activity(ies) to be authorized or reference the applicable HCP or Implementing Agreement page numbers identifying the subject information.

The HCP must specify:

1. The impact that will likely result from the incidental taking. A discussion of the impact that will likely result from the incidental take should include quantification of any anticipated effects to the habitat of the species sought to be covered by the permit.

2. The steps that will be taken to minimize and mitigate such impacts, the funding that will be available to implement such steps, and the procedures to deal with unforeseen circumstances.

3. The steps that will be taken to monitor and report on such impacts, including a copy of the monitoring plan. We are authorized to require reports of activities conducted under a permit per the U.S. Fish & Wildlife Service's general permit regulations at 50 CFR 13.45.

4. Alternative actions to such incidental taking that have been considered and the reasons why these alternatives are not proposed for use.

5. The biological goals(s) and objectives for the HCP.

6. The duration requested for the proposed permit.

Page(s) & source document : See attached HCP summary.

D. Implementing Agreement

An Implementing Agreement

is *is not* (FWS *Regional Office* to circle one)

required as part of the permit application for a Habitat Conservation Plan.

This Implementing Agreement must be signed at finalization of the HCP. Are you willing to commit to an Implementing Agreement at finalization of the HCP?

☒ Yes, I am willing to commit to an Implementing Agreement. Please submit any unsigned, draft Implementing Agreement that you have prepared with our Field Office.

☐ No, I am not willing to commit to an Implementing Agreement.

Incidental Take Permit Application: Option IV. Permit Transfer or Succession of a Permit

Complete the following if you are applying for transfer of a valid Incidental Take permit to you or obtaining rights of succession of a valid Incidental Take permit. In addition, you and the current permit holder may also need to sign an Assumption Agreement. Please contact our Ecological Services Field Office nearest your activity to determine whether you and the current permit holder need to execute an Assumption Agreement. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please indicate the name of the HCP to be transferred or succeeded and indicate the document's date.

Name of HCP _____

Date of HCP _____

An Assumption Agreement

is ***is not*** (FWS Ecological Services *Field Office* to circle one)

required as part of the transfer or succession permit application for the HCP.

Incidental Take Permit Application

Certification Notice

The same person who signs in box D. on page 1 of the application should sign (in blue ink) the following certification.

By submitting this application and receiving an Incidental Take permit pursuant to Section 10(a)(1)(B) of the Endangered Species Act, I

Barron G. Collier, III (print name(s)) attest that I/we own the lands indicated in this application, or have sufficient authority or rights over these lands to implement the measures of the Habitat Conservation Plan (and Implementing Agreement if applicable) covered by the Incidental Take permit. Further, upon receipt of the Incidental Take permit, I/we agree to conduct the activities as specified in the Habitat Conservation Plan (and Implementing Agreement if applicable) according to the terms and conditions of the Incidental Take permit and its supporting documents.

Barron G. Collier III
signature (in blue ink)

6-1-10
date

Barron G. Collier, III
please print name legibly

signature (in blue ink)

date

please print name legibly

****

The public reporting burden for completing this application for an Incidental Take permit is estimated to be 3 hours, including time for reviewing instructions, gathering and maintaining application data, and completing and reviewing the forms. Comments regarding the burden estimate or any other aspect of the reporting requirement(s) should be directed to the U.S. Fish & Wildlife Service Information Collection Clearance Officer, MS 222 ARLSQ, U.S. Fish and Wildlife Service, Washington, DC 20240.

An agency may not conduct and a person is not required to respond to a collection of information unless a currently valid OMB control number is displayed.

****

USFWS Regional Contacts for Native Endangered & Threatened Species Permits

Pacific Region (Region 1): HI, ID, OR, WA, American Samoa, Commonwealth of the Northern Mariana Islands, Guam, and the Pacific Trust Territories

U.S. Fish and Wildlife Service
Endangered Species Permit Office
911 NE 11th Avenue
Portland, Oregon 97232-4181

Web: http://www.fws.gov/pacific/ecoservices/endangered/index.html
Phone: (503) 231-2071
email: permitsR1ES@fws.gov
Fax: (503) 231-6243

California & Nevada Region (Region 8): CA and NV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
2800 Cottage Way, Suite W-2606
Sacramento, California 95825 -1846

Web: http://www.fws.gov/cno/es/recovery.html
Phone: (916) 414-6464
email: permitsCNES@fws.gov
Fax: (916) 414-6486

Southwest Region (Region 2): AZ, NM, OK, and TX

U.S. Fish and Wildlife Service
Endangered Species Permit Office
500 Gold Avenue S.W. (street address)
P.O. Box 1306 (mailing address)
Albuquerque, New Mexico 87103-1306

Web: http://www.fws.gov/southwest/es/EndangeredSpecies/
Phone: (505) 248-6633
email: permitsR2ES@fws.gov
Fax: (505) 248-6788

Midwest Region (Region 3): IA, IL, IN, MI, MN, MO, OH, and WI

U.S. Fish and Wildlife Service
Endangered Species Permit Office
B.H. Whipple Federal Building
One Federal Drive
Fort Snelling, Minnesota 55111-4056

Web: http://www.fws.gov/midwest/Endangered/
Phone: (612) 713-5343
email: permitsR3ES@fws.gov
Fax: (612) 713-5292

Southeast Region (Region 4): AL, AR, FL, GA, KY, LA, MS, NC, PR, SC, TN, and U.S. Virgin Islands

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1875 Century Blvd., Suite 200
Atlanta, Georgia 30345

Web: http://www.fws.gov/southeast/es/#
Phone: (404) 679-7313
email: permitsR4ES@fws.gov
Fax: (404) 679-7081

Northeast Region (Region 5): CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, and WV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
300 Westgate Center Drive
Hadley, MA 01035-9589

Web: http://www.fws.gov/northeast/endangered/
Phone: (413) 253-8615
email: permitsR5ES@fws.gov
Fax: (413) 253-8482

Mountain-Prairie Region (Region 6): CO, KS, MT, NE, ND, SD, UT, and WY

U.S. Fish and Wildlife Service
Endangered Species Permit Office
Denver Federal Center
P.O. Box 25486
Denver, Colorado 80225-0489

Web: http://www.fws.gov/mountain%2Dprairie/endspp/
Phone: (303) 236-7400
email: permitsR6ES@fws.gov
Fax: (303) 236-0027

Alaska Region (Region 7): AK

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1011 E. Tudor Road
Anchorage, Alaska 99503-6199

Web: http://alaska.fws.gov/fisheries/endangered/index.htm
Phone: (907) 786-3323
email: permitsR7ES@fws.gov
Fax: (907) 786-3350

PERMIT APPLICATION FORM INSTRUCTIONS

The following instructions pertain to the standard permit form 3-200 that must be completed as an application for a U.S. Fish and Wildlife Service or CITES permit. The General Permit Procedures in 50 CFR 13 address the permitting process. For simplicity, all licenses, permits, registrations, and certificates will be referred to as a permit.

GENERAL INSTRUCTIONS:

- Complete all blocks/lines/questions in Sections A or B, and C and D. Complete all of Section E.
- **An incomplete application may cause delays in processing or may be returned to the applicant. Be sure you are filling in the appropriate application form for the proposed activity.**
- Print clearly or type in the information. Illegible applications may cause delays.
- Sign the application in blue ink. Faxes or copies of the original signature will not be accepted.
- Mail the original application to the address at the top of page one of the application or if applicable on the attached address list.
- **Keep a copy of your completed application.**
- **Please plan ahead. Allow at least 60 days for your application to be processed. Some applications may take longer than 90 days to process. (50 CFR 13.11)**
- Applications are processed in the order they are received.
- Additional forms and instructions are available from http://permits.fws.gov/ .

COMPLETE EITHER SECTION A OR SECTION B:

Section A. **Complete if applying as an individual:**

- Enter the complete name of the responsible individual who will be the permittee if a permit is issued. Enter personal information that identifies the applicant. ***Fax and e-mail are not required if not available.***
- If you are applying on behalf of a client, the personal information must pertain to the client, and a document evidencing power of attorney must be included with the application.
- **Affiliation/ Doing business as (dba)**: business, agency, organizational, or institutional affiliation *directly* related to the activity requested in the application (e.g., a taxidermist is an individual whose business can *directly* relate to the requested activity). The Division of Management Authority (DMA) will **not** accept *doing business as* affiliations for individuals.

Section B. **Complete if applying as a business, corporation, public agency, or institution:**

- Enter the complete name of the business, agency or institution that will be the permittee if a permit is issued. Give a brief description of the type of business the applicant is engaged in. Provide contact phone number(s) of the business.
- **Principal Officer** is the person in charge of the listed business, corporation, public agency, or institution. The principal officer is the person responsible for the application and any permitted activities. Often the principal officer is a Director or President. **Primary Contact** is the person at the business, corporation, public agency, or institution who will be available to answer questions about the application or permitted activities. Often this is the preparer of the application.

ALL APPLICANTS COMPLETE SECTION C:

- For all applications submitted to the Division of Management Authority (DMA) a physical U.S. address is **required.** Province and Country blocks are provided for those USFWS programs which use foreign addresses and are not required by DMA..
- **Mailing address** is address where communications from USFWS should be mailed if different than applicant's physical address.

ALL APPLICANTS COMPLETE SECTION D:

Section D.1 **Application processing fee:**

- An application processing fee is required at the time of application; unless exempted under 50 CFR13.11(d)(3). The application processing fee is assessed to partially cover the cost of processing a request. **The fee does not guarantee the issuance of a permit. Fees will not be refunded for applications that are approved, abandoned, or denied.** We may return fees for withdrawn applications prior to any significant processing occurring.
- **Documentation of fee exempt status is not required for Federal, tribal, State, or local government agencies; but must be supplied by those applicants acting on behalf of such agencies.** Those applicants acting on behalf of such agencies must submit a letter on agency letterhead and signed by the head of the unit of government for which the applicant is acting on behalf, confirming that the applicant will be carrying out the permitted activity for the agency.

Section D.2 **Federal Fish and Wildlife permits:**

- List the number(s) of your most current FWS or CITES permit or the number of the most recent permit if none are currently valid. If applying for re-issuance of a CITES permit, the original permit must be returned with this application.

Section D.3 **CERTIFICATION:**

- **The individual identified in Section A, the principal officer named in Section B, or person with a valid power of attorney (documentation must be included in the application) must sign and date the application in blue ink.** This signature binds the applicant to the statement of certification. This means that you certify that you have read and understand the regulations that apply to the permit. You also certify that everything included in the application is true to the best of your knowledge. Be sure to read the statement and re-read the application and your answers before signing.

Please continue to next page

APPLICATION FOR A FEDERAL FISH AND WILDLIFE PERMIT

Paperwork Reduction Act, Privacy Act, and Freedom of Information Act – Notices

In accordance with the Paperwork Reduction Act of 1995 (44 U.S.C. 3501, *et seq.*) and the Privacy Act of 1974 (5 U.S.C. 552a), please be advised:

1. The gathering of information on fish and wildlife is authorized by:
   (Authorizing statutes can be found at: http://www.gpoaccess.gov/cfr/index.html and http://www.fws.gov/permits/ltr/ltr.shtml.)

   a. Bald and Golden Eagle Protection Act (16 U.S.C. 668), 50 CFR 22;
   b. Endangered Species Act of 1973 (16 U.S.C. 1531-1544), 50CFR 17;
   c. Migratory Bird Treaty Act (16 U.S.C. 703-712), 50 CFR 21;
   d. Marine Mammal Protection Act of 1972 (16 U.S.C. 1361, *et. seq.*), 50 CFR 18;
   e. Wild Bird Conservation Act (16 U.S.C. 4901-4916), 50 CFR 15;
   f. Lacey Act: Injurious Wildlife (18 U.S.C. 42), 50 CFR 16;
   g. Convention on International Trade in Endangered Species of Wild Fauna and Flora (TIAS 8249), http://www.cites.org/ , 50 CFR 23;
   h. General Provisions, 50 CFR 10;
   i. General Permit Procedures, 50 CFR 13; and
   j. Wildlife Provisions (Import/export/transport), 50 CFR 14.

2. Information requested in this form is purely voluntary. However, submission of requested information is required in order to process applications for permits authorized under the above laws. Failure to provide all requested information may be sufficient cause for the U.S. Fish and Wildlife Service to deny the request. Response is not required unless a currently valid Office of Management and Budget (OMB) control number is displayed on form.

3. Certain applications for permits authorized under the Endangered Species Act of 1973 (16 U.S.C. 1539) and the Marine Mammal Protection Act of 1972 (16 U.S.C. 1374) will be published in the **Federal Register** as required by the two laws.

4. Disclosures outside the Department of the Interior may be made without the consent of an individual under the routine uses listed below, if the disclosure is compatible with the purposes for which the record was collected. (Ref. 68 FR 52611, September 4, 2003)

   a. Routine disclosure to subject matter experts, and Federal, tribal, State, local, and foreign agencies, for the purpose of obtaining advice relevant to making a decision on an application for a permit or when necessary to accomplish a FWS function related to this system of records.
   b. Routine disclosure to the public as a result of publishing **Federal Register** notices announcing the receipt of permit applications for public comment or notice of the decision on a permit application.
   c. Routine disclosure to Federal, tribal, State, local, or foreign wildlife and plant agencies for the exchange of information on permits granted or denied to assure compliance with all applicable permitting requirements.
   d. Routine disclosure to Captive-bred Wildlife registrants under the Endangered Species Act for the exchange of authorized species, and to share information on the captive breeding of these species.
   e. Routine disclosure to Federal, tribal, State, and local authorities who need to know who is permitted to receive and rehabilitate sick, orphaned, and injured birds under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act; federally permitted rehabilitators; individuals seeking a permitted rehabilitator with whom to place a bird in need of care; and licensed veterinarians who receive, treat, or diagnose sick, orphaned, and injured birds.
   f. Routine disclosure to the Department of Justice, or a court, adjudicative, or other administrative body or to a party in litigation before a court or adjudicative or administrative body, under certain circumstances.
   g. Routine disclosure to the appropriate Federal, tribal, State, local, or foreign governmental agency responsible for investigating, prosecuting, enforcing, or implementing statutes, rules, or licenses, when we become aware of a violation or potential violation of such statutes, rules, or licenses, or when we need to monitor activities associated with a permit or regulated use.
   h. Routine disclosure to a congressional office in response to an inquiry to the office by the individual to whom the record pertains.
   i. Routine disclosure to the General Accounting Office or Congress when the information is required for the evaluation of the permit programs.
   j. Routine disclosure to provide addresses obtained from the Internal Revenue Service to debt collection agencies for purposes of locating a debtor to collect or compromise a Federal claim against the debtor or to consumer reporting agencies to prepare a commercial credit report for use by the FWS.

5. For individuals, personal information such as home address and telephone number, financial data, and personal identifiers (social security number, birth date, etc.) will be removed prior to any release of the application.

6. The public reporting burden on the applicant for information collection varies depending on the activity for which a permit is requested. The relevant burden for an **Incidental Take** permit application is **3 hours**. This burden estimate includes time for reviewing instructions, gathering and maintaining data and completing and reviewing the form. You may direct comments regarding the burden estimate or any other aspect of the form to the Service Information Clearance Officer, U.S. Fish and Wildlife Service, Mail Stop 222, Arlington Square, U.S. Department of the Interior, 1849 C Street, NW, Washington D.C. 20240.

Freedom of Information Act – Notice

For organizations, businesses, or individuals operating as a business (i.e., permittees not covered by the Privacy Act), we request that you identify any information that should be considered privileged and confidential business information to allow the Service to meet its responsibilities under FOIA. Confidential business information must be clearly marked "Business Confidential" at the top of the letter or page and each succeeding page and must be accompanied by a non-confidential summary of the confidential information. The non-confidential summary and remaining documents may be made available to the public under FOIA [43 CFR 2.13(c)(4), 43 CFR 2.15(d)(1)(i)].

Department of the Interior
U.S. Fish and Wildlife Service

Expires Nov. 30, 2010
OMB No. 1018-0094

Federal Fish and Wildlife Permit Application Form

Return to: U.S. Fish and Wildlife Service (USFWS)

Type of Activity: Native Endangered and Threatened Species – Incidental Take Permits Associated with a Habitat Conservation Plan (HCP)

Complete Sections A or B, and C, D, and E of this application. U.S. address may be required in Section C, see instructions for details.
See attached instruction pages for information on how to make your application complete and help avoid unnecessary delays.

A. Complete if applying as an individual			
1.a. Last name	1.b. First name	1.c. Middle name or initial	1.d. Suffix
2. Date of birth (mm/dd/yyyy)	3. Social Security No.	4. Occupation	5. Affiliation/ Doing business as (see instructions)
6.a. Telephone number	6.b. Alternate telephone number	6.c. Fax number	6.d. E-mail address

B. Complete if applying on behalf of a business, corporation, public agency or institution			
1.a. Name of business, agency, or institution		1.b. Doing business as (dba)	
Collier Enterprises Management, Inc.			
2. Tax identification no.	3. Description of business, agency, or institution		
11-3734357.	Land Management		
4.a. Principal officer Last name	4.b. Principal officer First name	4.c. Principal officer Middle name/ initial	4.d. Suffix
Spilker	Christian	M.	
5. Principal officer title		6. Primary contact	
Vice President of Land Management		Christian Spilker	
7.a. Business telephone number	7.b. Alternate telephone number	7.c. Business fax number	7.d. Business e-mail address
239-261-4455		239-263-4437	cspilker@collierenterprises.com

C. All applicants complete address information				
1.a. Physical address (Street address; Apartment #, Suite #, or Room #; no P.O. Boxes)				
3003 Tamiami Trail N., Suite 400				
1.b. City	1.c. State	1.d. Zip code/Postal code:	1.e. County/Province	1.f. Country
Naples	FL	34103	Collier	USA
2.a. Mailing Address (include if different than physical address; include name of contact person if applicable)				
2.b. City	2.c. State	2.d. Zip code/Postal code:	2.e. County/Province	2.f. Country

D. All applicants MUST complete

1. Attach check or money order payable to the U.S. FISH AND WILDLIFE SERVICE **in the amount indicated on page 2.** Federal, tribal, State, and local government agencies, and those acting on behalf of such agencies, are exempt from the processing fee – *attach documentation of fee exempt status as outlined in instructions.* (50 CFR 13.11(d))

2. Do you currently have or have you ever had any Federal Fish and Wildlife permits?
   Yes ☐ If yes, list the number of the most current permit you have held or that you are applying to renew/re-issue: _____
   No ☒

3. Certification: I hereby certify that I have read and am familiar with the regulations contained in *Title 50, Part 13 of the Code of Federal Regulations* and the other *applicable parts in subchapter B of Chapter I of Title 50*, and I certify that the information submitted in this application for a permit is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to the criminal penalties of 18 U.S.C. 1001.

   _____ 5/25/10
   Signature **(in blue ink)** of applicant/person responsible for permit (No photocopied or stamped signatures) Date of signature (mm/dd/yyyy)

Please continue to next page

** See page 14 for additional instructions on completing the above form. See page 15 for information on the Paperwork Reduction Act, Privacy Act, and Freedom of Information Act aspects of this application form.

Section E. ALL APPLICANTS COMPLETE SECTION E. Provide the information outlined in Section E. on the following pages. Be as complete and descriptive as possible. Please do not send pages that are over 8.5"X 11", videotapes, or DVDs.

INCIDENTAL TAKE PERMITS ASSOCIATED WITH A HABITAT CONSERVATION PLAN (HCP)

Have you obtained all required State, Federal or foreign government approval to conduct the activity you propose? Please be aware that there may be other requirements necessary to conduct this activity such as an import permit, collection permit, permission to work on Federal lands, Federal bird banding permit, Corps of Engineers permits, Environmental Protection Agency NPDES permits, State, county or local permits, etc.

☐ Yes. Provide a copy of the approval(s). List the State, Federal or foreign countries involved and type of document required. Include a copy of these documents with the application.

☐ I have applied. List the State, Federal or foreign countries involved and type of documents required. Provide the reasons why the permits have not been issued _____.

☒ Not required. ~~The proposed activity is not regulated.~~ Not required at this time. MSHCP precedes future activities.

Application Processing Fees

The application processing fee for a new Incidental Take permit, or to renew/re-issue an existing valid permit, is $100. If permit amendment is required at a time other than renewal/re-issuance, the processing fee is $50.

Check the appropriate box below and enclose check or money order payable to the *U.S. Fish and Wildlife Service* in the amount of

☒ $100 for a **new** permit

OR

☐ $100 to **renew/re-issue** my existing valid permit (with only *minor changes* such as updating my name and address) using my current application package on file.

OR

☐ $50 to make a **substantive amendment** (with *major changes*) to my existing valid permit [50 CFR 13.11(d)(2)].

If the information in your current application package on file has changed in a manner that triggers a major amendment or a change not otherwise specified in the permit, then you must apply for an amendment to your valid permit. For example, such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit. Please contact our Ecological Services Field Office located closest to your proposed activity for technical assistance in making this determination. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please check the **type of amendment** you are requesting --

☐ add species (specify) _____

☐ add a geographic area ☐ change in personnel

☐ other (specify) _____

If this application includes **transfer or succession** of a valid Incidental Take permit, please check the box below:

☐ Transfer or succession of a valid Incidental Take permit associated with a HCP using the current application package on file. No application fee is required.

Application Processing Time

To expedite a final decision on your application, you are urged to coordinate with us as soon as possible for guidance in assembling a complete application package. If you are renewing or amending a valid permit, your complete application package must be received at least 30 days prior to the expiration of the valid permit. This time period begins when we receive a complete permit application package and does not include any time required for requesting clarification or additional information about your application.

The time required to process an application for an Incidental Take permit will vary depending on the size, complexity, and impacts of the HCP involved. Procedurally, the most variable factor in application processing is the level of analysis required for the proposed HCP under the National Environmental Policy Act (e.g., whether an application requires preparation of an Environmental Impact Statement, Environmental Assessment, or whether a categorical exclusion applies), although other factors such as public controversy can also affect application processing times. The target processing timeline from when we receive a complete application package to our final decision on a permit application is: up to 3 months for low-effect HCPs, 4 to 6 months for HCPs with an Environmental Assessment, and up to 12 months for HCPs with a 90-day comment period and/or an Environmental Impact Statement. Although not mandated by law or regulation, these targets are adopted as U.S. Fish & Wildlife Service and National Marine Fisheries Service (NMFS/NOAA Fisheries) policy and all offices are expected to streamline their Incidental Take permit programs, and to meet these targets to the maximum extent practicable.

The information provided in your permit application will be used to evaluate your application for compliance with the Endangered Species Act, its implementing regulations (which may require a 30 day public comment period), and with U.S. Fish and Wildlife Service policy. Receipt and possession of a permit under the Endangered Species Act should be regarded as a privilege, as we must balance permit issuance with our duties to protect and recover listed species.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal, re-issuance or amendment.

If your activities may affect species under the authority of the National Marine Fisheries Service (NMFS/NOAA Fisheries), then you may need to obtain a separate permit from that agency. In addition we share jurisdiction with NMFS/NOAA Fisheries for sea turtles (e.g., we evaluate applications for permits to conduct activities impacting sea turtles on land, and NMFS/NOAA Fisheries evaluates applications for permits to conduct activities impacting sea turtles in the marine environment). To apply for a permit to conduct activities with sea turtles in the marine environment or other species under NMFS/NOAA Fisheries jurisdiction, please contact them via their permit web page at http://www.nmfs.noaa.gov/pr/permits/

We cannot issue an Incidental Take permit under Section 10(a)(2)(A)(i) of the Endangered Species Act unless you submit a conservation plan that specifies the impacts that are likely to result from the incidental take associated with your activity.

Our general permit regulations at 50 CFR 13.12(a)(9) allow us to collect such other information as we determine that is relevant to the processing of a permit application. Before you submit an application for an Incidental Take permit, we may require that you conduct biological surveys to determine which species and/or habitat would be impacted by the activities sought to be covered under the permit. Biological surveys provide information necessary to develop an adequate HCP, and to assess the biological impacts of the proposed activities. In addition, the information provided in a biological survey can reduce the applicant's risk of take under Section 9 of the Endangered Species Act by ensuring that affected species and/or habitat are identified and appropriately covered under the permit.

You are required to obtain a Scientific Purposes, Enhancement of Propagation or Survival permit (commonly called a Recovery permit) from us before engaging in any biological survey activities that would take listed species. Contact our Ecological Services Field Office closest to the location of your activity to obtain technical assistance in determining the need for both a biological survey and a Recovery permit for your survey activity. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

If a biological survey is required, you will need to send us your complete Recovery permit application package at least 3 months prior to commencement of survey activities to facilitate processing of your Recovery permit application. The Recovery permit application is designated as U.S. Fish & Wildlife Service form # 3-200-55 and can be found on our Endangered Species permit web page at http://www.fws.gov/forms/3-200-55.pdf.

We maintain a list of Recovery permittees (such as biological consultants) who have authorized the release of their contact information to third parties for conducting biological surveys on a contract basis. This list is provided to the public at the discretion of each U.S.

Fish and Wildlife Service Regional Office as time and workload allow. Please be aware that this list does not represent an endorsement by us of any particular permittee.

****

If you are not applying as an individual but as a business, corporation, institution, or non-Federal public agency (block B. on page 1 of the application), the person to whom the permit will be issued (e.g., the landowner, president, director, executive director, or executive officer) is legally responsible for implementing the permit. Although other people under the direct control of the permittee (e.g., employees, contractors, consultants) receive third party take authorization in their capacity as designees of the permittee, the individual named as the permittee ultimately is legally responsible for the permit and any activities carried out under the permit except as otherwise limited in the case of permits issued to State or local government entities under 50 CFR 13.25(e).

****

If you wish to coordinate the processing of this permit application through an **authorized agent**, and to have that agent represent you as the primary contact with us, check the box below. Sign (in blue ink) and date the authorization statement, and provide contact information for your authorized agent.

☑ I hereby authorize the following person to act as an authorized agent on my behalf in the processing of this permit application and to furnish, upon request, supplemental information in support of this permit application.

[signature] 5/25/10

signature (in blue ink) date

Christian Spilich

please print name legibly

Your Authorized Agent's Contact Information (please print legibly)

Name: Tom Jones

Address: 2600 Golden Gate Pkwy

City: Naples State: FL Zip Code: 34105

Telephone: 239-262-2600

Fax: 239-261-1797

E-Mail: TJones@barroncollier.com

INCIDENTAL TAKE PERMIT APPLICATION INSTRUCTIONS

You have 4 options for providing the required information for an Incidental Take permit application. Choose only one option.

Incidental Take Permit Application: Option I. Renewal of a Valid Incidental Take Permit.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal.

Sign the following statement if you are applying to renew an existing valid Incidental Take permit. If you are proposing major changes to your Incidental Take permit, you must use Option II.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct and hereby request renewal of that permit.
>
> _____ _____
> signature (in blue ink) date
>
> _____
> please print name legibly
>
> * Please note: If you have signed the above statement, then your renewal request is complete. Please submit completed pages 1 through 5 of this application to our Regional Office (see attached list) covering the location of your proposed activity. Requests for renewals must be received no later than 30 days prior to permit expiration to ensure that your current permit remains in effect while we process your renewal request.

Incidental Take Permit Application: Option II. Amended Incidental Take Permit (with *major changes*)

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for amendment.

Sign the following statement if you are proposing to amend a valid Incidental Take permit by making major changes. Such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct, except for the changes listed below, and hereby request amendment of that permit.

_____ _____

signature (in blue ink) date

_____

please print name legibly

Provide a brief description of the changes to your valid permit (answer the appropriate questions for these changes under Incidental Take Permit Application Option III. below). Please submit completed pages 1 through 6 of this application form (along with the changed information relative to Option III. below) to our Regional Office (see attached list) covering the location of your proposed activity.

Incidental Take Permit Application: Option III. New Incidental Take Permit & Supplementary Information for Amendment of a Valid Permit (with *major changes*).

General permit regulations for the U.S. Fish & Wildlife Service can be found at 50 CFR 13. Regulations for an Incidental Take permit under the Endangered Species Act can be found at 50 CFR 17.22(b)(1) for endangered wildlife species and 50 CFR 17.32(b)(1) for threatened wildlife species.

Each landowner who wishes to be covered under a new or amended Incidental Take permit associated with an HCP must sign (in blue ink) and date the Incidental Take Permit Application Certification Notice at the end of this application, unless the landowner will be covered under this U.S. Fish & Wildlife Service Incidental Take permit via another vehicle, such as a certificate of inclusion (50 CFR 13.25(d)). Any change in the language of the Certification Notice must be reviewed by the Department of Interior, Office of the Solicitor and approved by the U.S. Fish & Wildlife Service. The same person who signs in box D. on page 1 of the application should sign the certification.

If the information in items A. - D. below is already provided in your final HCP (or Implementing Agreement, if applicable), then you do not have to provide it here. Instead, check the box below and use the spaces provided in items A. - D. to indicate the page numbers in your HCP or Implementing Agreement that provide the requested information.

☒ I am not providing the following information for items A. - D. as part of my Incidental Take permit application, because it is already provided in my final HCP or Implementing Agreement (copy attached or already submitted).

If the requested information in items A. - D. is not provided in your final HCP or final Implementing Agreement, or you are using Option II. to amend your existing valid Incidental Take permit, then attach separate pages for the missing information. In order to assist us in processing your request, please provide the item number (A. 1.a., etc.) of the required information before each of your responses. Thank you.

Please ensure that your final HCP and Implementing Agreement (if applicable) are attached if it has not been previously submitted.

If you have previously submitted a final draft HCP or Implementing Agreement, please indicate the document's date.

Date of final draft HCP TBD (MSHCP summary attached.)

Date of final draft Implementing Agreement TBD

Applications for an Incidental Take permit associated with an HCP must provide the following specific information (relevant to the activity) under items A.- D. below in addition to the general information on page 1 of this application.

A. Identify species and activity:

1. For a new Incidental Take permit:

   a. Provide the common and scientific names of the species being requested for coverage in the permit and their status (endangered (E), threatened (T), proposed endangered (PE), proposed threatened (PT), candidate for listing (C), or species likely to become a candidate (LC)).

   b. Provide the number, age, and sex of such species to the extent known

   c. Quantify the anticipated effects to their habitat.

   d. Describe the land use or water management activity sought to be authorized for each species.

2. For an amended Incidental Take permit:

   a. Identify the species to be added to your valid permit (provide both the scientific, to the most specific taxonomic level, and common names), as well as the species status (see 1.a.. above).

   b. Provide the number, age and sex of such species to the extent known.

   c. If any activities requested in this application differ from those authorized in your valid permit, then for each

species state the currently authorized activity, the requested new activity, and how the new activity will impact each species.

d. Identify each activity associated with your project that would result in the incidental take of each species.

e. Quantify any anticipated effects to the habitat of each added species.

f. Identify species to be deleted from your valid permit and the reason(s) for the deletion.

Page(s) & source document : _____

B. Identify location of the proposed activity:

1. Provide the name of the State, county, and specific location of the proposed activity site(s). Include a formal legal description, section/township/range information, county tax parcel number, local address, or any other identifying property designation that will precisely place the location of the proposed activity site(s). Attach a location map and plat of the project site clearly depicting the project boundaries and the footprint and location of all portions of the property that would be affected by your proposed activities.

2. Provide the total number of acres covered by the HCP 177,000+/-

   Is this the total acreage of the parcel? (circle one) (yes) no

3. Provide the approximate number of acres to be impacted 45,000

4. Provide the approximate number of acres to be protected 132,000

5. Provide a complete description, including timeframes, for implementation of proposed voluntary management activities to enhance, restore, or maintain habitat benefiting federally listed, proposed or candidate species, or other species likely to become candidates. Include schedules for implementing these activities.

Page(s) & source document: See attached MSHCP summary.

C. Describe the proposed activities in the conservation plan:

You must submit a Habitat Conservation Plan. We strongly encourage you to ensure that your HCP is consistent with the Habitat Conservation Planning Handbook, subsequent Handbook addendums, and current policies to minimize delays in evaluating your application. The Handbook and other HCP information is available on the U.S. Fish & Wildlife Service's Endangered Species web page at http://www.fws.gov/endangered/hcp/index.html

Provide a complete description of activity(ies) to be authorized or reference the applicable HCP or Implementing Agreement page numbers identifying the subject information.

The HCP must specify:

1. The impact that will likely result from the incidental taking. A discussion of the impact that will likely result from the incidental take should include quantification of any anticipated effects to the habitat of the species sought to be covered by the permit.

2. The steps that will be taken to minimize and mitigate such impacts, the funding that will be available to implement such steps, and the procedures to deal with unforeseen circumstances.

3. The steps that will be taken to monitor and report on such impacts, including a copy of the monitoring plan. We are authorized to require reports of activities conducted under a permit per the U.S. Fish & Wildlife Service's general permit regulations at 50 CFR 13.45.

4. Alternative actions to such incidental taking that have been considered and the reasons why these alternatives are not proposed for use.

5. The biological goals(s) and objectives for the HCP.

6. The duration requested for the proposed permit.

Page(s) & source document : See attached HCP summary.

D. Implementing Agreement

An Implementing Agreement

is *is not* (FWS *Regional Office* to circle one)

required as part of the permit application for a Habitat Conservation Plan.

This Implementing Agreement must be signed at finalization of the HCP. Are you willing to commit to an Implementing Agreement at finalization of the HCP?

☒ Yes, I am willing to commit to an Implementing Agreement. Please submit any unsigned, draft Implementing Agreement that you have prepared with our Field Office.

☐ No, I am not willing to commit to an Implementing Agreement.

Incidental Take Permit Application: Option IV. Permit Transfer or Succession of a Permit

Complete the following if you are applying for transfer of a valid Incidental Take permit to you or obtaining rights of succession of a valid Incidental Take permit. In addition, you and the current permit holder may also need to sign an Assumption Agreement. Please contact our Ecological Services Field Office nearest your activity to determine whether you and the current permit holder need to execute an Assumption Agreement. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please indicate the name of the HCP to be transferred or succeeded and indicate the document's date.

Name of HCP _____

Date of HCP _____

An Assumption Agreement

is *is not* (FWS Ecological Services *Field Office* to circle one)

required as part of the transfer or succession permit application for the HCP.

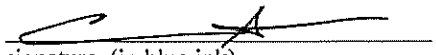
Incidental Take Permit Application

Certification Notice

The same person who signs in box D. on page 1 of the application should sign (in blue ink) the following certification.

By submitting this application and receiving an Incidental Take permit pursuant to Section 10(a)(1)(B) of the Endangered Species Act, I

Christian Spilker (print name(s)) attest that I/we own the lands indicated in this application, or have sufficient authority or rights over these lands to implement the measures of the Habitat Conservation Plan (and Implementing Agreement if applicable) covered by the Incidental Take permit. Further, upon receipt of the Incidental Take permit, I/we agree to conduct the activities as specified in the Habitat Conservation Plan (and Implementing Agreement if applicable) according to the terms and conditions of the Incidental Take permit and its supporting documents.



signature (in blue ink)

5/25/10
date

Christian Spilker
please print name legibly

signature (in blue ink)

date

please print name legibly

****

The public reporting burden for completing this application for an Incidental Take permit is estimated to be 3 hours, including time for reviewing instructions, gathering and maintaining application data, and completing and reviewing the forms. Comments regarding the burden estimate or any other aspect of the reporting requirement(s) should be directed to the U.S. Fish & Wildlife Service Information Collection Clearance Officer, MS 222 ARLSQ, U.S. Fish and Wildlife Service, Washington, DC 20240.

An agency may not conduct and a person is not required to respond to a collection of information unless a currently valid OMB control number is displayed.

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USFWS Regional Contacts for Native Endangered & Threatened Species Permits

Pacific Region (Region 1): HI, ID, OR, WA, American Samoa, Commonwealth of the Northern Mariana Islands, Guam, and the Pacific Trust Territories

U.S. Fish and Wildlife Service
Endangered Species Permit Office
911 NE 11th Avenue
Portland, Oregon 97232-4181

Web: http://www.fws.gov/pacific/ecoservices/endangered/index.html
Phone: (503) 231-2071
email: permitsR1ES@fws.gov
Fax: (503) 231-6243

California & Nevada Region (Region 8): CA and NV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
2800 Cottage Way, Suite W-2606
Sacramento, California 95825 -1846

Web: http://www.fws.gov/cno/es/recovery.html
Phone: (916) 414-6464
email: permitsCNES@fws.gov
Fax: (916) 414-6486

Southwest Region (Region 2): AZ, NM, OK, and TX

U.S. Fish and Wildlife Service
Endangered Species Permit Office
500 Gold Avenue S.W. (street address)
P.O. Box 1306 (mailing address)
Albuquerque, New Mexico 87103-1306

Web: http://www.fws.gov/southwest/es/EndangeredSpecies/
Phone: (505) 248-6633
email: permitsR2ES@fws.gov
Fax: (505) 248-6788

Midwest Region (Region 3): IA, IL, IN, MI, MN, MO, OH, and WI

U.S. Fish and Wildlife Service
Endangered Species Permit Office
B.H. Whipple Federal Building
One Federal Drive
Fort Snelling, Minnesota 55111-4056

Web: http://www.fws.gov/midwest/Endangered/
Phone: (612) 713-5343
email: permitsR3ES@fws.gov
Fax: (612) 713-5292

Southeast Region (Region 4): AL, AR, FL, GA, KY, LA, MS, NC, PR, SC, TN, and U.S. Virgin Islands

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1875 Century Blvd., Suite 200
Atlanta, Georgia 30345

Web: http://www.fws.gov/southeast/es/#
Phone: (404) 679-7313
email: permitsR4ES@fws.gov
Fax: (404) 679-7081

Northeast Region (Region 5): CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, and WV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
300 Westgate Center Drive
Hadley, MA 01035-9589

Web: http://www.fws.gov/northeast/endangered/
Phone: (413) 253-8615
email: permitsR5ES@fws.gov
Fax: (413) 253-8482

Mountain-Prairie Region (Region 6): CO, KS, MT, NE, ND, SD, UT, and WY

U.S. Fish and Wildlife Service
Endangered Species Permit Office
Denver Federal Center
P.O. Box 25486
Denver, Colorado 80225-0489

Web: http://www.fws.gov/mountain%2Dprairie/endspp/
Phone: (303) 236-7400
email: permitsR6ES@fws.gov
Fax: (303) 236-0027

Alaska Region (Region 7): AK

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1011 E. Tudor Road
Anchorage, Alaska 99503-6199

Web: http://alaska.fws.gov/fisheries/endangered/index.htm
Phone: (907) 786-3323
email: permitsR7ES@fws.gov
Fax: (907) 786-3350

PERMIT APPLICATION FORM INSTRUCTIONS

The following instructions pertain to the standard permit form 3-200 that must be completed as an application for a U.S. Fish and Wildlife Service or CITES permit. The General Permit Procedures in 50 CFR 13 address the permitting process. For simplicity, all licenses, permits, registrations, and certificates will be referred to as a permit.

GENERAL INSTRUCTIONS:

- Complete all blocks/lines/questions in Sections A or B, and C and D. Complete all of Section E.
- **An incomplete application may cause delays in processing or may be returned to the applicant. Be sure you are filling in the appropriate application form for the proposed activity.**
- Print clearly or type in the information. Illegible applications may cause delays.
- Sign the application in blue ink. Faxes or copies of the original signature will not be accepted.
- Mail the original application to the address at the top of page one of the application or if applicable on the attached address list.
- **Keep a copy of your completed application.**
- **Please plan ahead. Allow at least 60 days for your application to be processed. Some applications may take longer than 90 days to process. (50 CFR 13.11)**
- Applications are processed in the order they are received.
- Additional forms and instructions are available from http://permits.fws.gov/ .

COMPLETE EITHER SECTION A OR SECTION B:

Section A. **Complete if applying as an individual:**

- Enter the complete name of the responsible individual who will be the permittee if a permit is issued. Enter personal information that identifies the applicant. ***Fax and e-mail are not required if not available.***
- If you are applying on behalf of a client, the personal information must pertain to the client, and a document evidencing power of attorney must be included with the application.
- **Affiliation/ Doing business as (dba):** business, agency, organizational, or institutional affiliation *directly* related to the activity requested in the application (e.g., a taxidermist is an individual whose business can *directly* relate to the requested activity). The Division of Management Authority (DMA) will **not** accept *doing business as* affiliations for individuals.

Section B. **Complete if applying as a business, corporation, public agency, or institution:**

- Enter the complete name of the business, agency or institution that will be the permittee if a permit is issued. Give a brief description of the type of business the applicant is engaged in. Provide contact phone number(s) of the business.
- **Principal Officer** is the person in charge of the listed business, corporation, public agency, or institution. The principal officer is the person responsible for the application and any permitted activities. Often the principal officer is a Director or President. **Primary Contact** is the person at the business, corporation, public agency, or institution who will be available to answer questions about the application or permitted activities. Often this is the preparer of the application.

ALL APPLICANTS COMPLETE SECTION C:

- For all applications submitted to the Division of Management Authority (DMA) a physical U.S. address is **required**. Province and Country blocks are provided for those USFWS programs which use foreign addresses and are not required by DMA..
- **Mailing address** is address where communications from USFWS should be mailed if different than applicant's physical address.

ALL APPLICANTS COMPLETE SECTION D:

Section D.1 **Application processing fee:**

- An application processing fee is required at the time of application; unless exempted under 50 CFR13.11(d)(3). The application processing fee is assessed to partially cover the cost of processing a request. **The fee does not guarantee the issuance of a permit. Fees will not be refunded for applications that are approved, abandoned, or denied.** We may return fees for withdrawn applications prior to any significant processing occurring.
- **Documentation of fee exempt status is not required for Federal, tribal, State, or local government agencies; but must be supplied by those applicants acting on behalf of such agencies.** Those applicants acting on behalf of such agencies must submit a letter on agency letterhead and signed by the head of the unit of government for which the applicant is acting on behalf, confirming that the applicant will be carrying out the permitted activity for the agency.

Section D.2 **Federal Fish and Wildlife permits:**

- List the number(s) of your most current FWS or CITES permit or the number of the most recent permit if none are currently valid. If applying for re-issuance of a CITES permit, the original permit must be returned with this application.

Section D.3 **CERTIFICATION:**

- **The individual identified in Section A, the principal officer named in Section B, or person with a valid power of attorney (documentation must be included in the application) must sign and date the application in blue ink.** This signature binds the applicant to the statement of certification. This means that you certify that you have read and understand the regulations that apply to the permit. You also certify that everything included in the application is true to the best of your knowledge. Be sure to read the statement and re-read the application and your answers before signing.

Please continue to next page

APPLICATION FOR A FEDERAL FISH AND WILDLIFE PERMIT
Paperwork Reduction Act, Privacy Act, and Freedom of Information Act – Notices

In accordance with the Paperwork Reduction Act of 1995 (44 U.S.C. 3501, *et seq.*) and the Privacy Act of 1974 (5 U.S.C. 552a), please be advised:

1. The gathering of information on fish and wildlife is authorized by:
(Authorizing statutes can be found at: http://www.gpoaccess.gov/cfr/index.html and http://www.fws.gov/permits/ltr/ltr.shtml.)

   a. Bald and Golden Eagle Protection Act (16 U.S.C. 668), 50 CFR 22;
   b. Endangered Species Act of 1973 (16 U.S.C. 1531-1544), 50CFR 17;
   c. Migratory Bird Treaty Act (16 U.S.C. 703-712), 50 CFR 21;
   d. Marine Mammal Protection Act of 1972 (16 U.S.C. 1361, *et. seq.*), 50 CFR 18;
   e. Wild Bird Conservation Act (16 U.S.C. 4901-4916), 50 CFR 15;
   f. Lacey Act: Injurious Wildlife (18 U.S.C. 42), 50 CFR 16;
   g. Convention on International Trade in Endangered Species of Wild Fauna and Flora (TIAS 8249), http://www.cites.org/ , 50 CFR 23;
   h. General Provisions, 50 CFR 10;
   i. General Permit Procedures, 50 CFR 13; and
   j. Wildlife Provisions (Import/export/transport), 50 CFR 14.

2. Information requested in this form is purely voluntary. However, submission of requested information is required in order to process applications for permits authorized under the above laws. Failure to provide all requested information may be sufficient cause for the U.S. Fish and Wildlife Service to deny the request. Response is not required unless a currently valid Office of Management and Budget (OMB) control number is displayed on form.

3. Certain applications for permits authorized under the Endangered Species Act of 1973 (16 U.S.C. 1539) and the Marine Mammal Protection Act of 1972 (16 U.S.C. 1374) will be published in the **Federal Register** as required by the two laws.

4. Disclosures outside the Department of the Interior may be made without the consent of an individual under the routine uses listed below, if the disclosure is compatible with the purposes for which the record was collected. (Ref. 68 FR 52611, September 4, 2003)

   a. Routine disclosure to subject matter experts, and Federal, tribal, State, local, and foreign agencies, for the purpose of obtaining advice relevant to making a decision on an application for a permit or when necessary to accomplish a FWS function related to this system of records.
   b. Routine disclosure to the public as a result of publishing **Federal Register** notices announcing the receipt of permit applications for public comment or notice of the decision on a permit application.
   c. Routine disclosure to Federal, tribal, State, local, or foreign wildlife and plant agencies for the exchange of information on permits granted or denied to assure compliance with all applicable permitting requirements.
   d. Routine disclosure to Captive-bred Wildlife registrants under the Endangered Species Act for the exchange of authorized species, and to share information on the captive breeding of these species.
   e. Routine disclosure to Federal, tribal, State, and local authorities who need to know who is permitted to receive and rehabilitate sick, orphaned, and injured birds under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act; federally permitted rehabilitators; individuals seeking a permitted rehabilitator with whom to place a bird in need of care; and licensed veterinarians who receive, treat, or diagnose sick, orphaned, and injured birds.
   f. Routine disclosure to the Department of Justice, or a court, adjudicative, or other administrative body or to a party in litigation before a court or adjudicative or administrative body, under certain circumstances.
   g. Routine disclosure to the appropriate Federal, tribal, State, local, or foreign governmental agency responsible for investigating, prosecuting, enforcing, or implementing statutes, rules, or licenses, when we become aware of a violation or potential violation of such statutes, rules, or licenses, or when we need to monitor activities associated with a permit or regulated use.
   h. Routine disclosure to a congressional office in response to an inquiry to the office by the individual to whom the record pertains.
   i. Routine disclosure to the General Accounting Office or Congress when the information is required for the evaluation of the permit programs.
   j. Routine disclosure to provide addresses obtained from the Internal Revenue Service to debt collection agencies for purposes of locating a debtor to collect or compromise a Federal claim against the debtor or to consumer reporting agencies to prepare a commercial credit report for use by the FWS.

5. For individuals, personal information such as home address and telephone number, financial data, and personal identifiers (social security number, birth date, etc.) will be removed prior to any release of the application.

6. The public reporting burden on the applicant for information collection varies depending on the activity for which a permit is requested. The relevant burden for an **Incidental Take** permit application is **3 hours**. This burden estimate includes time for reviewing instructions, gathering and maintaining data and completing and reviewing the form. You may direct comments regarding the burden estimate or any other aspect of the form to the Service Information Clearance Officer, U.S. Fish and Wildlife Service, Mail Stop 222, Arlington Square, U.S. Department of the Interior, 1849 C Street, NW, Washington D.C. 20240.

Freedom of Information Act – Notice

For organizations, businesses, or individuals operating as a business (i.e., permittees not covered by the Privacy Act), we request that you identify any information that should be considered privileged and confidential business information to allow the Service to meet its responsibilities under FOIA. Confidential business information must be clearly marked "Business Confidential" at the top of the letter or page and each succeeding page and must be accompanied by a non-confidential summary of the confidential information. The non-confidential summary and remaining documents may be made available to the public under FOIA [43 CFR 2.13(c)(4), 43 CFR 2.15(d)(1)(i)].

Department of the Interior
U.S. Fish and Wildlife Service

Federal Fish and Wildlife Permit Application Form

Expires Nov 30, 2010
OMB No. 1018-0094

Return to: U.S. Fish and Wildlife Service (USFWS)

Type of Activity: Native Endangered and Threatened Species – **Incidental Take Permits Associated with a Habitat Conservation Plan (HCP)**

Complete Sections A or B, and C, D, and E of this application. U.S. address may be required in Section C, see instructions for details.
See attached instruction pages for information on how to make your application complete and help avoid unnecessary delays.

A. Complete if applying as an individual

1.a. Last name	1.b. First name	1.c Middle name or initial	1.d Suffix

2. Date of birth (mm/dd/yyyy)	3. Social Security No.	4. Occupation	5. Affiliation/ Doing business as (see instructions)

6.a Telephone number	6.b. Alternate telephone number	6.c. Fax number	6.d E-mail address

B. Complete if applying on behalf of a business, corporation, public agency or institution

1.a Name of business, agency, or institution	1.b Doing business as (dba)
Consolidated Citrus Limited Partnership	

2. Tax identification no.	3. Description of business, agency, or institution
52-2134024	Agricultural Operation - Citrus

4.a Principal officer Last name	4.b. Principal officer First name	4.c Principal officer Middle name/ initial	4.d. Suffix
Lucas	Charles	W	Mr.

5. Principal officer title	6. Primary contact
President	Mitch Hutchcraft

7.a. Business telephone number	7.b Alternate telephone number	7.c Business fax number	7.d. Business e-mail address
239-275-4060	239-405-1694	239-275-4973	mhutchcraft@cclpcitrus.com

C. All applicants complete address information

1.a Physical address (Street address: Apartment #, Suite #, or Room #; no P.O. Boxes)
4210 Metro Parkway, Suite 250

1.b City	1.c. State	1.d. Zip code/Postal code	1.e. County/Province	1.f. Country
Fort Myers	FL	33916	Lee	USA

2.a Mailing Address (include if different than physical address; include name of contact person if applicable)

2.b. City	2.c State	2.d Zip code/Postal code	2.e County/Province	2.f. Country

D. All applicants MUST complete

1. Attach check or money order payable to the U.S. FISH AND WILDLIFE SERVICE in **the amount indicated on page 2.** Federal, tribal, State, and local government agencies, and those acting on behalf of such agencies, are exempt from the processing fee – ***attach documentation of fee exempt status as outlined in instructions.*** (50 CFR 13.11(d))

2. Do you currently have or have you ever had any Federal Fish and Wildlife permits?
Yes ☐ If yes, list the number of the most current permit you have held or that you are applying to renew/re-issue _____
No ☒

3. Certification: I hereby certify that I have read and am familiar with the regulations contained in ***Title 50, Part 13 of the Code of Federal Regulations*** and the other ***applicable parts in subchapter B of Chapter I of Title 50***, and I certify that the information submitted in this application for a permit is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to the criminal penalties of 18 U.S.C. 1001.

Signature (in blue ink) of applicant/person responsible for permit (No photocopied or stamped signatures) — Date of signature (mm/dd/yyyy): 05-24-2010

Please continue to next page

** See page 14 for additional instructions on completing the above form. See page 15 for information on the Paperwork Reduction Act, Privacy Act, and Freedom of Information Act aspects of this application form.

Section E. **ALL APPLICANTS COMPLETE SECTION E.** Provide the information outlined in Section E. on the following pages. Be as complete and descriptive as possible. Please do not send pages that are over 8.5"X 11", videotapes, or DVDs.

INCIDENTAL TAKE PERMITS ASSOCIATED WITH A HABITAT CONSERVATION PLAN (HCP)

Have you obtained all required State, Federal or foreign government approval to conduct the activity you propose? Please be aware that there may be other requirements necessary to conduct this activity such as an import permit, collection permit, permission to work on Federal lands, Federal bird banding permit, Corps of Engineers permits, Environmental Protection Agency NPDES permits, State, county or local permits, etc.

☐ Yes. Provide a copy of the approval(s). List the State, Federal or foreign countries involved and type of document required. Include a copy of these documents with the application.

☐ I have applied. List the State, Federal or foreign countries involved and type of documents required. Provide the reasons why the permits have not been issued _____.

☒ Not required. ~~The proposed activity is not regulated.~~ Not required at this time. MSHCP precedes future activities.

Application Processing Fees
The application processing fee for a new Incidental Take permit, or to renew/re-issue an existing valid permit, is $100. If permit amendment is required at a time other than renewal/re-issuance, the processing fee is $50.

Check the appropriate box below and enclose check or money order payable to the *U.S. Fish and Wildlife Service* in the amount of

☒ $100 for a **new** permit

OR

☐ $100 to **renew/re-issue** my existing valid permit (with only *minor changes* such as updating my name and address) using my current application package on file.

OR

☐ $50 to make a **substantive amendment** (with *major changes*) to my existing valid permit [50 CFR 13.11(d)(2)].

If the information in your current application package on file has changed in a manner that triggers a major amendment or a change not otherwise specified in the permit, then you must apply for an amendment to your valid permit. For example, such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit. Please contact our Ecological Services Field Office located closest to your proposed activity for technical assistance in making this determination. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please check the **type of amendment** you are requesting --

☐ add species (specify) _____

☐ add a geographic area ☐ change in personnel

☐ other (specify) _____

If this application includes **transfer or succession** of a valid Incidental Take permit, please check the box below:

☐ Transfer or succession of a valid Incidental Take permit associated with a HCP using the current application package on file. No application fee is required.

Application Processing Time

To expedite a final decision on your application, you are urged to coordinate with us as soon as possible for guidance in assembling a complete application package. If you are renewing or amending a valid permit, your complete application package must be received at least 30 days prior to the expiration of the valid permit. This time period begins when we receive a complete permit application package and does not include any time required for requesting clarification or additional information about your application.

The time required to process an application for an Incidental Take permit will vary depending on the size, complexity, and impacts of the HCP involved. Procedurally, the most variable factor in application processing is the level of analysis required for the proposed HCP under the National Environmental Policy Act (e.g., whether an application requires preparation of an Environmental Impact Statement, Environmental Assessment, or whether a categorical exclusion applies), although other factors such as public controversy can also affect application processing times. The target processing timeline from when we receive a complete application package to our final decision on a permit application is: up to 3 months for low-effect HCPs, 4 to 6 months for HCPs with an Environmental Assessment, and up to 12 months for HCPs with a 90-day comment period and/or an Environmental Impact Statement. Although not mandated by law or regulation, these targets are adopted as U.S. Fish & Wildlife Service and National Marine Fisheries Service (NMFS/NOAA Fisheries) policy and all offices are expected to streamline their Incidental Take permit programs, and to meet these targets to the maximum extent practicable.

The information provided in your permit application will be used to evaluate your application for compliance with the Endangered Species Act, its implementing regulations (which may require a 30 day public comment period), and with U.S. Fish and Wildlife Service policy. Receipt and possession of a permit under the Endangered Species Act should be regarded as a privilege, as we must balance permit issuance with our duties to protect and recover listed species.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal, re-issuance or amendment.

If your activities may affect species under the authority of the National Marine Fisheries Service (NMFS/NOAA Fisheries), then you may need to obtain a separate permit from that agency. In addition we share jurisdiction with NMFS/NOAA Fisheries for sea turtles (e.g., we evaluate applications for permits to conduct activities impacting sea turtles on land, and NMFS/NOAA Fisheries evaluates applications for permits to conduct activities impacting sea turtles in the marine environment). To apply for a permit to conduct activities with sea turtles in the marine environment or other species under NMFS/NOAA Fisheries jurisdiction, please contact them via their permit web page at http://www.nmfs.noaa.gov/pr/permits/

We cannot issue an Incidental Take permit under Section 10(a)(2)(A)(i) of the Endangered Species Act unless you submit a conservation plan that specifies the impacts that are likely to result from the incidental take associated with your activity.

Our general permit regulations at 50 CFR 13.12(a)(9) allow us to collect such other information as we determine that is relevant to the processing of a permit application. Before you submit an application for an Incidental Take permit, we may require that you conduct biological surveys to determine which species and/or habitat would be impacted by the activities sought to be covered under the permit. Biological surveys provide information necessary to develop an adequate HCP, and to assess the biological impacts of the proposed activities. In addition, the information provided in a biological survey can reduce the applicant's risk of take under Section 9 of the Endangered Species Act by ensuring that affected species and/or habitat are identified and appropriately covered under the permit.

You are required to obtain a Scientific Purposes, Enhancement of Propagation or Survival permit (commonly called a Recovery permit) from us before engaging in any biological survey activities that would take listed species. Contact our Ecological Services Field Office closest to the location of your activity to obtain technical assistance in determining the need for both a biological survey and a Recovery permit for your survey activity. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

If a biological survey is required, you will need to send us your complete Recovery permit application package at least 3 months prior to commencement of survey activities to facilitate processing of your Recovery permit application. The Recovery permit application is designated as U.S. Fish & Wildlife Service form # 3-200-55 and can be found on our Endangered Species permit web page at http://www.fws.gov/forms/3-200-55.pdf.

We maintain a list of Recovery permittees (such as biological consultants) who have authorized the release of their contact information to third parties for conducting biological surveys on a contract basis. This list is provided to the public at the discretion of each U.S.

Fish and Wildlife Service Regional Office as time and workload allow. Please be aware that this list does not represent an endorsement by us of any particular permittee.

****

If you are not applying as an individual but as a business, corporation, institution, or non-Federal public agency (block B. on page 1 of the application), the person to whom the permit will be issued (e.g., the landowner, president, director, executive director, or executive officer) is legally responsible for implementing the permit. Although other people under the direct control of the permittee (e.g., employees, contractors, consultants) receive third party take authorization in their capacity as designees of the permittee, the individual named as the permittee ultimately is legally responsible for the permit and any activities carried out under the permit except as otherwise limited in the case of permits issued to State or local government entities under 50 CFR 13.25(c).

****

If you wish to coordinate the processing of this permit application through an **authorized agent**, and to have that agent represent you as the primary contact with us, check the box below. Sign **(in blue ink)** and date the authorization statement, and provide contact information for your authorized agent.

☐ I hereby authorize the following person to act as an authorized agent on my behalf in the processing of this permit application and to furnish, upon request, supplemental information in support of this permit application.

signature (in blue ink) 6.1.10 date

Matthew Hitchcraft
please print name legibly

Your Authorized Agent's Contact Information (please print legibly)

Name: Tom Jones

Address: 2600 Golden Gate Pkwy.

City: Naples State: FL Zip Code: 34105

Telephone: 239-262-2600

Fax: 239-261-1797

E-Mail: Tjones@barroncollier.com

INCIDENTAL TAKE PERMIT APPLICATION INSTRUCTIONS

You have 4 options for providing the required information for an Incidental Take permit application. Choose only one option.

Incidental Take Permit Application: Option I. Renewal of a Valid Incidental Take Permit.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal.

Sign the following statement if you are applying to renew an existing valid Incidental Take permit. If you are proposing major changes to your Incidental Take permit, you must use Option II.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct and hereby request renewal of that permit.
>
> _____ _____
> signature (in blue ink) date
>
> _____
> please print name legibly
>
> * Please note: If you have signed the above statement, then your renewal request is complete. Please submit completed pages 1 through 5 of this application to our Regional Office (see attached list) covering the location of your proposed activity. Requests for renewals must be received no later than 30 days prior to permit expiration to ensure that your current permit remains in effect while we process your renewal request.

Incidental Take Permit Application: Option II. Amended Incidental Take Permit (with *major changes*)

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for amendment.

Sign the following statement if you are proposing to amend a valid Incidental Take permit by making major changes. Such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct, except for the changes listed below, and hereby request amendment of that permit.

_____ _____

signature (in blue ink) date

_____

please print name legibly

Provide a brief description of the changes to your valid permit (answer the appropriate questions for these changes under Incidental Take Permit Application Option III. below). Please submit completed pages 1 through 6 of this application form (along with the changed information relative to Option III. below) to our Regional Office (see attached list) covering the location of your proposed activity.

Incidental Take Permit Application: Option III. New Incidental Take Permit & Supplementary Information for Amendment of a Valid Permit (with *major changes*).

General permit regulations for the U.S. Fish & Wildlife Service can be found at 50 CFR 13. Regulations for an Incidental Take permit under the Endangered Species Act can be found at 50 CFR 17.22(b)(1) for endangered wildlife species and 50 CFR 17.32(b)(1) for threatened wildlife species.

Each landowner who wishes to be covered under a new or amended Incidental Take permit associated with an HCP must sign (in blue ink) and date the Incidental Take Permit Application Certification Notice at the end of this application, unless the landowner will be covered under this U.S. Fish & Wildlife Service Incidental Take permit via another vehicle, such as a certificate of inclusion (50 CFR 13.25(d)). Any change in the language of the Certification Notice must be reviewed by the Department of Interior, Office of the Solicitor and approved by the U.S. Fish & Wildlife Service. The same person who signs in box D. on page 1 of the application should sign the certification.

If the information in items A. - D. below is already provided in your final HCP (or Implementing Agreement, if applicable), then you do not have to provide it here. Instead, check the box below and use the spaces provided in items A. - D. to indicate the page numbers in your HCP or Implementing Agreement that provide the requested information.

☒ I am not providing the following information for items A. - D. as part of my Incidental Take permit application, because it is already provided in my final HCP or Implementing Agreement (copy attached or already submitted).

If the requested information in items A. - D. is not provided in your final HCP or final Implementing Agreement, or you are using Option II. to amend your existing valid Incidental Take permit, then attach separate pages for the missing information. In order to assist us in processing your request, please provide the item number (A. 1.a., etc.) of the required information before each of your responses. Thank you.

Please ensure that your final HCP and Implementing Agreement (if applicable) are attached if it has not been previously submitted.

If you have previously submitted a final draft HCP or Implementing Agreement, please indicate the document's date.

Date of final draft HCP TBD (MSHCP summary attached.)

Date of final draft Implementing Agreement TBD

Applications for an Incidental Take permit associated with an HCP must provide the following specific information (relevant to the activity) under items A.- D. below in addition to the general information on page 1 of this application.

A. Identify species and activity:

1. For a new Incidental Take permit:

   a. Provide the common and scientific names of the species being requested for coverage in the permit and their status (endangered (E), threatened (T), proposed endangered (PE), proposed threatened (PT), candidate for listing (C), or species likely to become a candidate (LC)).

   b. Provide the number, age, and sex of such species to the extent known

   c. Quantify the anticipated effects to their habitat.

   d. Describe the land use or water management activity sought to be authorized for each species.

2. For an amended Incidental Take permit:

   a. Identify the species to be added to your valid permit (provide both the scientific, to the most specific taxonomic level, and common names), as well as the species status (see 1.a.. above).

   b. Provide the number, age and sex of such species to the extent known.

   c. If any activities requested in this application differ from those authorized in your valid permit, then for each

species state the currently authorized activity, the requested new activity, and how the new activity will impact each species.

d. Identify each activity associated with your project that would result in the incidental take of each species.

e. Quantify any anticipated effects to the habitat of each added species.

f. Identify species to be deleted from your valid permit and the reason(s) for the deletion.

Page(s) & source document : _____

B. Identify location of the proposed activity:

1. Provide the name of the State, county, and specific location of the proposed activity site(s). Include a formal legal description, section/township/range information, county tax parcel number, local address, or any other identifying property designation that will precisely place the location of the proposed activity site(s). Attach a location map and plat of the project site clearly depicting the project boundaries and the footprint and location of all portions of the property that would be affected by your proposed activities.

2. Provide the total number of acres covered by the HCP 177,000+/-

   Is this the total acreage of the parcel? (circle one) (yes) no

3. Provide the approximate number of acres to be impacted 45,000

4. Provide the approximate number of acres to be protected 132,000

5. Provide a complete description, including timeframes, for implementation of proposed voluntary management activities to enhance, restore, or maintain habitat benefiting federally listed, proposed or candidate species, or other species likely to become candidates. Include schedules for implementing these activities.

Page(s) & source document: See attached MSHCP summary.

C. Describe the proposed activities in the conservation plan:
You must submit a Habitat Conservation Plan. We strongly encourage you to ensure that your HCP is consistent with the Habitat Conservation Planning Handbook, subsequent Handbook addendums, and current policies to minimize delays in evaluating your application. The Handbook and other HCP information is available on the U.S. Fish & Wildlife Service's Endangered Species web page at http://www.fws.gov/endangered/hcp/index.html

Provide a complete description of activity(ies) to be authorized or reference the applicable HCP or Implementing Agreement page numbers identifying the subject information.

The HCP must specify:

1. The impact that will likely result from the incidental taking. A discussion of the impact that will likely result from the incidental take should include quantification of any anticipated effects to the habitat of the species sought to be covered by the permit.

2. The steps that will be taken to minimize and mitigate such impacts, the funding that will be available to implement such steps, and the procedures to deal with unforeseen circumstances.

3. The steps that will be taken to monitor and report on such impacts, including a copy of the monitoring plan. We are authorized to require reports of activities conducted under a permit per the U.S. Fish & Wildlife Service's general permit regulations at 50 CFR 13.45.

4. Alternative actions to such incidental taking that have been considered and the reasons why these alternatives are not proposed for use.

5. The biological goals(s) and objectives for the HCP.

6. The duration requested for the proposed permit.

Page(s) & source document : See attached HCP summary.

D. Implementing Agreement

An Implementing Agreement

is *is not* (FWS *Regional Office* to circle one)

required as part of the permit application for a Habitat Conservation Plan.

This Implementing Agreement must be signed at finalization of the HCP. Are you willing to commit to an Implementing Agreement at finalization of the HCP?

☒ Yes, I am willing to commit to an Implementing Agreement. Please submit any unsigned, draft Implementing Agreement that you have prepared with our Field Office.

☐ No, I am not willing to commit to an Implementing Agreement.

Incidental Take Permit Application

Certification Notice

The same person who signs in box D. on page 1 of the application should sign (in blue ink) the following certification.

By submitting this application and receiving an Incidental Take permit pursuant to Section 10(a)(1)(B) of the Endangered Species Act, I

Mitch Hutchcraft (print name(s)) attest that I/we own the lands indicated in this application, or have sufficient authority or rights over these lands to implement the measures of the Habitat Conservation Plan (and Implementing Agreement if applicable) covered by the Incidental Take permit. Further, upon receipt of the Incidental Take permit, I/we agree to conduct the activities as specified in the Habitat Conservation Plan (and Implementing Agreement if applicable) according to the terms and conditions of the Incidental Take permit and its supporting documents.

signature (in blue ink) 5-25-2010 date

Mitchel A. Hutchcraft
please print name legibly

signature (in blue ink) date

please print name legibly

****

The public reporting burden for completing this application for an Incidental Take permit is estimated to be 3 hours, including time for reviewing instructions, gathering and maintaining application data, and completing and reviewing the forms. Comments regarding the burden estimate or any other aspect of the reporting requirement(s) should be directed to the U.S. Fish & Wildlife Service Information Collection Clearance Officer, MS 222 ARLSQ, U.S. Fish and Wildlife Service, Washington, DC 20240.

An agency may not conduct and a person is not required to respond to a collection of information unless a currently valid OMB control number is displayed.

****

Incidental Take Permit Application: Option IV. Permit Transfer or Succession of a Permit

Complete the following if you are applying for transfer of a valid Incidental Take permit to you or obtaining rights of succession of a valid Incidental Take permit. In addition, you and the current permit holder may also need to sign an Assumption Agreement. Please contact our Ecological Services Field Office nearest your activity to determine whether you and the current permit holder need to execute an Assumption Agreement. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please indicate the name of the HCP to be transferred or succeeded and indicate the document's date.

Name of HCP _____

Date of HCP _____

An Assumption Agreement

is ***is not*** (FWS Ecological Services *Field Office* to circle one)

required as part of the transfer or succession permit application for the HCP.

USFWS Regional Contacts for Native Endangered & Threatened Species Permits

Pacific Region (Region 1): HI, ID, OR, WA, American Samoa, Commonwealth of the Northern Mariana Islands, Guam, and the Pacific Trust Territories

U.S. Fish and Wildlife Service
Endangered Species Permit Office
911 NE 11th Avenue
Portland, Oregon 97232-4181

Web: http://www.fws.gov/pacific/ecoservices/endangered/index.html
Phone: (503) 231-2071
email: permitsR1ES@fws.gov
Fax: (503) 231-6243

California & Nevada Region (Region 8): CA and NV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
2800 Cottage Way, Suite W-2606
Sacramento, California 95825 -1846

Web: http://www.fws.gov/cno/es/recovery.html
Phone: (916) 414-6464
email: permitsCNES@fws.gov
Fax: (916) 414-6486

Southwest Region (Region 2): AZ, NM, OK, and TX

U.S. Fish and Wildlife Service
Endangered Species Permit Office
500 Gold Avenue S.W. (street address)
P.O. Box 1306 (mailing address)
Albuquerque, New Mexico 87103-1306

Web: http://www.fws.gov/southwest/es/EndangeredSpecies/
Phone: (505) 248-6633
email: permitsR2ES@fws.gov
Fax: (505) 248-6788

Midwest Region (Region 3): IA, IL, IN, MI, MN, MO, OH, and WI

U.S. Fish and Wildlife Service
Endangered Species Permit Office
B.H. Whipple Federal Building
One Federal Drive
Fort Snelling, Minnesota 55111-4056

Web: http://www.fws.gov/midwest/Endangered/
Phone: (612) 713-5343
email: permitsR3ES@fws.gov
Fax: (612) 713-5292

Southeast Region (Region 4): AL, AR, FL, GA, KY, LA, MS, NC, PR, SC, TN, and U.S. Virgin Islands

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1875 Century Blvd., Suite 200
Atlanta, Georgia 30345

Web: http://www.fws.gov/southeast/es/#
Phone: (404) 679-7313
email: permitsR4ES@fws.gov
Fax: (404) 679-7081

Northeast Region (Region 5): CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, and WV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
300 Westgate Center Drive
Hadley, MA 01035-9589

Web: http://www.fws.gov/northeast/endangered/
Phone: (413) 253-8615
email: permitsR5ES@fws.gov
Fax: (413) 253-8482

Mountain-Prairie Region (Region 6): CO, KS, MT, NE, ND, SD, UT, and WY

U.S. Fish and Wildlife Service
Endangered Species Permit Office
Denver Federal Center
P.O. Box 25486
Denver, Colorado 80225-0489

Web: http://www.fws.gov/mountain%2Dprairie/endspp/
Phone: (303) 236-7400
email: permitsR6ES@fws.gov
Fax: (303) 236-0027

Alaska Region (Region 7): AK

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1011 E. Tudor Road
Anchorage, Alaska 99503-6199

Web: http://alaska.fws.gov/fisheries/endangered/index.htm
Phone: (907) 786-3323
email: permitsR7ES@fws.gov
Fax: (907) 786-3350

PERMIT APPLICATION FORM INSTRUCTIONS

The following instructions pertain to the standard permit form 3-200 that must be completed as an application for a U.S. Fish and Wildlife Service or CITES permit. The General Permit Procedures in 50 CFR 13 address the permitting process. For simplicity, all licenses, permits, registrations, and certificates will be referred to as a permit.

GENERAL INSTRUCTIONS:

- Complete all blocks/lines/questions in Sections A or B, and C and D. Complete all of Section E.
- **An incomplete application may cause delays in processing or may be returned to the applicant. Be sure you are filling in the appropriate application form for the proposed activity.**
- Print clearly or type in the information. Illegible applications may cause delays.
- Sign the application in blue ink. Faxes or copies of the original signature will not be accepted.
- Mail the original application to the address at the top of page one of the application or if applicable on the attached address list.
- **Keep a copy of your completed application.**
- **Please plan ahead. Allow at least 60 days for your application to be processed. Some applications may take longer than 90 days to process. (50 CFR 13.11)**
- Applications are processed in the order they are received.
- Additional forms and instructions are available from http://permits.fws.gov/ .

COMPLETE EITHER SECTION A OR SECTION B:

Section A. **Complete if applying as an individual:**

- Enter the complete name of the responsible individual who will be the permittee if a permit is issued. Enter personal information that identifies the applicant. ***Fax and e-mail are not required if not available.***
- If you are applying on behalf of a client, the personal information must pertain to the client, and a document evidencing power of attorney must be included with the application.
- **Affiliation/ Doing business as (dba):** business, agency, organizational, or institutional affiliation *directly* related to the activity requested in the application (e.g., a taxidermist is an individual whose business can *directly* relate to the requested activity). The Division of Management Authority (DMA) will **not** accept *doing business as* affiliations for individuals.

Section B. **Complete if applying as a business, corporation, public agency, or institution:**

- Enter the complete name of the business, agency or institution that will be the permittee if a permit is issued. Give a brief description of the type of business the applicant is engaged in. Provide contact phone number(s) of the business.
- **Principal Officer** is the person in charge of the listed business, corporation, public agency, or institution. The principal officer is the person responsible for the application and any permitted activities. Often the principal officer is a Director or President. **Primary Contact** is the person at the business, corporation, public agency, or institution who will be available to answer questions about the application or permitted activities. Often this is the preparer of the application.

ALL APPLICANTS COMPLETE SECTION C:

- For all applications submitted to the Division of Management Authority (DMA) a physical U.S. address is **required**. Province and Country blocks are provided for those USFWS programs which use foreign addresses and are not required by DMA..
- **Mailing address** is address where communications from USFWS should be mailed if different than applicant's physical address.

ALL APPLICANTS COMPLETE SECTION D:

Section D.1 **Application processing fee:**

- An application processing fee is required at the time of application; unless exempted under 50 CFR13.11(d)(3). The application processing fee is assessed to partially cover the cost of processing a request. **The fee does not guarantee the issuance of a permit. Fees will not be refunded for applications that are approved, abandoned, or denied.** We may return fees for withdrawn applications prior to any significant processing occurring.
- **Documentation of fee exempt status is not required for Federal, tribal, State, or local government agencies; but must be supplied by those applicants acting on behalf of such agencies.** Those applicants acting on behalf of such agencies must submit a letter on agency letterhead and signed by the head of the unit of government for which the applicant is acting on behalf, confirming that the applicant will be carrying out the permitted activity for the agency.

Section D.2 **Federal Fish and Wildlife permits:**

- List the number(s) of your most current FWS or CITES permit or the number of the most recent permit if none are currently valid. If applying for re-issuance of a CITES permit, the original permit must be returned with this application.

Section D.3 **CERTIFICATION:**

- **The individual identified in Section A, the principal officer named in Section B, or person with a valid power of attorney (documentation must be included in the application) must sign and date the application in blue ink.** This signature binds the applicant to the statement of certification. This means that you certify that you have read and understand the regulations that apply to the permit. You also certify that everything included in the application is true to the best of your knowledge. Be sure to read the statement and re-read the application and your answers before signing.

Please continue to next page

APPLICATION FOR A FEDERAL FISH AND WILDLIFE PERMIT

Paperwork Reduction Act, Privacy Act, and Freedom of Information Act – Notices

In accordance with the Paperwork Reduction Act of 1995 (44 U.S.C. 3501, *et seq.*) and the Privacy Act of 1974 (5 U.S.C. 552a), please be advised:

1. The gathering of information on fish and wildlife is authorized by:
   (Authorizing statutes can be found at: http://www.gpoaccess.gov/cfr/index.html and http://www.fws.gov/permits/ltr/ltr.shtml.)

   a. Bald and Golden Eagle Protection Act (16 U.S.C. 668), 50 CFR 22;
   b. Endangered Species Act of 1973 (16 U.S.C. 1531-1544), 50CFR 17;
   c. Migratory Bird Treaty Act (16 U.S.C. 703-712), 50 CFR 21;
   d. Marine Mammal Protection Act of 1972 (16 U.S.C. 1361, *et. seq.*), 50 CFR 18;
   e. Wild Bird Conservation Act (16 U.S.C. 4901-4916), 50 CFR 15;
   f. Lacey Act: Injurious Wildlife (18 U.S.C. 42), 50 CFR 16;
   g. Convention on International Trade in Endangered Species of Wild Fauna and Flora (TIAS 8249), http://www.cites.org/ , 50 CFR 23;
   h. General Provisions, 50 CFR 10;
   i. General Permit Procedures, 50 CFR 13; and
   j. Wildlife Provisions (Import/export/transport), 50 CFR 14.

2. Information requested in this form is purely voluntary. However, submission of requested information is required in order to process applications for permits authorized under the above laws. Failure to provide all requested information may be sufficient cause for the U.S. Fish and Wildlife Service to deny the request. Response is not required unless a currently valid Office of Management and Budget (OMB) control number is displayed on form.

3. Certain applications for permits authorized under the Endangered Species Act of 1973 (16 U.S.C. 1539) and the Marine Mammal Protection Act of 1972 (16 U.S.C. 1374) will be published in the **Federal Register** as required by the two laws.

4. Disclosures outside the Department of the Interior may be made without the consent of an individual under the routine uses listed below, if the disclosure is compatible with the purposes for which the record was collected. (Ref. 68 FR 52611, September 4, 2003)

   a. Routine disclosure to subject matter experts, and Federal, tribal, State, local, and foreign agencies, for the purpose of obtaining advice relevant to making a decision on an application for a permit or when necessary to accomplish a FWS function related to this system of records.
   b. Routine disclosure to the public as a result of publishing **Federal Register** notices announcing the receipt of permit applications for public comment or notice of the decision on a permit application.
   c. Routine disclosure to Federal, tribal, State, local, or foreign wildlife and plant agencies for the exchange of information on permits granted or denied to assure compliance with all applicable permitting requirements.
   d. Routine disclosure to Captive-bred Wildlife registrants under the Endangered Species Act for the exchange of authorized species, and to share information on the captive breeding of these species.
   e. Routine disclosure to Federal, tribal, State, and local authorities who need to know who is permitted to receive and rehabilitate sick, orphaned, and injured birds under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act; federally permitted rehabilitators; individuals seeking a permitted rehabilitator with whom to place a bird in need of care; and licensed veterinarians who receive, treat, or diagnose sick, orphaned, and injured birds.
   f. Routine disclosure to the Department of Justice, or a court, adjudicative, or other administrative body or to a party in litigation before a court or adjudicative or administrative body, under certain circumstances.
   g. Routine disclosure to the appropriate Federal, tribal, State, local, or foreign governmental agency responsible for investigating, prosecuting, enforcing, or implementing statutes, rules, or licenses, when we become aware of a violation or potential violation of such statutes, rules, or licenses, or when we need to monitor activities associated with a permit or regulated use.
   h. Routine disclosure to a congressional office in response to an inquiry to the office by the individual to whom the record pertains.
   i. Routine disclosure to the General Accounting Office or Congress when the information is required for the evaluation of the permit programs.
   j. Routine disclosure to provide addresses obtained from the Internal Revenue Service to debt collection agencies for purposes of locating a debtor to collect or compromise a Federal claim against the debtor or to consumer reporting agencies to prepare a commercial credit report for use by the FWS.

5. For individuals, personal information such as home address and telephone number, financial data, and personal identifiers (social security number, birth date, etc.) will be removed prior to any release of the application.

6. The public reporting burden on the applicant for information collection varies depending on the activity for which a permit is requested. The relevant burden for an **Incidental Take** permit application is **3 hours**. This burden estimate includes time for reviewing instructions, gathering and maintaining data and completing and reviewing the form. You may direct comments regarding the burden estimate or any other aspect of the form to the Service Information Clearance Officer, U.S. Fish and Wildlife Service, Mail Stop 222, Arlington Square, U.S. Department of the Interior, 1849 C Street, NW, Washington D.C. 20240.

Freedom of Information Act – Notice

For organizations, businesses, or individuals operating as a business (i.e., permittees not covered by the Privacy Act), we request that you identify any information that should be considered privileged and confidential business information to allow the Service to meet its responsibilities under FOIA. Confidential business information must be clearly marked "Business Confidential" at the top of the letter or page and each succeeding page and must be accompanied by a non-confidential summary of the confidential information. The non-confidential summary and remaining documents may be made available to the public under FOIA [43 CFR 2.13(c)(4), 43 CFR 2.15(d)(1)(i)].

Department of the Interior
U.S. Fish and Wildlife Service
Federal Fish and Wildlife Permit Application Form

Expires Nov. 30, 2010
OMB No. 1018-0094

Return to: U.S. Fish and Wildlife Service (USFWS)

Type of Activity: **Native Endangered and Threatened Species – Incidental Take Permits Associated with a Habitat Conservation Plan (HCP)**

Complete Sections A or B, and C, D, and E of this application. U.S. address may be required in Section C, see instructions for details.
See attached instruction pages for information on how to make your application complete and help avoid unnecessary delays.

A.	**Complete if applying as an individual**		
1.a. Last name	1.b. First name	1.c. Middle name or initial	1.d. Suffix
2. Date of birth (mm/dd/yyyy)	3. Social Security No.	4. Occupation	5. Affiliation/ Doing business as (see instructions)
6.a. Telephone number	6.b. Alternate telephone number	6.c. Fax number	6.d. E-mail address

B.	**Complete if applying on behalf of a business, corporation, public agency or institution**		
1.a. Name of business, agency, or institution		1.b. Doing business as (dba)	
ENGLISH BROS PARTNERSHIP			
2. Tax identification no.	3. Description of business, agency, or institution		
59-2320884	AGRICULTURE (CITRUS)		
4.a. Principal officer Last name	4.b. Principal officer First name	4.c. Principal officer Middle name/ initial	4.d. Suffix
ENGLISH	JOSEPH	C	
5. Principal officer title		6. Primary contact	
PARTNER		JOSEPH C ENGLISH	
7.a. Business telephone number	7.b. Alternate telephone number	7.c. Business fax number	7.d. Business e-mail address
239-334-9191		239-470-3734	JENGLISH@WWRECPA.COM

C.	**All applicants complete address information**			
1.a. Physical address (Street address; Apartment #, Suite #, or Room #; no P.O. Boxes)				
921 GLENN AVE				
1.b. City	1.c. State	1.d. Zip code/Postal code:	1.e. County/Province	1.f. Country
LEHIGH ACRES	FL	33972	LEE, FL	USA
2.a. Mailing Address (include if different than physical address; include name of contact person if applicable)				
921 GLENN AVE				
2.b. City	2.c. State	2.d. Zip code/Postal code:	2.e. County/Province	2.f. Country
LEHIGH ACRES	FL	33972	LEE, FL	USA

D.	**All applicants MUST complete**
1.	Attach check or money order payable to the U.S. FISH AND WILDLIFE SERVICE **in the amount indicated on page 2.** Federal, tribal, State, and local government agencies, and those acting on behalf of such agencies, are exempt from the processing fee – ***attach documentation of fee exempt status as outlined in instructions.*** (50 CFR 13.11(d))
2.	Do you currently have or have you ever had any Federal Fish and Wildlife permits? Yes ☐ If yes, list the number of the most current permit you have held or that you are applying to renew/re-issue: _____ No ☒
3.	Certification: I hereby certify that I have read and am familiar with the regulations contained in ***Title 50, Part 13 of the Code of Federal Regulations*** and the other ***applicable parts in subchapter B of Chapter I of Title 50***, and I certify that the information submitted in this application for a permit is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to the criminal penalties of 18 U.S.C. 1001. Joseph C English — 6-2-10 Signature (in blue ink) of applicant/person responsible for permit (No photocopied or stamped signatures) — Date of signature (mm/dd/yyyy)

Please continue to next page

** See page 14 for additional instructions on completing the above form. See page 15 for information on the Paperwork Reduction Act, Privacy Act, and Freedom of Information Act aspects of this application form.

Section E. **ALL APPLICANTS COMPLETE SECTION E.** Provide the information outlined in Section E. on the following pages. Be as complete and descriptive as possible. Please do not send pages that are over 8.5"X 11", videotapes, or DVDs.

INCIDENTAL TAKE PERMITS ASSOCIATED WITH A HABITAT CONSERVATION PLAN (HCP)

Have you obtained all required State, Federal or foreign government approval to conduct the activity you propose? Please be aware that there may be other requirements necessary to conduct this activity such as an import permit, collection permit, permission to work on Federal lands, Federal bird banding permit, Corps of Engineers permits, Environmental Protection Agency NPDES permits, State, county or local permits, etc.

☐ Yes. Provide a copy of the approval(s). List the State, Federal or foreign countries involved and type of document required. Include a copy of these documents with the application.

☐ I have applied. List the State, Federal or foreign countries involved and type of documents required. Provide the reasons why the permits have not been issued _____.

☒ Not required. ~~The proposed activity is not regulated.~~ Not required at this time. MSHCP precedes future activities.

Application Processing Fees

The application processing fee for a new Incidental Take permit, or to renew/re-issue an existing valid permit, is $100. If permit amendment is required at a time other than renewal/re-issuance, the processing fee is $50.

Check the appropriate box below and enclose check or money order payable to the *U.S. Fish and Wildlife Service* in the amount of

☒ $100 for a **new** permit

OR

☐ $100 to **renew/re-issue** my existing valid permit (with only *minor changes* such as updating my name and address) using my current application package on file.

OR

☐ $50 to make a **substantive amendment** (with *major changes*) to my existing valid permit [50 CFR 13.11(d)(2)].

If the information in your current application package on file has changed in a manner that triggers a major amendment or a change not otherwise specified in the permit, then you must apply for an amendment to your valid permit. For example, such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit. Please contact our Ecological Services Field Office located closest to your proposed activity for technical assistance in making this determination. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please check the **type of amendment** you are requesting --

☐ add species (specify) _____

☐ add a geographic area ☐ change in personnel

☐ other (specify) _____

If this application includes **transfer or succession** of a valid Incidental Take permit, please check the box below:

☐ Transfer or succession of a valid Incidental Take permit associated with a HCP using the current application package on file. No application fee is required.

Application Processing Time

To expedite a final decision on your application, you are urged to coordinate with us as soon as possible for guidance in assembling a complete application package. If you are renewing or amending a valid permit, your complete application package must be received at least 30 days prior to the expiration of the valid permit. This time period begins when we receive a complete permit application package and does not include any time required for requesting clarification or additional information about your application.

The time required to process an application for an Incidental Take permit will vary depending on the size, complexity, and impacts of the HCP involved. Procedurally, the most variable factor in application processing is the level of analysis required for the proposed HCP under the National Environmental Policy Act (e.g., whether an application requires preparation of an Environmental Impact Statement, Environmental Assessment, or whether a categorical exclusion applies), although other factors such as public controversy can also affect application processing times. The target processing timeline from when we receive a complete application package to our final decision on a permit application is: up to 3 months for low-effect HCPs, 4 to 6 months for HCPs with an Environmental Assessment, and up to 12 months for HCPs with a 90-day comment period and/or an Environmental Impact Statement. Although not mandated by law or regulation, these targets are adopted as U.S. Fish & Wildlife Service and National Marine Fisheries Service (NMFS/NOAA Fisheries) policy and all offices are expected to streamline their Incidental Take permit programs, and to meet these targets to the maximum extent practicable.

The information provided in your permit application will be used to evaluate your application for compliance with the Endangered Species Act, its implementing regulations (which may require a 30 day public comment period), and with U.S. Fish and Wildlife Service policy. Receipt and possession of a permit under the Endangered Species Act should be regarded as a privilege, as we must balance permit issuance with our duties to protect and recover listed species.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal, re-issuance or amendment.

If your activities may affect species under the authority of the National Marine Fisheries Service (NMFS/NOAA Fisheries), then you may need to obtain a separate permit from that agency. In addition we share jurisdiction with NMFS/NOAA Fisheries for sea turtles (e.g., we evaluate applications for permits to conduct activities impacting sea turtles on land, and NMFS/NOAA Fisheries evaluates applications for permits to conduct activities impacting sea turtles in the marine environment). To apply for a permit to conduct activities with sea turtles in the marine environment or other species under NMFS/NOAA Fisheries jurisdiction, please contact them via their permit web page at http://www.nmfs.noaa.gov/pr/permits/

We cannot issue an Incidental Take permit under Section 10(a)(2)(A)(i) of the Endangered Species Act unless you submit a conservation plan that specifies the impacts that are likely to result from the incidental take associated with your activity.

Our general permit regulations at 50 CFR 13.12(a)(9) allow us to collect such other information as we determine that is relevant to the processing of a permit application. Before you submit an application for an Incidental Take permit, we may require that you conduct biological surveys to determine which species and/or habitat would be impacted by the activities sought to be covered under the permit. Biological surveys provide information necessary to develop an adequate HCP, and to assess the biological impacts of the proposed activities. In addition, the information provided in a biological survey can reduce the applicant's risk of take under Section 9 of the Endangered Species Act by ensuring that affected species and/or habitat are identified and appropriately covered under the permit.

You are required to obtain a Scientific Purposes, Enhancement of Propagation or Survival permit (commonly called a Recovery permit) from us before engaging in any biological survey activities that would take listed species. Contact our Ecological Services Field Office closest to the location of your activity to obtain technical assistance in determining the need for both a biological survey and a Recovery permit for your survey activity. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

If a biological survey is required, you will need to send us your complete Recovery permit application package at least 3 months prior to commencement of survey activities to facilitate processing of your Recovery permit application. The Recovery permit application is designated as U.S. Fish & Wildlife Service form # 3-200-55 and can be found on our Endangered Species permit web page at http://www.fws.gov/forms/3-200-55.pdf.

We maintain a list of Recovery permittees (such as biological consultants) who have authorized the release of their contact information to third parties for conducting biological surveys on a contract basis. This list is provided to the public at the discretion of each U.S.

Fish and Wildlife Service Regional Office as time and workload allow. Please be aware that this list does not represent an endorsement by us of any particular permittee.

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If you are not applying as an individual but as a business, corporation, institution, or non-Federal public agency (block B. on page 1 of the application), the person to whom the permit will be issued (e.g., the landowner, president, director, executive director, or executive officer) is legally responsible for implementing the permit. Although other people under the direct control of the permittee (e.g., employees, contractors, consultants) receive third party take authorization in their capacity as designees of the permittee, the individual named as the permittee ultimately is legally responsible for the permit and any activities carried out under the permit except as otherwise limited in the case of permits issued to State or local government entities under 50 CFR 13.25(e).

****

If you wish to coordinate the processing of this permit application through an **authorized agent**, and to have that agent represent you as the primary contact with us, check the box below. Sign (in blue ink) and date the authorization statement, and provide contact information for your authorized agent.

☐ I hereby authorize the following person to act as an authorized agent on my behalf in the processing of this permit application and to furnish, upon request, supplemental information in support of this permit application.

signature (in blue ink) 6-2-10 date

JOSEPH C ENGLISH
please print name legibly

Your Authorized Agent's Contact Information (please print legibly)

Name: Tom Jones

Address: 2600 Golden Gate Pkwy.

City: Naples State: FL Zip Code: 34105

Telephone: 239-262-2600

Fax: 239-261-1797

E-Mail: Tjones@barroncollier.com

INCIDENTAL TAKE PERMIT APPLICATION INSTRUCTIONS

You have 4 options for providing the required information for an Incidental Take permit application. Choose only one option.

Incidental Take Permit Application: Option I. Renewal of a Valid Incidental Take Permit.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal.

Sign the following statement if you are applying to renew an existing valid Incidental Take permit. If you are proposing major changes to your Incidental Take permit, you must use Option II.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct and hereby request renewal of that permit.
>
> _____ _____
> signature (in blue ink) date
>
> _____
> please print name legibly
>
> * Please note: If you have signed the above statement, then your renewal request is complete. Please submit completed pages 1 through 5 of this application to our Regional Office (see attached list) covering the location of your proposed activity. Requests for renewals must be received no later than 30 days prior to permit expiration to ensure that your current permit remains in effect while we process your renewal request.

Incidental Take Permit Application: Option II. Amended Incidental Take Permit (with *major changes*)

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for amendment.

Sign the following statement if you are proposing to amend a valid Incidental Take permit by making major changes. Such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct, except for the changes listed below, and hereby request amendment of that permit.

_____ _____

signature (in blue ink) date

_____

please print name legibly

Provide a brief description of the changes to your valid permit (answer the appropriate questions for these changes under Incidental Take Permit Application Option III. below). Please submit completed pages 1 through 6 of this application form (along with the changed information relative to Option III. below) to our Regional Office (see attached list) covering the location of your proposed activity.

Incidental Take Permit Application: Option III. New Incidental Take Permit & Supplementary Information for Amendment of a Valid Permit (with *major changes*).

General permit regulations for the U.S. Fish & Wildlife Service can be found at 50 CFR 13. Regulations for an Incidental Take permit under the Endangered Species Act can be found at 50 CFR 17.22(b)(1) for endangered wildlife species and 50 CFR 17.32(b)(1) for threatened wildlife species.

Each landowner who wishes to be covered under a new or amended Incidental Take permit associated with an HCP must sign (in blue ink) and date the Incidental Take Permit Application Certification Notice at the end of this application, unless the landowner will be covered under this U.S. Fish & Wildlife Service Incidental Take permit via another vehicle, such as a certificate of inclusion (50 CFR 13.25(d)). Any change in the language of the Certification Notice must be reviewed by the Department of Interior, Office of the Solicitor and approved by the U.S. Fish & Wildlife Service. The same person who signs in box D. on page 1 of the application should sign the certification.

If the information in items A. - D. below is already provided in your final HCP (or Implementing Agreement, if applicable), then you do not have to provide it here. Instead, check the box below and use the spaces provided in items A. - D. to indicate the page numbers in your HCP or Implementing Agreement that provide the requested information.

☒ I am not providing the following information for items A. - D. as part of my Incidental Take permit application, because it is already provided in my final HCP or Implementing Agreement (copy attached or already submitted).

If the requested information in items A. - D. is not provided in your final HCP or final Implementing Agreement, or you are using Option II. to amend your existing valid Incidental Take permit, then attach separate pages for the missing information. In order to assist us in processing your request, please provide the item number (A. 1.a., etc.) of the required information before each of your responses. Thank you.

Please ensure that your final HCP and Implementing Agreement (if applicable) are attached if it has not been previously submitted.

If you have previously submitted a final draft HCP or Implementing Agreement, please indicate the document's date.

Date of final draft HCP TBD (MSHCP summary attached.)

Date of final draft Implementing Agreement TBD

Applications for an Incidental Take permit associated with an HCP must provide the following specific information (relevant to the activity) under items A.- D. below in addition to the general information on page 1 of this application.

A. Identify species and activity:

1. For a new Incidental Take permit:

   a. Provide the common and scientific names of the species being requested for coverage in the permit and their status (endangered (E), threatened (T), proposed endangered (PE), proposed threatened (PT), candidate for listing (C), or species likely to become a candidate (LC)).

   b. Provide the number, age, and sex of such species to the extent known

   c. Quantify the anticipated effects to their habitat.

   d. Describe the land use or water management activity sought to be authorized for each species.

2. For an amended Incidental Take permit:

   a. Identify the species to be added to your valid permit (provide both the scientific, to the most specific taxonomic level, and common names), as well as the species status (see 1.a.. above).

   b. Provide the number, age and sex of such species to the extent known.

   c. If any activities requested in this application differ from those authorized in your valid permit, then for each

species state the currently authorized activity, the requested new activity, and how the new activity will impact each species.

d. Identify each activity associated with your project that would result in the incidental take of each species.

e. Quantify any anticipated effects to the habitat of each added species.

f. Identify species to be deleted from your valid permit and the reason(s) for the deletion.

Page(s) & source document : _____

B. Identify location of the proposed activity:

1. Provide the name of the State, county, and specific location of the proposed activity site(s). Include a formal legal description, section/township/range information, county tax parcel number, local address, or any other identifying property designation that will precisely place the location of the proposed activity site(s). Attach a location map and plat of the project site clearly depicting the project boundaries and the footprint and location of all portions of the property that would be affected by your proposed activities.

2. Provide the total number of acres covered by the HCP 177,000+/-

   Is this the total acreage of the parcel? (circle one) (yes) no

3. Provide the approximate number of acres to be impacted 45,000

4. Provide the approximate number of acres to be protected 132,000

5. Provide a complete description, including timeframes, for implementation of proposed voluntary management activities to enhance, restore, or maintain habitat benefiting federally listed, proposed or candidate species, or other species likely to become candidates. Include schedules for implementing these activities.

Page(s) & source document: See attached MSHCP summary.

C. Describe the proposed activities in the conservation plan:
You must submit a Habitat Conservation Plan. We strongly encourage you to ensure that your HCP is consistent with the Habitat Conservation Planning Handbook, subsequent Handbook addendums, and current policies to minimize delays in evaluating your application. The Handbook and other HCP information is available on the U.S. Fish & Wildlife Service's Endangered Species web page at http://www.fws.gov/endangered/hcp/index.html

Provide a complete description of activity(ies) to be authorized or reference the applicable HCP or Implementing Agreement page numbers identifying the subject information.

The HCP must specify:

1. The impact that will likely result from the incidental taking. A discussion of the impact that will likely result from the incidental take should include quantification of any anticipated effects to the habitat of the species sought to be covered by the permit.

2. The steps that will be taken to minimize and mitigate such impacts, the funding that will be available to implement such steps, and the procedures to deal with unforeseen circumstances.

3. The steps that will be taken to monitor and report on such impacts, including a copy of the monitoring plan. We are authorized to require reports of activities conducted under a permit per the U.S. Fish & Wildlife Service's general permit regulations at 50 CFR 13.45.

4. Alternative actions to such incidental taking that have been considered and the reasons why these alternatives are not proposed for use.

5. The biological goals(s) and objectives for the HCP.

6. The duration requested for the proposed permit.

Page(s) & source document : See attached HCP summary.

D. Implementing Agreement

An Implementing Agreement

is *is not* (FWS *Regional Office* to circle one)

required as part of the permit application for a Habitat Conservation Plan.

This Implementing Agreement must be signed at finalization of the HCP. Are you willing to commit to an Implementing Agreement at finalization of the HCP?

☒ Yes, I am willing to commit to an Implementing Agreement. Please submit any unsigned, draft Implementing Agreement that you have prepared with our Field Office.

☐ No, I am not willing to commit to an Implementing Agreement.

Incidental Take Permit Application: Option IV. Permit Transfer or Succession of a Permit

Complete the following if you are applying for transfer of a valid Incidental Take permit to you or obtaining rights of succession of a valid Incidental Take permit. In addition, you and the current permit holder may also need to sign an Assumption Agreement. Please contact our Ecological Services Field Office nearest your activity to determine whether you and the current permit holder need to execute an Assumption Agreement. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please indicate the name of the HCP to be transferred or succeeded and indicate the document's date.

Name of HCP _____

Date of HCP _____

An Assumption Agreement

is ***is not*** (FWS Ecological Services *Field Office* to circle one)

required as part of the transfer or succession permit application for the HCP.

Incidental Take Permit Application

Certification Notice

The same person who signs in box D. on page 1 of the application should sign (in blue ink) the following certification.

By submitting this application and receiving an Incidental Take permit pursuant to Section 10(a)(1)(B) of the Endangered Species Act, I

ENGLISH BROS PARTNERSHIP (print name(s)) attest that I/we own the lands indicated in this application, or have sufficient authority or rights over these lands to implement the measures of the Habitat Conservation Plan (and Implementing Agreement if applicable) covered by the Incidental Take permit. Further, upon receipt of the Incidental Take permit, I/we agree to conduct the activities as specified in the Habitat Conservation Plan (and Implementing Agreement if applicable) according to the terms and conditions of the Incidental Take permit and its supporting documents.

Joseph C English — signature (in blue ink)

6-2-10 — date

JOSEPH C ENGLISH
please print name legibly

_____ — signature (in blue ink)

_____ — date

_____
please print name legibly

****

The public reporting burden for completing this application for an Incidental Take permit is estimated to be 3 hours, including time for reviewing instructions, gathering and maintaining application data, and completing and reviewing the forms. Comments regarding the burden estimate or any other aspect of the reporting requirement(s) should be directed to the U.S. Fish & Wildlife Service Information Collection Clearance Officer, MS 222 ARLSQ, U.S. Fish and Wildlife Service, Washington, DC 20240.

An agency may not conduct and a person is not required to respond to a collection of information unless a currently valid OMB control number is displayed.

****

USFWS Regional Contacts for Native Endangered & Threatened Species Permits

Pacific Region (Region 1): HI, ID, OR, WA, American Samoa, Commonwealth of the Northern Mariana Islands, Guam, and the Pacific Trust Territories

U.S. Fish and Wildlife Service
Endangered Species Permit Office
911 NE 11th Avenue
Portland, Oregon 97232-4181

Web: http://www.fws.gov/pacific/ecoservices/endangered/index.html
Phone: (503) 231-2071
email: permitsR1ES@fws.gov
Fax: (503) 231-6243

California & Nevada Region (Region 8): CA and NV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
2800 Cottage Way, Suite W-2606
Sacramento, California 95825 -1846

Web: http://www.fws.gov/cno/es/recovery.html
Phone: (916) 414-6464
email: permitsCNES@fws.gov
Fax: (916) 414-6486

Southwest Region (Region 2): AZ, NM, OK, and TX

U.S. Fish and Wildlife Service
Endangered Species Permit Office
500 Gold Avenue S.W. (street address)
P.O. Box 1306 (mailing address)
Albuquerque, New Mexico 87103-1306

Web: http://www.fws.gov/southwest/es/EndangeredSpecies/
Phone: (505) 248-6633
email: permitsR2ES@fws.gov
Fax: (505) 248-6788

Midwest Region (Region 3): IA, IL, IN, MI, MN, MO, OH, and WI

U.S. Fish and Wildlife Service
Endangered Species Permit Office
B.H. Whipple Federal Building
One Federal Drive
Fort Snelling, Minnesota 55111-4056

Web: http://www.fws.gov/midwest/Endangered/
Phone: (612) 713-5343
email: permitsR3ES@fws.gov
Fax: (612) 713-5292

Southeast Region (Region 4): AL, AR, FL, GA, KY, LA, MS, NC, PR, SC, TN, and U.S. Virgin Islands

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1875 Century Blvd., Suite 200
Atlanta, Georgia 30345

Web: http://www.fws.gov/southeast/es/#
Phone: (404) 679-7313
email: permitsR4ES@fws.gov
Fax: (404) 679-7081

Northeast Region (Region 5): CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, and WV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
300 Westgate Center Drive
Hadley, MA 01035-9589

Web: http://www.fws.gov/northeast/endangered/
Phone: (413) 253-8615
email: permitsR5ES@fws.gov
Fax: (413) 253-8482

Mountain-Prairie Region (Region 6): CO, KS, MT, NE, ND, SD, UT, and WY

U.S. Fish and Wildlife Service
Endangered Species Permit Office
Denver Federal Center
P.O. Box 25486
Denver, Colorado 80225-0489

Web: http://www.fws.gov/mountain%2Dprairie/endspp/
Phone: (303) 236-7400
email: permitsR6ES@fws.gov
Fax: (303) 236-0027

Alaska Region (Region 7): AK

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1011 E. Tudor Road
Anchorage, Alaska 99503-6199

Web: http://alaska.fws.gov/fisheries/endangered/index.htm
Phone: (907) 786-3323
email: permitsR7ES@fws.gov
Fax: (907) 786-3350

PERMIT APPLICATION FORM INSTRUCTIONS

The following instructions pertain to the standard permit form 3-200 that must be completed as an application for a U.S. Fish and Wildlife Service or CITES permit. The General Permit Procedures in 50 CFR 13 address the permitting process. For simplicity, all licenses, permits, registrations, and certificates will be referred to as a permit.

GENERAL INSTRUCTIONS:

- Complete all blocks/lines/questions in Sections A or B, and C and D. Complete all of Section E.
- **An incomplete application may cause delays in processing or may be returned to the applicant. Be sure you are filling in the appropriate application form for the proposed activity.**
- Print clearly or type in the information. Illegible applications may cause delays.
- Sign the application in blue ink. Faxes or copies of the original signature will not be accepted.
- Mail the original application to the address at the top of page one of the application or if applicable on the attached address list.
- **Keep a copy of your completed application.**
- **Please plan ahead. Allow at least 60 days for your application to be processed. Some applications may take longer than 90 days to process. (50 CFR 13.11)**
- Applications are processed in the order they are received.
- Additional forms and instructions are available from http://permits.fws.gov/ .

COMPLETE EITHER SECTION A OR SECTION B:

Section A. **Complete if applying as an individual:**

- Enter the complete name of the responsible individual who will be the permittee if a permit is issued. Enter personal information that identifies the applicant. ***Fax and e-mail are not required if not available.***
- If you are applying on behalf of a client, the personal information must pertain to the client, and a document evidencing power of attorney must be included with the application.
- **Affiliation/ Doing business as (dba)**: business, agency, organizational, or institutional affiliation *directly* related to the activity requested in the application (e.g., a taxidermist is an individual whose business can *directly* relate to the requested activity). The Division of Management Authority (DMA) will **not** accept *doing business as* affiliations for individuals.

Section B. **Complete if applying as a business, corporation, public agency, or institution:**

- Enter the complete name of the business, agency or institution that will be the permittee if a permit is issued. Give a brief description of the type of business the applicant is engaged in. Provide contact phone number(s) of the business.
- **Principal Officer** is the person in charge of the listed business, corporation, public agency, or institution. The principal officer is the person responsible for the application and any permitted activities. Often the principal officer is a Director or President. **Primary Contact** is the person at the business, corporation, public agency, or institution who will be available to answer questions about the application or permitted activities. Often this is the preparer of the application.

ALL APPLICANTS COMPLETE SECTION C:

- For all applications submitted to the Division of Management Authority (DMA) a physical U.S. address is **required**. Province and Country blocks are provided for those USFWS programs which use foreign addresses and are not required by DMA..
- **Mailing address** is address where communications from USFWS should be mailed if different than applicant's physical address.

ALL APPLICANTS COMPLETE SECTION D:

Section D.1 **Application processing fee:**

- An application processing fee is required at the time of application; unless exempted under 50 CFR13.11(d)(3). The application processing fee is assessed to partially cover the cost of processing a request. **The fee does not guarantee the issuance of a permit. Fees will not be refunded for applications that are approved, abandoned, or denied.** We may return fees for withdrawn applications prior to any significant processing occurring.
- **Documentation of fee exempt status is not required for Federal, tribal, State, or local government agencies; but must be supplied by those applicants acting on behalf of such agencies.** Those applicants acting on behalf of such agencies must submit a letter on agency letterhead and signed by the head of the unit of government for which the applicant is acting on behalf, confirming that the applicant will be carrying out the permitted activity for the agency.

Section D.2 **Federal Fish and Wildlife permits:**

- List the number(s) of your most current FWS or CITES permit or the number of the most recent permit if none are currently valid. If applying for re-issuance of a CITES permit, the original permit must be returned with this application.

Section D.3 CERTIFICATION:

- **The individual identified in Section A, the principal officer named in Section B, or person with a valid power of attorney (documentation must be included in the application) must sign and date the application in blue ink.** This signature binds the applicant to the statement of certification. This means that you certify that you have read and understand the regulations that apply to the permit. You also certify that everything included in the application is true to the best of your knowledge. Be sure to read the statement and re-read the application and your answers before signing.

Please continue to next page

APPLICATION FOR A FEDERAL FISH AND WILDLIFE PERMIT

Paperwork Reduction Act, Privacy Act, and Freedom of Information Act – Notices

In accordance with the Paperwork Reduction Act of 1995 (44 U.S.C. 3501, *et seq.*) and the Privacy Act of 1974 (5 U.S.C. 552a), please be advised:

1. The gathering of information on fish and wildlife is authorized by:
   (Authorizing statutes can be found at: http://www.gpoaccess.gov/cfr/index.html and http://www.fws.gov/permits/ltr/ltr.shtml.)

   a. Bald and Golden Eagle Protection Act (16 U.S.C. 668), 50 CFR 22;
   b. Endangered Species Act of 1973 (16 U.S.C. 1531-1544), 50CFR 17;
   c. Migratory Bird Treaty Act (16 U.S.C. 703-712), 50 CFR 21;
   d. Marine Mammal Protection Act of 1972 (16 U.S.C. 1361, *et. seq.*), 50 CFR 18;
   e. Wild Bird Conservation Act (16 U.S.C. 4901-4916), 50 CFR 15;
   f. Lacey Act: Injurious Wildlife (18 U.S.C. 42), 50 CFR 16;
   g. Convention on International Trade in Endangered Species of Wild Fauna and Flora (TIAS 8249), http://www.cites.org/ , 50 CFR 23;
   h. General Provisions, 50 CFR 10;
   i. General Permit Procedures, 50 CFR 13; and
   j. Wildlife Provisions (Import/export/transport), 50 CFR 14.

2. Information requested in this form is purely voluntary. However, submission of requested information is required in order to process applications for permits authorized under the above laws. Failure to provide all requested information may be sufficient cause for the U.S. Fish and Wildlife Service to deny the request. Response is not required unless a currently valid Office of Management and Budget (OMB) control number is displayed on form.

3. Certain applications for permits authorized under the Endangered Species Act of 1973 (16 U.S.C. 1539) and the Marine Mammal Protection Act of 1972 (16 U.S.C. 1374) will be published in the **Federal Register** as required by the two laws.

4. Disclosures outside the Department of the Interior may be made without the consent of an individual under the routine uses listed below, if the disclosure is compatible with the purposes for which the record was collected. (Ref. 68 FR 52611, September 4, 2003)

   a. Routine disclosure to subject matter experts, and Federal, tribal, State, local, and foreign agencies, for the purpose of obtaining advice relevant to making a decision on an application for a permit or when necessary to accomplish a FWS function related to this system of records.
   b. Routine disclosure to the public as a result of publishing **Federal Register** notices announcing the receipt of permit applications for public comment or notice of the decision on a permit application.
   c. Routine disclosure to Federal, tribal, State, local, or foreign wildlife and plant agencies for the exchange of information on permits granted or denied to assure compliance with all applicable permitting requirements.
   d. Routine disclosure to Captive-bred Wildlife registrants under the Endangered Species Act for the exchange of authorized species, and to share information on the captive breeding of these species.
   e. Routine disclosure to Federal, tribal, State, and local authorities who need to know who is permitted to receive and rehabilitate sick, orphaned, and injured birds under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act; federally permitted rehabilitators; individuals seeking a permitted rehabilitator with whom to place a bird in need of care; and licensed veterinarians who receive, treat, or diagnose sick, orphaned, and injured birds.
   f. Routine disclosure to the Department of Justice, or a court, adjudicative, or other administrative body or to a party in litigation before a court or adjudicative or administrative body, under certain circumstances.
   g. Routine disclosure to the appropriate Federal, tribal, State, local, or foreign governmental agency responsible for investigating, prosecuting, enforcing, or implementing statutes, rules, or licenses, when we become aware of a violation or potential violation of such statutes, rules, or licenses, or when we need to monitor activities associated with a permit or regulated use.
   h. Routine disclosure to a congressional office in response to an inquiry to the office by the individual to whom the record pertains.
   i. Routine disclosure to the General Accounting Office or Congress when the information is required for the evaluation of the permit programs.
   j. Routine disclosure to provide addresses obtained from the Internal Revenue Service to debt collection agencies for purposes of locating a debtor to collect or compromise a Federal claim against the debtor or to consumer reporting agencies to prepare a commercial credit report for use by the FWS.

5. For individuals, personal information such as home address and telephone number, financial data, and personal identifiers (social security number, birth date, etc.) will be removed prior to any release of the application.

6. The public reporting burden on the applicant for information collection varies depending on the activity for which a permit is requested. The relevant burden for an **Incidental Take** permit application is **3 hours**. This burden estimate includes time for reviewing instructions, gathering and maintaining data and completing and reviewing the form. You may direct comments regarding the burden estimate or any other aspect of the form to the Service Information Clearance Officer, U.S. Fish and Wildlife Service, Mail Stop 222, Arlington Square, U.S. Department of the Interior, 1849 C Street, NW, Washington D.C. 20240.

Freedom of Information Act – Notice

For organizations, businesses, or individuals operating as a business (i.e., permittees not covered by the Privacy Act), we request that you identify any information that should be considered privileged and confidential business information to allow the Service to meet its responsibilities under FOIA. Confidential business information must be clearly marked "Business Confidential" at the top of the letter or page and each succeeding page and must be accompanied by a non-confidential summary of the confidential information. The non-confidential summary and remaining documents may be made available to the public under FOIA [43 CFR 2.13(c)(4), 43 CFR 2.15(d)(1)(i)].

Department of the Interior
U.S. Fish and Wildlife Service

Expires Nov. 30, 2010
OMB No. 1018-0094

Federal Fish and Wildlife Permit Application Form

Return to: U.S. Fish and Wildlife Service (USFWS)

Type of Activity: **Native Endangered and Threatened Species – Incidental Take Permits Associated with a Habitat Conservation Plan (HCP)**

Complete Sections A or B, and C, D, and E of this application. U.S. address may be required in Section C, see instructions for details.
See attached instruction pages for information on how to make your application complete and help avoid unnecessary delays.

A. Complete if applying as an individual

1.a. Last name	1.b. First name	1.c. Middle name or initial	1.d. Suffix

2. Date of birth (mm/dd/yyyy)	3. Social Security No.	4. Occupation	5. Affiliation/ Doing business as (see instructions)

6.a. Telephone number	6.b. Alternate telephone number	6.c. Fax number	6.d. E-mail address

B. Complete if applying on behalf of a business, corporation, public agency or institution

1.a. Name of business, agency, or institution	1.b. Doing business as (dba)
Half Circle L Ranch, LLP	

2. Tax identification no.	3. Description of business, agency, or institution
59-0700531	Agriculture

4.a. Principal officer Last name	4.b. Principal officer First name	4.c. Principal officer Middle name/ initial	4.d. Suffix
Scofield	Dane	Thorp	

5. Principal officer title	6. Primary contact
Managing Partner	Dane Scofield

7.a. Business telephone number	7.b. Alternate telephone number	7.c. Business fax number	7.d. Business e-mail address
239-657-3401	239-253-5503	2390657-3915	ljthorp@aol.com

C. All applicants complete address information

1.a. Physical address (Street address; Apartment #, Suite #, or Room #; no P.O. Boxes)
2424 Thorp Road

1.b. City	1.c. State	1.d. Zip code/Postal code:	1.e. County/Province	1.f. Country
Immokalee	FL	34142	Collier	USA

2.a. Mailing Address (include if different than physical address; include name of contact person if applicable)
Same

2.b. City	2.c. State	2.d. Zip code/Postal code:	2.e. County/Province	2.f. Country

D. All applicants MUST complete

1. Attach check or money order payable to the U.S. FISH AND WILDLIFE SERVICE in the amount indicated on page 2. Federal, tribal, State, and local government agencies, and those acting on behalf of such agencies, are exempt from the processing fee – ***attach documentation of fee exempt status as outlined in instructions.*** (50 CFR 13.11(d))

2. Do you currently have or have you ever had any Federal Fish and Wildlife permits?
   Yes ☐ If yes, list the number of the most current permit you have held or that you are applying to renew/re-issue: _____
   No ☒

3. Certification: I hereby certify that I have read and am familiar with the regulations contained in ***Title 50, Part 13 of the Code of Federal Regulations*** and the other ***applicable parts in subchapter B of Chapter I of Title 50,*** and I certify that the information submitted in this application for a permit is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to the criminal penalties of 18 U.S.C. 1001.

Dane Scofield — Signature (in blue ink) of applicant/person responsible for permit (No photocopied or stamped signatures)

05/25/2010 — Date of signature (mm/dd/yyyy)

Please continue to next page

** See page 14 for additional instructions on completing the above form. See page 15 for information on the Paperwork Reduction Act, Privacy Act, and Freedom of Information Act aspects of this application form.

Section E. **ALL APPLICANTS COMPLETE SECTION E.** Provide the information outlined in Section E. on the following pages. Be as complete and descriptive as possible. Please do not send pages that are over 8.5"X 11", videotapes, or DVDs.

INCIDENTAL TAKE PERMITS ASSOCIATED WITH A HABITAT CONSERVATION PLAN (HCP)

Have you obtained all required State, Federal or foreign government approval to conduct the activity you propose? Please be aware that there may be other requirements necessary to conduct this activity such as an import permit, collection permit, permission to work on Federal lands, Federal bird banding permit, Corps of Engineers permits, Environmental Protection Agency NPDES permits, State, county or local permits, etc.

☐ Yes. Provide a copy of the approval(s). List the State, Federal or foreign countries involved and type of document required. Include a copy of these documents with the application.

☐ I have applied. List the State, Federal or foreign countries involved and type of documents required. Provide the reasons why the permits have not been issued _____.

☒ Not required. The proposed activity is not regulated. Not required at this time. MSHCP precedes future activities.

Application Processing Fees
The application processing fee for a new Incidental Take permit, or to renew/re-issue an existing valid permit, is $100. If permit amendment is required at a time other than renewal/re-issuance, the processing fee is $50.

Check the appropriate box below and enclose check or money order payable to the *U.S. Fish and Wildlife Service* in the amount of

☒ $100 for a **new** permit

OR

☐ $100 to **renew/re-issue** my existing valid permit (with only *minor changes* such as updating my name and address) using my current application package on file.

OR

☐ $50 to make a **substantive amendment** (with *major changes*) to my existing valid permit [50 CFR 13.11(d)(2)].

If the information in your current application package on file has changed in a manner that triggers a major amendment or a change not otherwise specified in the permit, then you must apply for an amendment to your valid permit. For example, such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit. Please contact our Ecological Services Field Office located closest to your proposed activity for technical assistance in making this determination. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please check the **type of amendment** you are requesting --

☐ add species (specify) _____

☐ add a geographic area ☐ change in personnel

☐ other (specify) _____

If this application includes **transfer or succession** of a valid Incidental Take permit, please check the box below:

☐ Transfer or succession of a valid Incidental Take permit associated with a HCP using the current application package on file. No application fee is required.

Application Processing Time

To expedite a final decision on your application, you are urged to coordinate with us as soon as possible for guidance in assembling a complete application package. If you are renewing or amending a valid permit, your complete application package must be received at least 30 days prior to the expiration of the valid permit. This time period begins when we receive a complete permit application package and does not include any time required for requesting clarification or additional information about your application.

The time required to process an application for an Incidental Take permit will vary depending on the size, complexity, and impacts of the HCP involved. Procedurally, the most variable factor in application processing is the level of analysis required for the proposed HCP under the National Environmental Policy Act (e.g., whether an application requires preparation of an Environmental Impact Statement, Environmental Assessment, or whether a categorical exclusion applies), although other factors such as public controversy can also affect application processing times. The target processing timeline from when we receive a complete application package to our final decision on a permit application is: up to 3 months for low-effect HCPs, 4 to 6 months for HCPs with an Environmental Assessment, and up to 12 months for HCPs with a 90-day comment period and/or an Environmental Impact Statement. Although not mandated by law or regulation, these targets are adopted as U.S. Fish & Wildlife Service and National Marine Fisheries Service (NMFS/NOAA Fisheries) policy and all offices are expected to streamline their Incidental Take permit programs, and to meet these targets to the maximum extent practicable.

The information provided in your permit application will be used to evaluate your application for compliance with the Endangered Species Act, its implementing regulations (which may require a 30 day public comment period), and with U.S. Fish and Wildlife Service policy. Receipt and possession of a permit under the Endangered Species Act should be regarded as a privilege, as we must balance permit issuance with our duties to protect and recover listed species.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal, re-issuance or amendment.

If your activities may affect species under the authority of the National Marine Fisheries Service (NMFS/NOAA Fisheries), then you may need to obtain a separate permit from that agency. In addition we share jurisdiction with NMFS/NOAA Fisheries for sea turtles (e.g., we evaluate applications for permits to conduct activities impacting sea turtles on land, and NMFS/NOAA Fisheries evaluates applications for permits to conduct activities impacting sea turtles in the marine environment). To apply for a permit to conduct activities with sea turtles in the marine environment or other species under NMFS/NOAA Fisheries jurisdiction, please contact them via their permit web page at http://www.nmfs.noaa.gov/pr/permits/

We cannot issue an Incidental Take permit under Section 10(a)(2)(A)(i) of the Endangered Species Act unless you submit a conservation plan that specifies the impacts that are likely to result from the incidental take associated with your activity.

Our general permit regulations at 50 CFR 13.12(a)(9) allow us to collect such other information as we determine that is relevant to the processing of a permit application. Before you submit an application for an Incidental Take permit, we may require that you conduct biological surveys to determine which species and/or habitat would be impacted by the activities sought to be covered under the permit. Biological surveys provide information necessary to develop an adequate HCP, and to assess the biological impacts of the proposed activities. In addition, the information provided in a biological survey can reduce the applicant's risk of take under Section 9 of the Endangered Species Act by ensuring that affected species and/or habitat are identified and appropriately covered under the permit.

You are required to obtain a Scientific Purposes, Enhancement of Propagation or Survival permit (commonly called a Recovery permit) from us before engaging in any biological survey activities that would take listed species. Contact our Ecological Services Field Office closest to the location of your activity to obtain technical assistance in determining the need for both a biological survey and a Recovery permit for your survey activity. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

If a biological survey is required, you will need to send us your complete Recovery permit application package at least 3 months prior to commencement of survey activities to facilitate processing of your Recovery permit application. The Recovery permit application is designated as U.S. Fish & Wildlife Service form # 3-200-55 and can be found on our Endangered Species permit web page at http://www.fws.gov/forms/3-200-55.pdf.

We maintain a list of Recovery permittees (such as biological consultants) who have authorized the release of their contact information to third parties for conducting biological surveys on a contract basis. This list is provided to the public at the discretion of each U.S.

Fish and Wildlife Service Regional Office as time and workload allow. Please be aware that this list does not represent an endorsement by us of any particular permittee.

****

If you are not applying as an individual but as a business, corporation, institution, or non-Federal public agency (block B. on page 1 of the application), the person to whom the permit will be issued (e.g., the landowner, president, director, executive director, or executive officer) is legally responsible for implementing the permit. Although other people under the direct control of the permittee (e.g., employees, contractors, consultants) receive third party take authorization in their capacity as designees of the permittee, the individual named as the permittee ultimately is legally responsible for the permit and any activities carried out under the permit except as otherwise limited in the case of permits issued to State or local government entities under 50 CFR 13.25(e).

****

If you wish to coordinate the processing of this permit application through an **authorized agent**, and to have that agent represent you as the primary contact with us, check the box below. Sign (in blue ink) and date the authorization statement, and provide contact information for your authorized agent.

☐ I hereby authorize the following person to act as an authorized agent on my behalf in the processing of this permit application and to furnish, upon request, supplemental information in support of this permit application.

Dane Scofield — signature (in blue ink)

5/25/2010 — date

DANE SCOFIELD — please print name legibly

Your Authorized Agent's Contact Information (please print legibly)

Name: Tom Jones

Address: 2600 Golden Gate Pkwy

City: Naples State: FL Zip Code: 34105

Telephone: 239-262-2600

Fax: 239-261-1797

E-Mail: TJones@barroncollier.com

INCIDENTAL TAKE PERMIT APPLICATION INSTRUCTIONS

You have 4 options for providing the required information for an Incidental Take permit application. Choose only one option.

Incidental Take Permit Application: Option I. Renewal of a Valid Incidental Take Permit.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal.

Sign the following statement if you are applying to renew an existing valid Incidental Take permit. If you are proposing major changes to your Incidental Take permit, you must use Option II.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct and hereby request renewal of that permit.
>
> _____ _____
> signature (in blue ink) date
>
> _____
> please print name legibly
>
> * Please note: If you have signed the above statement, then your renewal request is complete. Please submit completed pages 1 through 5 of this application to our Regional Office (see attached list) covering the location of your proposed activity. Requests for renewals must be received no later than 30 days prior to permit expiration to ensure that your current permit remains in effect while we process your renewal request.

Incidental Take Permit Application: Option II. Amended Incidental Take Permit (with *major changes*)

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for amendment.

Sign the following statement if you are proposing to amend a valid Incidental Take permit by making major changes. Such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct, except for the changes listed below, and hereby request amendment of that permit.

_____ _____

signature (in blue ink) date

_____

please print name legibly

Provide a brief description of the changes to your valid permit (answer the appropriate questions for these changes under Incidental Take Permit Application Option III. below). Please submit completed pages 1 through 6 of this application form (along with the changed information relative to Option III. below) to our Regional Office (see attached list) covering the location of your proposed activity.

Incidental Take Permit Application: Option III. New Incidental Take Permit & Supplementary Information for Amendment of a Valid Permit (with *major changes*).

General permit regulations for the U.S. Fish & Wildlife Service can be found at 50 CFR 13. Regulations for an Incidental Take permit under the Endangered Species Act can be found at 50 CFR 17.22(b)(1) for endangered wildlife species and 50 CFR 17.32(b)(1) for threatened wildlife species.

Each landowner who wishes to be covered under a new or amended Incidental Take permit associated with an HCP must sign (in blue ink) and date the Incidental Take Permit Application Certification Notice at the end of this application, unless the landowner will be covered under this U.S. Fish & Wildlife Service Incidental Take permit via another vehicle, such as a certificate of inclusion (50 CFR 13.25(d)). Any change in the language of the Certification Notice must be reviewed by the Department of Interior, Office of the Solicitor and approved by the U.S. Fish & Wildlife Service. The same person who signs in box D. on page 1 of the application should sign the certification.

If the information in items A. - D. below is already provided in your final HCP (or Implementing Agreement, if applicable), then you do not have to provide it here. Instead, check the box below and use the spaces provided in items A. - D. to indicate the page numbers in your HCP or Implementing Agreement that provide the requested information.

☒ I am not providing the following information for items A. - D. as part of my Incidental Take permit application, because it is already provided in my final HCP or Implementing Agreement (copy attached or already submitted).

If the requested information in items A. - D. is not provided in your final HCP or final Implementing Agreement, or you are using Option II. to amend your existing valid Incidental Take permit, then attach separate pages for the missing information. In order to assist us in processing your request, please provide the item number (A. 1.a., etc.) of the required information before each of your responses. Thank you.

Please ensure that your final HCP and Implementing Agreement (if applicable) are attached if it has not been previously submitted.

If you have previously submitted a final draft HCP or Implementing Agreement, please indicate the document's date.

Date of final draft HCP TBD (MSHCP summary attached.)

Date of final draft Implementing Agreement TBD

Applications for an Incidental Take permit associated with an HCP must provide the following specific information (relevant to the activity) under items A.- D. below in addition to the general information on page 1 of this application.

A. Identify species and activity:

1. For a new Incidental Take permit:

   a. Provide the common and scientific names of the species being requested for coverage in the permit and their status (endangered (E), threatened (T), proposed endangered (PE), proposed threatened (PT), candidate for listing (C), or species likely to become a candidate (LC)).

   b. Provide the number, age, and sex of such species to the extent known

   c. Quantify the anticipated effects to their habitat.

   d. Describe the land use or water management activity sought to be authorized for each species.

2. For an amended Incidental Take permit:

   a. Identify the species to be added to your valid permit (provide both the scientific, to the most specific taxonomic level, and common names), as well as the species status (see 1.a.. above).

   b. Provide the number, age and sex of such species to the extent known.

   c. If any activities requested in this application differ from those authorized in your valid permit, then for each

species state the currently authorized activity, the requested new activity, and how the new activity will impact each species.

d. Identify each activity associated with your project that would result in the incidental take of each species.

e. Quantify any anticipated effects to the habitat of each added species.

f. Identify species to be deleted from your valid permit and the reason(s) for the deletion.

Page(s) & source document : _____

B. Identify location of the proposed activity:

1. Provide the name of the State, county, and specific location of the proposed activity site(s). Include a formal legal description, section/township/range information, county tax parcel number, local address, or any other identifying property designation that will precisely place the location of the proposed activity site(s). Attach a location map and plat of the project site clearly depicting the project boundaries and the footprint and location of all portions of the property that would be affected by your proposed activities.

2. Provide the total number of acres covered by the HCP 177,000+/-

   Is this the total acreage of the parcel? (circle one) (yes) no

3. Provide the approximate number of acres to be impacted 45,000

4. Provide the approximate number of acres to be protected 132,000

5. Provide a complete description, including timeframes, for implementation of proposed voluntary management activities to enhance, restore, or maintain habitat benefiting federally listed, proposed or candidate species, or other species likely to become candidates. Include schedules for implementing these activities.

Page(s) & source document: See attached MSHCP summary.

C. Describe the proposed activities in the conservation plan:
You must submit a Habitat Conservation Plan. We strongly encourage you to ensure that your HCP is consistent with the Habitat Conservation Planning Handbook, subsequent Handbook addendums, and current policies to minimize delays in evaluating your application. The Handbook and other HCP information is available on the U.S. Fish & Wildlife Service's Endangered Species web page at http://www.fws.gov/endangered/hcp/index.html

Provide a complete description of activity(ies) to be authorized or reference the applicable HCP or Implementing Agreement page numbers identifying the subject information.

The HCP must specify:

1. The impact that will likely result from the incidental taking. A discussion of the impact that will likely result from the incidental take should include quantification of any anticipated effects to the habitat of the species sought to be covered by the permit.

2. The steps that will be taken to minimize and mitigate such impacts, the funding that will be available to implement such steps, and the procedures to deal with unforeseen circumstances.

3. The steps that will be taken to monitor and report on such impacts, including a copy of the monitoring plan. We are authorized to require reports of activities conducted under a permit per the U.S. Fish & Wildlife Service's general permit regulations at 50 CFR 13.45.

4. Alternative actions to such incidental taking that have been considered and the reasons why these alternatives are not proposed for use.

5. The biological goals(s) and objectives for the HCP.

6. The duration requested for the proposed permit.

Page(s) & source document: See attached HCP summary.

D. Implementing Agreement

An Implementing Agreement

is *is not* (FWS *Regional Office* to circle one)

required as part of the permit application for a Habitat Conservation Plan.

This Implementing Agreement must be signed at finalization of the HCP. Are you willing to commit to an Implementing Agreement at finalization of the HCP?

☒ Yes, I am willing to commit to an Implementing Agreement. Please submit any unsigned, draft Implementing Agreement that you have prepared with our Field Office.

☐ No, I am not willing to commit to an Implementing Agreement.

Incidental Take Permit Application: Option IV. Permit Transfer or Succession of a Permit

Complete the following if you are applying for transfer of a valid Incidental Take permit to you or obtaining rights of succession of a valid Incidental Take permit. In addition, you and the current permit holder may also need to sign an Assumption Agreement. Please contact our Ecological Services Field Office nearest your activity to determine whether you and the current permit holder need to execute an Assumption Agreement. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please indicate the name of the HCP to be transferred or succeeded and indicate the document's date.

Name of HCP _____

Date of HCP _____

An Assumption Agreement

is ***is not*** (FWS Ecological Services *Field Office* to circle one)

required as part of the transfer or succession permit application for the HCP.

Incidental Take Permit Application

Certification Notice

The same person who signs in box D. on page 1 of the application should sign (in blue ink) the following certification.

By submitting this application and receiving an Incidental Take permit pursuant to Section 10(a)(1)(B) of the Endangered Species Act, I

_____(print name(s)) attest that I/we own the lands indicated in this application, or have sufficient authority or rights over these lands to implement the measures of the Habitat Conservation Plan (and Implementing Agreement if applicable) covered by the Incidental Take permit. Further, upon receipt of the Incidental Take permit, I/we agree to conduct the activities as specified in the Habitat Conservation Plan (and Implementing Agreement if applicable) according to the terms and conditions of the Incidental Take permit and its supporting documents.

Dane Scofield — signature (in blue ink)

5/25/2010 — date

DANE SCOFIELD — please print name legibly

_____ — signature (in blue ink)

_____ — date

_____ — please print name legibly

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The public reporting burden for completing this application for an Incidental Take permit is estimated to be 3 hours, including time for reviewing instructions, gathering and maintaining application data, and completing and reviewing the forms. Comments regarding the burden estimate or any other aspect of the reporting requirement(s) should be directed to the U.S. Fish & Wildlife Service Information Collection Clearance Officer, MS 222 ARLSQ, U.S. Fish and Wildlife Service, Washington, DC 20240.

An agency may not conduct and a person is not required to respond to a collection of information unless a currently valid OMB control number is displayed.

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USFWS Regional Contacts for Native Endangered & Threatened Species Permits

Pacific Region (Region 1): HI, ID, OR, WA, American Samoa, Commonwealth of the Northern Mariana Islands, Guam, and the Pacific Trust Territories

U.S. Fish and Wildlife Service
Endangered Species Permit Office
911 NE 11th Avenue
Portland, Oregon 97232-4181

Web: http://www.fws.gov/pacific/ecoservices/endangered/index.html
Phone: (503) 231-2071
email: permitsR1ES@fws.gov
Fax: (503) 231-6243

California & Nevada Region (Region 8): CA and NV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
2800 Cottage Way, Suite W-2606
Sacramento, California 95825 -1846

Web: http://www.fws.gov/cno/es/recovery.html
Phone: (916) 414-6464
email: permitsCNES@fws.gov
Fax: (916) 414-6486

Southwest Region (Region 2): AZ, NM, OK, and TX

U.S. Fish and Wildlife Service
Endangered Species Permit Office
500 Gold Avenue S.W. (street address)
P.O. Box 1306 (mailing address)
Albuquerque, New Mexico 87103-1306

Web: http://www.fws.gov/southwest/es/EndangeredSpecies/
Phone: (505) 248-6633
email: permitsR2ES@fws.gov
Fax: (505) 248-6788

Midwest Region (Region 3): IA, IL, IN, MI, MN, MO, OH, and WI

U.S. Fish and Wildlife Service
Endangered Species Permit Office
B.H. Whipple Federal Building
One Federal Drive
Fort Snelling, Minnesota 55111-4056

Web: http://www.fws.gov/midwest/Endangered/
Phone: (612) 713-5343
email: permitsR3ES@fws.gov
Fax: (612) 713-5292

Southeast Region (Region 4): AL, AR, FL, GA, KY, LA, MS, NC, PR, SC, TN, and U.S. Virgin Islands

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1875 Century Blvd., Suite 200
Atlanta, Georgia 30345

Web: http://www.fws.gov/southeast/es/#
Phone: (404) 679-7313
email: permitsR4ES@fws.gov
Fax: (404) 679-7081

Northeast Region (Region 5): CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, and WV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
300 Westgate Center Drive
Hadley, MA 01035-9589

Web: http://www.fws.gov/northeast/endangered/
Phone: (413) 253-8615
email: permitsR5ES@fws.gov
Fax: (413) 253-8482

Mountain-Prairie Region (Region 6): CO, KS, MT, NE, ND, SD, UT, and WY

U.S. Fish and Wildlife Service
Endangered Species Permit Office
Denver Federal Center
P.O. Box 25486
Denver, Colorado 80225-0489

Web: http://www.fws.gov/mountain%2Dprairie/endspp/
Phone: (303) 236-7400
email: permitsR6ES@fws.gov
Fax: (303) 236-0027

Alaska Region (Region 7): AK

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1011 E. Tudor Road
Anchorage, Alaska 99503-6199

Web: http://alaska.fws.gov/fisheries/endangered/index.htm
Phone: (907) 786-3323
email: permitsR7ES@fws.gov
Fax: (907) 786-3350

PERMIT APPLICATION FORM INSTRUCTIONS

The following instructions pertain to the standard permit form 3-200 that must be completed as an application for a U.S. Fish and Wildlife Service or CITES permit. The General Permit Procedures in 50 CFR 13 address the permitting process. For simplicity, all licenses, permits, registrations, and certificates will be referred to as a permit.

GENERAL INSTRUCTIONS:

- Complete all blocks/lines/questions in Sections A or B, and C and D. Complete all of Section E.
- **An incomplete application may cause delays in processing or may be returned to the applicant. Be sure you are filling in the appropriate application form for the proposed activity.**
- Print clearly or type in the information. Illegible applications may cause delays.
- Sign the application in blue ink. Faxes or copies of the original signature will not be accepted.
- Mail the original application to the address at the top of page one of the application or if applicable on the attached address list.
- **Keep a copy of your completed application.**
- **Please plan ahead. Allow at least 60 days for your application to be processed. Some applications may take longer than 90 days to process. (50 CFR 13.11)**
- Applications are processed in the order they are received.
- Additional forms and instructions are available from http://permits.fws.gov/ .

COMPLETE EITHER SECTION A OR SECTION B:

Section A. **Complete if applying as an individual:**

- Enter the complete name of the responsible individual who will be the permittee if a permit is issued. Enter personal information that identifies the applicant. ***Fax and e-mail are not required if not available.***
- If you are applying on behalf of a client, the personal information must pertain to the client, and a document evidencing power of attorney must be included with the application.
- **Affiliation/ Doing business as (dba)**: business, agency, organizational, or institutional affiliation *directly* related to the activity requested in the application (e.g., a taxidermist is an individual whose business can *directly* relate to the requested activity). The Division of Management Authority (DMA) will **not** accept *doing business as* affiliations for individuals.

Section B. **Complete if applying as a business, corporation, public agency, or institution:**

- Enter the complete name of the business, agency or institution that will be the permittee if a permit is issued. Give a brief description of the type of business the applicant is engaged in. Provide contact phone number(s) of the business.
- **Principal Officer** is the person in charge of the listed business, corporation, public agency, or institution. The principal officer is the person responsible for the application and any permitted activities. Often the principal officer is a Director or President. **Primary Contact** is the person at the business, corporation, public agency, or institution who will be available to answer questions about the application or permitted activities. Often this is the preparer of the application.

ALL APPLICANTS COMPLETE SECTION C:

- For all applications submitted to the Division of Management Authority (DMA) a physical U.S. address is **required**. Province and Country blocks are provided for those USFWS programs which use foreign addresses and are not required by DMA..
- **Mailing address** is address where communications from USFWS should be mailed if different than applicant's physical address.

ALL APPLICANTS COMPLETE SECTION D:

Section D.1 **Application processing fee:**

- An application processing fee is required at the time of application; unless exempted under 50 CFR13.11(d)(3). The application processing fee is assessed to partially cover the cost of processing a request. **The fee does not guarantee the issuance of a permit. Fees will not be refunded for applications that are approved, abandoned, or denied.** We may return fees for withdrawn applications prior to any significant processing occurring.
- **Documentation of fee exempt status is not required for Federal, tribal, State, or local government agencies; but must be supplied by those applicants acting on behalf of such agencies.** Those applicants acting on behalf of such agencies must submit a letter on agency letterhead and signed by the head of the unit of government for which the applicant is acting on behalf, confirming that the applicant will be carrying out the permitted activity for the agency.

Section D.2 **Federal Fish and Wildlife permits:**

- List the number(s) of your most current FWS or CITES permit or the number of the most recent permit if none are currently valid. If applying for re-issuance of a CITES permit, the original permit must be returned with this application.

Section D.3 **CERTIFICATION:**

- **The individual identified in Section A, the principal officer named in Section B, or person with a valid power of attorney (documentation must be included in the application) must sign and date the application in blue ink.** This signature binds the applicant to the statement of certification. This means that you certify that you have read and understand the regulations that apply to the permit. You also certify that everything included in the application is true to the best of your knowledge. Be sure to read the statement and re-read the application and your answers before signing.

Please continue to next page

APPLICATION FOR A FEDERAL FISH AND WILDLIFE PERMIT
Paperwork Reduction Act, Privacy Act, and Freedom of Information Act – Notices

In accordance with the Paperwork Reduction Act of 1995 (44 U.S.C. 3501, *et seq.*) and the Privacy Act of 1974 (5 U.S.C. 552a), please be advised:

1. The gathering of information on fish and wildlife is authorized by:
(Authorizing statutes can be found at: http://www.gpoaccess.gov/cfr/index.html and http://www.fws.gov/permits/ltr/ltr.shtml.)

   a. Bald and Golden Eagle Protection Act (16 U.S.C. 668), 50 CFR 22;
   b. Endangered Species Act of 1973 (16 U.S.C. 1531-1544), 50CFR 17;
   c. Migratory Bird Treaty Act (16 U.S.C. 703-712), 50 CFR 21;
   d. Marine Mammal Protection Act of 1972 (16 U.S.C. 1361, *et. seq.*), 50 CFR 18;
   e. Wild Bird Conservation Act (16 U.S.C. 4901-4916), 50 CFR 15;
   f. Lacey Act: Injurious Wildlife (18 U.S.C. 42), 50 CFR 16;
   g. Convention on International Trade in Endangered Species of Wild Fauna and Flora (TIAS 8249), http://www.cites.org/ , 50 CFR 23;
   h. General Provisions, 50 CFR 10;
   i. General Permit Procedures, 50 CFR 13; and
   j. Wildlife Provisions (Import/export/transport), 50 CFR 14.

2. Information requested in this form is purely voluntary. However, submission of requested information is required in order to process applications for permits authorized under the above laws. Failure to provide all requested information may be sufficient cause for the U.S. Fish and Wildlife Service to deny the request. Response is not required unless a currently valid Office of Management and Budget (OMB) control number is displayed on form.

3. Certain applications for permits authorized under the Endangered Species Act of 1973 (16 U.S.C. 1539) and the Marine Mammal Protection Act of 1972 (16 U.S.C. 1374) will be published in the **Federal Register** as required by the two laws.

4. Disclosures outside the Department of the Interior may be made without the consent of an individual under the routine uses listed below, if the disclosure is compatible with the purposes for which the record was collected. (Ref. 68 FR 52611, September 4, 2003)

   a. Routine disclosure to subject matter experts, and Federal, tribal, State, local, and foreign agencies, for the purpose of obtaining advice relevant to making a decision on an application for a permit or when necessary to accomplish a FWS function related to this system of records.
   b. Routine disclosure to the public as a result of publishing **Federal Register** notices announcing the receipt of permit applications for public comment or notice of the decision on a permit application.
   c. Routine disclosure to Federal, tribal, State, local, or foreign wildlife and plant agencies for the exchange of information on permits granted or denied to assure compliance with all applicable permitting requirements.
   d. Routine disclosure to Captive-bred Wildlife registrants under the Endangered Species Act for the exchange of authorized species, and to share information on the captive breeding of these species.
   e. Routine disclosure to Federal, tribal, State, and local authorities who need to know who is permitted to receive and rehabilitate sick, orphaned, and injured birds under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act; federally permitted rehabilitators; individuals seeking a permitted rehabilitator with whom to place a bird in need of care; and licensed veterinarians who receive, treat, or diagnose sick, orphaned, and injured birds.
   f. Routine disclosure to the Department of Justice, or a court, adjudicative, or other administrative body or to a party in litigation before a court or adjudicative or administrative body, under certain circumstances.
   g. Routine disclosure to the appropriate Federal, tribal, State, local, or foreign governmental agency responsible for investigating, prosecuting, enforcing, or implementing statutes, rules, or licenses, when we become aware of a violation or potential violation of such statutes, rules, or licenses, or when we need to monitor activities associated with a permit or regulated use.
   h. Routine disclosure to a congressional office in response to an inquiry to the office by the individual to whom the record pertains.
   i. Routine disclosure to the General Accounting Office or Congress when the information is required for the evaluation of the permit programs.
   j. Routine disclosure to provide addresses obtained from the Internal Revenue Service to debt collection agencies for purposes of locating a debtor to collect or compromise a Federal claim against the debtor or to consumer reporting agencies to prepare a commercial credit report for use by the FWS.

5. For individuals, personal information such as home address and telephone number, financial data, and personal identifiers (social security number, birth date, etc.) will be removed prior to any release of the application.

6. The public reporting burden on the applicant for information collection varies depending on the activity for which a permit is requested. The relevant burden for an **Incidental Take** permit application is **3 hours**. This burden estimate includes time for reviewing instructions, gathering and maintaining data and completing and reviewing the form. You may direct comments regarding the burden estimate or any other aspect of the form to the Service Information Clearance Officer, U.S. Fish and Wildlife Service, Mail Stop 222, Arlington Square, U.S. Department of the Interior, 1849 C Street, NW, Washington D.C. 20240.

Freedom of Information Act – Notice

For organizations, businesses, or individuals operating as a business (i.e., permittees not covered by the Privacy Act), we request that you identify any information that should be considered privileged and confidential business information to allow the Service to meet its responsibilities under FOIA. Confidential business information must be clearly marked "Business Confidential" at the top of the letter or page and each succeeding page and must be accompanied by a non-confidential summary of the confidential information. The non-confidential summary and remaining documents may be made available to the public under FOIA [43 CFR 2.13(c)(4), 43 CFR 2.15(d)(1)(i)].

Department of the Interior
U.S. Fish and Wildlife Service

Expires Nov. 30, 2010
OMB No. 1018-0094

Federal Fish and Wildlife Permit Application Form

Return to: U.S. Fish and Wildlife Service (USFWS)

Type of Activity: Native Endangered and Threatened Species – Incidental Take Permits Associated with a Habitat Conservation Plan (HCP)

Complete Sections A or B, and C, D, and E of this application. U.S. address may be required in Section C, see instructions for details.
See attached instruction pages for information on how to make your application complete and help avoid unnecessary delays.

A.	Complete if applying as an individual			
1.a. Last name		1.b. First name	1.c. Middle name or initial	1.d. Suffix
2. Date of birth (mm/dd/yyyy)	3. Social Security No.	4. Occupation	5. Affiliation/ Doing business as (see instructions)	
6.a. Telephone number	6.b. Alternate telephone number	6.c. Fax number	6.d. E-mail address	

B.	Complete if applying on behalf of a business, corporation, public agency or institution		
1.a. Name of business, agency, or institution: John E. Price Jr. Trust		1.b. Doing business as (dba): JB Ranch	
2. Tax identification no.: 87-0797157		3. Description of business, agency, or institution: ranching and land management	
4.a. Principal officer Last name: Priddy	4.b. Principal officer First name: Aliese	4.c. Principal officer Middle name/ initial: Price	4.d. Suffix
5. Principal officer title: Co-Trustee		6. Primary contact: Russell A. Priddy	
7.a. Business telephone number: 239 289-0064	7.b. Alternate telephone number: 239 657-4380	7.c. Business fax number	7.d. Business e-mail address: RAP053155@aol.com

C.	All applicants complete address information			
1.a. Physical address (Street address; Apartment #, Suite #, or Room #; no P.O. Boxes): 7007 State Road 29 South				
1.b. City: Immokalee	1.c. State: FL	1.d. Zip code/Postal code: 34143	1.e. County/Province: Collier	1.f. Country: USA
2.a. Mailing Address (include if different than physical address; include name of contact person if applicable): P.O. Box 930				
2.b. City: Immokalee	2.c. State: FL	2.d. Zip code/Postal code: 34143	2.e. County/Province: Collier	2.f. Country: USA

D.	All applicants MUST complete
1.	Attach check or money order payable to the U.S. FISH AND WILDLIFE SERVICE **in the amount indicated on page 2.** Federal, tribal, State, and local government agencies, and those acting on behalf of such agencies, are exempt from the processing fee – ***attach documentation of fee exempt status as outlined in instructions.*** (50 CFR 13.11(d))
2.	Do you currently have or have you ever had any Federal Fish and Wildlife permits? Yes ☐ If yes, list the number of the most current permit you have held or that you are applying to renew/re-issue: _____ No ☒
3.	Certification: I hereby certify that I have read and am familiar with the regulations contained in ***Title 50, Part 13 of the Code of Federal Regulations*** and the other ***applicable parts in subchapter B of Chapter I of Title 50,*** and I certify that the information submitted in this application for a permit is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to the criminal penalties of 18 U.S.C. 1001. Aliese P. Priddy — 05/23/2010 Signature (**in blue ink**) of applicant/person responsible for permit (No photocopied or stamped signatures) — Date of signature (mm/dd/yyyy)

Please continue to next page

** See page 14 for additional instructions on completing the above form. See page 15 for information on the Paperwork Reduction Act, Privacy Act, and Freedom of Information Act aspects of this application form.

Section E. **ALL APPLICANTS COMPLETE SECTION E.** Provide the information outlined in Section E. on the following pages. Be as complete and descriptive as possible. Please do not send pages that are over 8.5"X 11", videotapes, or DVDs.

INCIDENTAL TAKE PERMITS ASSOCIATED WITH A HABITAT CONSERVATION PLAN (HCP)

Have you obtained all required State, Federal or foreign government approval to conduct the activity you propose? Please be aware that there may be other requirements necessary to conduct this activity such as an import permit, collection permit, permission to work on Federal lands, Federal bird banding permit, Corps of Engineers permits, Environmental Protection Agency NPDES permits, State, county or local permits, etc.

☐ Yes. Provide a copy of the approval(s). List the State, Federal or foreign countries involved and type of document required. Include a copy of these documents with the application.

☐ I have applied. List the State, Federal or foreign countries involved and type of documents required. Provide the reasons why the permits have not been issued _____.

☒ Not required. ~~The proposed activity is not regulated.~~ Not required at this time. MSHCP precedes future activities.

Application Processing Fees

The application processing fee for a new Incidental Take permit, or to renew/re-issue an existing valid permit, is $100. If permit amendment is required at a time other than renewal/re-issuance, the processing fee is $50.

Check the appropriate box below and enclose check or money order payable to the *U.S. Fish and Wildlife Service* in the amount of

☒ $100 for a **new** permit

OR

☐ $100 to **renew/re-issue** my existing valid permit (with only *minor changes* such as updating my name and address) using my current application package on file.

OR

☐ $50 to make a **substantive amendment** (with *major changes*) to my existing valid permit [50 CFR 13.11(d)(2)].

If the information in your current application package on file has changed in a manner that triggers a major amendment or a change not otherwise specified in the permit, then you must apply for an amendment to your valid permit. For example, such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit. Please contact our Ecological Services Field Office located closest to your proposed activity for technical assistance in making this determination. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please check the **type of amendment** you are requesting --

☐ add species (specify) _____

☐ add a geographic area ☐ change in personnel

☐ other (specify) _____

If this application includes **transfer or succession** of a valid Incidental Take permit, please check the box below:

☐ Transfer or succession of a valid Incidental Take permit associated with a HCP using the current application package on file. No application fee is required.

Application Processing Time

To expedite a final decision on your application, you are urged to coordinate with us as soon as possible for guidance in assembling a complete application package. If you are renewing or amending a valid permit, your complete application package must be received at least 30 days prior to the expiration of the valid permit. This time period begins when we receive a complete permit application package and does not include any time required for requesting clarification or additional information about your application.

The time required to process an application for an Incidental Take permit will vary depending on the size, complexity, and impacts of the HCP involved. Procedurally, the most variable factor in application processing is the level of analysis required for the proposed HCP under the National Environmental Policy Act (e.g., whether an application requires preparation of an Environmental Impact Statement, Environmental Assessment, or whether a categorical exclusion applies), although other factors such as public controversy can also affect application processing times. The target processing timeline from when we receive a complete application package to our final decision on a permit application is: up to 3 months for low-effect HCPs, 4 to 6 months for HCPs with an Environmental Assessment, and up to 12 months for HCPs with a 90-day comment period and/or an Environmental Impact Statement. Although not mandated by law or regulation, these targets are adopted as U.S. Fish & Wildlife Service and National Marine Fisheries Service (NMFS/NOAA Fisheries) policy and all offices are expected to streamline their Incidental Take permit programs, and to meet these targets to the maximum extent practicable.

The information provided in your permit application will be used to evaluate your application for compliance with the Endangered Species Act, its implementing regulations (which may require a 30 day public comment period), and with U.S. Fish and Wildlife Service policy. Receipt and possession of a permit under the Endangered Species Act should be regarded as a privilege, as we must balance permit issuance with our duties to protect and recover listed species.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal, re-issuance or amendment.

If your activities may affect species under the authority of the National Marine Fisheries Service (NMFS/NOAA Fisheries), then you may need to obtain a separate permit from that agency. In addition we share jurisdiction with NMFS/NOAA Fisheries for sea turtles (e.g., we evaluate applications for permits to conduct activities impacting sea turtles on land, and NMFS/NOAA Fisheries evaluates applications for permits to conduct activities impacting sea turtles in the marine environment). To apply for a permit to conduct activities with sea turtles in the marine environment or other species under NMFS/NOAA Fisheries jurisdiction, please contact them via their permit web page at http://www.nmfs.noaa.gov/pr/permits/

We cannot issue an Incidental Take permit under Section 10(a)(2)(A)(i) of the Endangered Species Act unless you submit a conservation plan that specifies the impacts that are likely to result from the incidental take associated with your activity.

Our general permit regulations at 50 CFR 13.12(a)(9) allow us to collect such other information as we determine that is relevant to the processing of a permit application. Before you submit an application for an Incidental Take permit, we may require that you conduct biological surveys to determine which species and/or habitat would be impacted by the activities sought to be covered under the permit. Biological surveys provide information necessary to develop an adequate HCP, and to assess the biological impacts of the proposed activities. In addition, the information provided in a biological survey can reduce the applicant's risk of take under Section 9 of the Endangered Species Act by ensuring that affected species and/or habitat are identified and appropriately covered under the permit.

You are required to obtain a Scientific Purposes, Enhancement of Propagation or Survival permit (commonly called a Recovery permit) from us before engaging in any biological survey activities that would take listed species. Contact our Ecological Services Field Office closest to the location of your activity to obtain technical assistance in determining the need for both a biological survey and a Recovery permit for your survey activity. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

If a biological survey is required, you will need to send us your complete Recovery permit application package at least 3 months prior to commencement of survey activities to facilitate processing of your Recovery permit application. The Recovery permit application is designated as U.S. Fish & Wildlife Service form # 3-200-55 and can be found on our Endangered Species permit web page at http://www.fws.gov/forms/3-200-55.pdf.

We maintain a list of Recovery permittees (such as biological consultants) who have authorized the release of their contact information to third parties for conducting biological surveys on a contract basis. This list is provided to the public at the discretion of each U.S.

Fish and Wildlife Service Regional Office as time and workload allow. Please be aware that this list does not represent an endorsement by us of any particular permittee.

****

If you are not applying as an individual but as a business, corporation, institution, or non-Federal public agency (block B. on page 1 of the application), the person to whom the permit will be issued (e.g., the landowner, president, director, executive director, or executive officer) is legally responsible for implementing the permit. Although other people under the direct control of the permittee (e.g., employees, contractors, consultants) receive third party take authorization in their capacity as designees of the permittee, the individual named as the permittee ultimately is legally responsible for the permit and any activities carried out under the permit except as otherwise limited in the case of permits issued to State or local government entities under 50 CFR 13.25(e).

****

If you wish to coordinate the processing of this permit application through an **authorized agent**, and to have that agent represent you as the primary contact with us, check the box below. Sign (in blue ink) and date the authorization statement, and provide contact information for your authorized agent.

☒ I hereby authorize the following person to act as an authorized agent on my behalf in the processing of this permit application and to furnish, upon request, supplemental information in support of this permit application.

Alise P. Priddy — signature (in blue ink)

5/23/10 — date

Alise P. Priddy — please print name legibly

Your Authorized Agent's Contact Information (please print legibly)

Name: Tom Jones

Address: 2600 Golden Gate Pkwy.

City: Naples State: FL Zip Code: 34105

Telephone: 239-262-2600

Fax: 239-261-1797

E-Mail: TJones@barroncollier.com

INCIDENTAL TAKE PERMIT APPLICATION INSTRUCTIONS

You have 4 options for providing the required information for an Incidental Take permit application. Choose only one option.

Incidental Take Permit Application: Option I. Renewal of a Valid Incidental Take Permit.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal.

Sign the following statement if you are applying to renew an existing valid Incidental Take permit. If you are proposing major changes to your Incidental Take permit, you must use Option II.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct and hereby request renewal of that permit.
>
> _____ _____
> signature (in blue ink) date
>
> _____
> please print name legibly
>
> * Please note: If you have signed the above statement, then your renewal request is complete. Please submit completed pages 1 through 5 of this application to our Regional Office (see attached list) covering the location of your proposed activity. Requests for renewals must be received no later than 30 days prior to permit expiration to ensure that your current permit remains in effect while we process your renewal request.

Incidental Take Permit Application: Option II. Amended Incidental Take Permit (with *major changes*)

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for amendment.

Sign the following statement if you are proposing to amend a valid Incidental Take permit by making major changes. Such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct, except for the changes listed below, and hereby request amendment of that permit.

_____ _____

signature (in blue ink) date

_____

please print name legibly

Provide a brief description of the changes to your valid permit (answer the appropriate questions for these changes under Incidental Take Permit Application Option III. below). Please submit completed pages 1 through 6 of this application form (along with the changed information relative to Option III. below) to our Regional Office (see attached list) covering the location of your proposed activity.

Incidental Take Permit Application: Option III. New Incidental Take Permit & Supplementary Information for Amendment of a Valid Permit (with *major changes*).

General permit regulations for the U.S. Fish & Wildlife Service can be found at 50 CFR 13. Regulations for an Incidental Take permit under the Endangered Species Act can be found at 50 CFR 17.22(b)(1) for endangered wildlife species and 50 CFR 17.32(b)(1) for threatened wildlife species.

Each landowner who wishes to be covered under a new or amended Incidental Take permit associated with an HCP must sign (in blue ink) and date the Incidental Take Permit Application Certification Notice at the end of this application, unless the landowner will be covered under this U.S. Fish & Wildlife Service Incidental Take permit via another vehicle, such as a certificate of inclusion (50 CFR 13.25(d)). Any change in the language of the Certification Notice must be reviewed by the Department of Interior, Office of the Solicitor and approved by the U.S. Fish & Wildlife Service. The same person who signs in box D. on page 1 of the application should sign the certification.

If the information in items A. - D. below is already provided in your final HCP (or Implementing Agreement, if applicable), then you do not have to provide it here. Instead, check the box below and use the spaces provided in items A. - D. to indicate the page numbers in your HCP or Implementing Agreement that provide the requested information.

☒ I am not providing the following information for items A. - D. as part of my Incidental Take permit application, because it is already provided in my final HCP or Implementing Agreement (copy attached or already submitted).

If the requested information in items A. - D. is not provided in your final HCP or final Implementing Agreement, or you are using Option II. to amend your existing valid Incidental Take permit, then attach separate pages for the missing information. In order to assist us in processing your request, please provide the item number (A. 1.a., etc.) of the required information before each of your responses. Thank you.

Please ensure that your final HCP and Implementing Agreement (if applicable) are attached if it has not been previously submitted.

If you have previously submitted a final draft HCP or Implementing Agreement, please indicate the document's date.

Date of final draft HCP TBD (MSHCP summary attached.)

Date of final draft Implementing Agreement TBD

Applications for an Incidental Take permit associated with an HCP must provide the following specific information (relevant to the activity) under items A.- D. below in addition to the general information on page 1 of this application.

A. Identify species and activity:

1. For a new Incidental Take permit:

   a. Provide the common and scientific names of the species being requested for coverage in the permit and their status (endangered (E), threatened (T), proposed endangered (PE), proposed threatened (PT), candidate for listing (C), or species likely to become a candidate (LC)).

   b. Provide the number, age, and sex of such species to the extent known

   c. Quantify the anticipated effects to their habitat.

   d. Describe the land use or water management activity sought to be authorized for each species.

2. For an amended Incidental Take permit:

   a. Identify the species to be added to your valid permit (provide both the scientific, to the most specific taxonomic level, and common names), as well as the species status (see 1.a.. above).

   b. Provide the number, age and sex of such species to the extent known.

   c. If any activities requested in this application differ from those authorized in your valid permit, then for each

species state the currently authorized activity, the requested new activity, and how the new activity will impact each species.

d. Identify each activity associated with your project that would result in the incidental take of each species.

e. Quantify any anticipated effects to the habitat of each added species.

f. Identify species to be deleted from your valid permit and the reason(s) for the deletion.

Page(s) & source document : _____

B. Identify location of the proposed activity:

1. Provide the name of the State, county, and specific location of the proposed activity site(s). Include a formal legal description, section/township/range information, county tax parcel number, local address, or any other identifying property designation that will precisely place the location of the proposed activity site(s). Attach a location map and plat of the project site clearly depicting the project boundaries and the footprint and location of all portions of the property that would be affected by your proposed activities.

2. Provide the total number of acres covered by the HCP 177,000+/-

   Is this the total acreage of the parcel? (circle one) (yes) no

3. Provide the approximate number of acres to be impacted 45,000

4. Provide the approximate number of acres to be protected 132,000

5. Provide a complete description, including timeframes, for implementation of proposed voluntary management activities to enhance, restore, or maintain habitat benefiting federally listed, proposed or candidate species, or other species likely to become candidates. Include schedules for implementing these activities.

Page(s) & source document: See attached MSHCP summary.

C. Describe the proposed activities in the conservation plan:
You must submit a Habitat Conservation Plan. We strongly encourage you to ensure that your HCP is consistent with the Habitat Conservation Planning Handbook, subsequent Handbook addendums, and current policies to minimize delays in evaluating your application. The Handbook and other HCP information is available on the U.S. Fish & Wildlife Service's Endangered Species web page at http://www.fws.gov/endangered/hcp/index.html

Provide a complete description of activity(ies) to be authorized or reference the applicable HCP or Implementing Agreement page numbers identifying the subject information.

The HCP must specify:

1. The impact that will likely result from the incidental taking. A discussion of the impact that will likely result from the incidental take should include quantification of any anticipated effects to the habitat of the species sought to be covered by the permit.

2. The steps that will be taken to minimize and mitigate such impacts, the funding that will be available to implement such steps, and the procedures to deal with unforeseen circumstances.

3. The steps that will be taken to monitor and report on such impacts, including a copy of the monitoring plan. We are authorized to require reports of activities conducted under a permit per the U.S. Fish & Wildlife Service's general permit regulations at 50 CFR 13.45.

4. Alternative actions to such incidental taking that have been considered and the reasons why these alternatives are not proposed for use.

5. The biological goals(s) and objectives for the HCP.

6. The duration requested for the proposed permit.

Page(s) & source document: See attached HCP summary.

D. Implementing Agreement

An Implementing Agreement

is *is not* (FWS *Regional Office* to circle one)

required as part of the permit application for a Habitat Conservation Plan.

This Implementing Agreement must be signed at finalization of the HCP. Are you willing to commit to an Implementing Agreement at finalization of the HCP?

☒ Yes, I am willing to commit to an Implementing Agreement. Please submit any unsigned, draft Implementing Agreement that you have prepared with our Field Office.

☐ No, I am not willing to commit to an Implementing Agreement.

Incidental Take Permit Application: Option IV. Permit Transfer or Succession of a Permit

Complete the following if you are applying for transfer of a valid Incidental Take permit to you or obtaining rights of succession of a valid Incidental Take permit. In addition, you and the current permit holder may also need to sign an Assumption Agreement. Please contact our Ecological Services Field Office nearest your activity to determine whether you and the current permit holder need to execute an Assumption Agreement. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please indicate the name of the HCP to be transferred or succeeded and indicate the document's date.

Name of HCP _____

Date of HCP _____

An Assumption Agreement

is ***is not*** (FWS Ecological Services *Field Office* to circle one)

required as part of the transfer or succession permit application for the HCP.

Incidental Take Permit Application

Certification Notice

The same person who signs in box D. on page 1 of the application should sign (in blue ink) the following certification.

By submitting this application and receiving an Incidental Take permit pursuant to Section 10(a)(1)(B) of the Endangered Species Act, I

Alise P. Priddy (print name(s)) attest that I/we own the lands indicated in this application, or have sufficient authority or rights over these lands to implement the measures of the Habitat Conservation Plan (and Implementing Agreement if applicable) covered by the Incidental Take permit. Further, upon receipt of the Incidental Take permit, I/we agree to conduct the activities as specified in the Habitat Conservation Plan (and Implementing Agreement if applicable) according to the terms and conditions of the Incidental Take permit and its supporting documents.

Alise P. Priddy — signature (in blue ink)

5/23/2010 — date

Alise P. Priddy — please print name legibly

_____ — signature (in blue ink)

_____ — date

_____ — please print name legibly

****

The public reporting burden for completing this application for an Incidental Take permit is estimated to be 3 hours, including time for reviewing instructions, gathering and maintaining application data, and completing and reviewing the forms. Comments regarding the burden estimate or any other aspect of the reporting requirement(s) should be directed to the U.S. Fish & Wildlife Service Information Collection Clearance Officer, MS 222 ARLSQ, U.S. Fish and Wildlife Service, Washington, DC 20240.

An agency may not conduct and a person is not required to respond to a collection of information unless a currently valid OMB control number is displayed.

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USFWS Regional Contacts for Native Endangered & Threatened Species Permits

Pacific Region (Region 1): HI, ID, OR, WA, American Samoa, Commonwealth of the Northern Mariana Islands, Guam, and the Pacific Trust Territories

U.S. Fish and Wildlife Service
Endangered Species Permit Office
911 NE 11th Avenue
Portland, Oregon 97232-4181

Web: http://www.fws.gov/pacific/ecoservices/endangered/index.html
Phone: (503) 231-2071
email: permitsR1ES@fws.gov
Fax: (503) 231-6243

California & Nevada Region (Region 8): CA and NV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
2800 Cottage Way, Suite W-2606
Sacramento, California 95825 -1846

Web: http://www.fws.gov/cno/es/recovery.html
Phone: (916) 414-6464
email: permitsCNES@fws.gov
Fax: (916) 414-6486

Southwest Region (Region 2): AZ, NM, OK, and TX

U.S. Fish and Wildlife Service
Endangered Species Permit Office
500 Gold Avenue S.W. (street address)
P.O. Box 1306 (mailing address)
Albuquerque, New Mexico 87103-1306

Web: http://www.fws.gov/southwest/es/EndangeredSpecies/
Phone: (505) 248-6633
email: permitsR2ES@fws.gov
Fax: (505) 248-6788

Midwest Region (Region 3): IA, IL, IN, MI, MN, MO, OH, and WI

U.S. Fish and Wildlife Service
Endangered Species Permit Office
B.H. Whipple Federal Building
One Federal Drive
Fort Snelling, Minnesota 55111-4056

Web: http://www.fws.gov/midwest/Endangered/
Phone: (612) 713-5343
email: permitsR3ES@fws.gov
Fax: (612) 713-5292

Southeast Region (Region 4): AL, AR, FL, GA, KY, LA, MS, NC, PR, SC, TN, and U.S. Virgin Islands

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1875 Century Blvd., Suite 200
Atlanta, Georgia 30345

Web: http://www.fws.gov/southeast/es/#
Phone: (404) 679-7313
email: permitsR4ES@fws.gov
Fax: (404) 679-7081

Northeast Region (Region 5): CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, and WV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
300 Westgate Center Drive
Hadley, MA 01035-9589

Web: http://www.fws.gov/northeast/endangered/
Phone: (413) 253-8615
email: permitsR5ES@fws.gov
Fax: (413) 253-8482

Mountain-Prairie Region (Region 6): CO, KS, MT, NE, ND, SD, UT, and WY

U.S. Fish and Wildlife Service
Endangered Species Permit Office
Denver Federal Center
P.O. Box 25486
Denver, Colorado 80225-0489

Web: http://www.fws.gov/mountain%2Dprairie/endspp/
Phone: (303) 236-7400
email: permitsR6ES@fws.gov
Fax: (303) 236-0027

Alaska Region (Region 7): AK

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1011 E. Tudor Road
Anchorage, Alaska 99503-6199

Web: http://alaska.fws.gov/fisheries/endangered/index.htm
Phone: (907) 786-3323
email: permitsR7ES@fws.gov
Fax: (907) 786-3350

PERMIT APPLICATION FORM INSTRUCTIONS

The following instructions pertain to the standard permit form 3-200 that must be completed as an application for a U.S. Fish and Wildlife Service or CITES permit. The General Permit Procedures in 50 CFR 13 address the permitting process. For simplicity, all licenses, permits, registrations, and certificates will be referred to as a permit.

GENERAL INSTRUCTIONS:

- Complete all blocks/lines/questions in Sections A or B, and C and D. Complete all of Section E.
- **An incomplete application may cause delays in processing or may be returned to the applicant. Be sure you are filling in the appropriate application form for the proposed activity.**
- Print clearly or type in the information. Illegible applications may cause delays.
- Sign the application in blue ink. Faxes or copies of the original signature will not be accepted.
- Mail the original application to the address at the top of page one of the application or if applicable on the attached address list.
- **Keep a copy of your completed application.**
- **Please plan ahead. Allow at least 60 days for your application to be processed. Some applications may take longer than 90 days to process. (50 CFR 13.11)**
- Applications are processed in the order they are received.
- Additional forms and instructions are available from http://permits.fws.gov/ .

COMPLETE EITHER SECTION A OR SECTION B:

Section A. **Complete if applying as an individual:**

- Enter the complete name of the responsible individual who will be the permittee if a permit is issued. Enter personal information that identifies the applicant. ***Fax and e-mail are not required if not available.***
- If you are applying on behalf of a client, the personal information must pertain to the client, and a document evidencing power of attorney must be included with the application.
- **Affiliation/ Doing business as (dba):** business, agency, organizational, or institutional affiliation *directly* related to the activity requested in the application (e.g., a taxidermist is an individual whose business can *directly* relate to the requested activity). The Division of Management Authority (DMA) will **not** accept *doing business as* affiliations for individuals.

Section B. **Complete if applying as a business, corporation, public agency, or institution:**

- Enter the complete name of the business, agency or institution that will be the permittee if a permit is issued. Give a brief description of the type of business the applicant is engaged in. Provide contact phone number(s) of the business.
- **Principal Officer** is the person in charge of the listed business, corporation, public agency, or institution. The principal officer is the person responsible for the application and any permitted activities. Often the principal officer is a Director or President. **Primary Contact** is the person at the business, corporation, public agency, or institution who will be available to answer questions about the application or permitted activities. Often this is the preparer of the application.

ALL APPLICANTS COMPLETE SECTION C:

- For all applications submitted to the Division of Management Authority (DMA) a physical U.S. address is **required.** Province and Country blocks are provided for those USFWS programs which use foreign addresses and are not required by DMA..
- **Mailing address** is address where communications from USFWS should be mailed if different than applicant's physical address.

ALL APPLICANTS COMPLETE SECTION D:

Section D.1 **Application processing fee:**

- An application processing fee is required at the time of application; unless exempted under 50 CFR13.11(d)(3). The application processing fee is assessed to partially cover the cost of processing a request. **The fee does not guarantee the issuance of a permit. Fees will not be refunded for applications that are approved, abandoned, or denied.** We may return fees for withdrawn applications prior to any significant processing occurring.
- **Documentation of fee exempt status is not required for Federal, tribal, State, or local government agencies; but must be supplied by those applicants acting on behalf of such agencies.** Those applicants acting on behalf of such agencies must submit a letter on agency letterhead and signed by the head of the unit of government for which the applicant is acting on behalf, confirming that the applicant will be carrying out the permitted activity for the agency.

Section D.2 **Federal Fish and Wildlife permits:**

- List the number(s) of your most current FWS or CITES permit or the number of the most recent permit if none are currently valid. If applying for re-issuance of a CITES permit, the original permit must be returned with this application.

Section D.3 **CERTIFICATION:**

- **The individual identified in Section A, the principal officer named in Section B, or person with a valid power of attorney (documentation must be included in the application) must sign and date the application in blue ink.** This signature binds the applicant to the statement of certification. This means that you certify that you have read and understand the regulations that apply to the permit. You also certify that everything included in the application is true to the best of your knowledge. Be sure to read the statement and re-read the application and your answers before signing.

Please continue to next page

APPLICATION FOR A FEDERAL FISH AND WILDLIFE PERMIT
Paperwork Reduction Act, Privacy Act, and Freedom of Information Act – Notices

In accordance with the Paperwork Reduction Act of 1995 (44 U.S.C. 3501, *et seq.*) and the Privacy Act of 1974 (5 U.S.C. 552a), please be advised:

1. The gathering of information on fish and wildlife is authorized by:
(Authorizing statutes can be found at: http://www.gpoaccess.gov/cfr/index.html and http://www.fws.gov/permits/ltr/ltr.shtml.)

   a. Bald and Golden Eagle Protection Act (16 U.S.C. 668), 50 CFR 22;
   b. Endangered Species Act of 1973 (16 U.S.C. 1531-1544), 50CFR 17;
   c. Migratory Bird Treaty Act (16 U.S.C. 703-712), 50 CFR 21;
   d. Marine Mammal Protection Act of 1972 (16 U.S.C. 1361, *et. seq.*), 50 CFR 18;
   e. Wild Bird Conservation Act (16 U.S.C. 4901-4916), 50 CFR 15;
   f. Lacey Act: Injurious Wildlife (18 U.S.C. 42), 50 CFR 16;
   g. Convention on International Trade in Endangered Species of Wild Fauna and Flora (TIAS 8249), http://www.cites.org/ , 50 CFR 23;
   h. General Provisions, 50 CFR 10;
   i. General Permit Procedures, 50 CFR 13; and
   j. Wildlife Provisions (Import/export/transport), 50 CFR 14.

2. Information requested in this form is purely voluntary. However, submission of requested information is required in order to process applications for permits authorized under the above laws. Failure to provide all requested information may be sufficient cause for the U.S. Fish and Wildlife Service to deny the request. Response is not required unless a currently valid Office of Management and Budget (OMB) control number is displayed on form.

3. Certain applications for permits authorized under the Endangered Species Act of 1973 (16 U.S.C. 1539) and the Marine Mammal Protection Act of 1972 (16 U.S.C. 1374) will be published in the **Federal Register** as required by the two laws.

4. Disclosures outside the Department of the Interior may be made without the consent of an individual under the routine uses listed below, if the disclosure is compatible with the purposes for which the record was collected. (Ref. 68 FR 52611, September 4, 2003)

   a. Routine disclosure to subject matter experts, and Federal, tribal, State, local, and foreign agencies, for the purpose of obtaining advice relevant to making a decision on an application for a permit or when necessary to accomplish a FWS function related to this system of records.
   b. Routine disclosure to the public as a result of publishing **Federal Register** notices announcing the receipt of permit applications for public comment or notice of the decision on a permit application.
   c. Routine disclosure to Federal, tribal, State, local, or foreign wildlife and plant agencies for the exchange of information on permits granted or denied to assure compliance with all applicable permitting requirements.
   d. Routine disclosure to Captive-bred Wildlife registrants under the Endangered Species Act for the exchange of authorized species, and to share information on the captive breeding of these species.
   e. Routine disclosure to Federal, tribal, State, and local authorities who need to know who is permitted to receive and rehabilitate sick, orphaned, and injured birds under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act; federally permitted rehabilitators; individuals seeking a permitted rehabilitator with whom to place a bird in need of care; and licensed veterinarians who receive, treat, or diagnose sick, orphaned, and injured birds.
   f. Routine disclosure to the Department of Justice, or a court, adjudicative, or other administrative body or to a party in litigation before a court or adjudicative or administrative body, under certain circumstances.
   g. Routine disclosure to the appropriate Federal, tribal, State, local, or foreign governmental agency responsible for investigating, prosecuting, enforcing, or implementing statutes, rules, or licenses, when we become aware of a violation or potential violation of such statutes, rules, or licenses, or when we need to monitor activities associated with a permit or regulated use.
   h. Routine disclosure to a congressional office in response to an inquiry to the office by the individual to whom the record pertains.
   i. Routine disclosure to the General Accounting Office or Congress when the information is required for the evaluation of the permit programs.
   j. Routine disclosure to provide addresses obtained from the Internal Revenue Service to debt collection agencies for purposes of locating a debtor to collect or compromise a Federal claim against the debtor or to consumer reporting agencies to prepare a commercial credit report for use by the FWS.

5. For individuals, personal information such as home address and telephone number, financial data, and personal identifiers (social security number, birth date, etc.) will be removed prior to any release of the application.

6. The public reporting burden on the applicant for information collection varies depending on the activity for which a permit is requested. The relevant burden for an **Incidental Take** permit application is **3 hours**. This burden estimate includes time for reviewing instructions, gathering and maintaining data and completing and reviewing the form. You may direct comments regarding the burden estimate or any other aspect of the form to the Service Information Clearance Officer, U.S. Fish and Wildlife Service, Mail Stop 222, Arlington Square, U.S. Department of the Interior, 1849 C Street, NW, Washington D.C. 20240.

Freedom of Information Act – Notice

For organizations, businesses, or individuals operating as a business (i.e., permittees not covered by the Privacy Act), we request that you identify any information that should be considered privileged and confidential business information to allow the Service to meet its responsibilities under FOIA. Confidential business information must be clearly marked "Business Confidential" at the top of the letter or page and each succeeding page and must be accompanied by a non-confidential summary of the confidential information. The non-confidential summary and remaining documents may be made available to the public under FOIA [43 CFR 2.13(c)(4), 43 CFR 2.15(d)(1)(i)].

Department of the Interior
U.S. Fish and Wildlife Service

Expires Nov. 30, 2010
OMB No. 1018-0094

Federal Fish and Wildlife Permit Application Form

Return to: U.S. Fish and Wildlife Service (USFWS)

Type of Activity: Native Endangered and Threatened Species –

Incidental Take Permits Associated with a Habitat Conservation Plan (HCP)

Complete Sections A or B, and C, D, and E of this application. U.S. address may be required in Section C, see instructions for details.
See attached instruction pages for information on how to make your application complete and help avoid unnecessary delays.

A. Complete if applying as an individual

1.a. Last name	1.b. First name	1.c. Middle name or initial	1.d. Suffix

2. Date of birth (mm/dd/yyyy)	3. Social Security No.	4. Occupation	5. Affiliation/ Doing business as (see instructions)

6.a. Telephone number	6.b. Alternate telephone number	6.c. Fax number	6.d. E-mail address

B. Complete if applying on behalf of a business, corporation, public agency or institution

1.a. Name of business, agency, or institution	1.b. Doing business as (dba)
Sunniland Family Limited Partnership	N/A

2. Tax identification no.	3. Description of business, agency, or institution
20-1804591	ranching and land management

4.a. Principal officer Last name	4.b. Principal officer First name	4.c. Principal officer Middle name/ initial	4.d. Suffix
Priddy	Aliese	Price	

5. Principal officer title	6. Primary contact
managing member	Russell A. Priddy

7.a. Business telephone number	7.b. Alternate telephone number	7.c. Business fax number	7.d. Business e-mail address
239 289-0064	239 657-4380	n/A	RAP053155@aol.com

C. All applicants complete address information

1.a. Physical address (Street address; Apartment #, Suite #, or Room #; no P.O. Boxes)
7007 State Road 29 South

1.b. City	1.c. State	1.d. Zip code/Postal code:	1.e. County/Province	1.f. Country
Immokalee	FL	34142	Collier	USA

2.a. Mailing Address (include if different than physical address; include name of contact person if applicable)
P.O. Box 930

2.b. City	2.c. State	2.d. Zip code/Postal code:	2.e. County/Province	2.f. Country
Immokalee	FL	34143	Collier	USA

D. All applicants MUST complete

1. Attach check or money order payable to the U.S. FISH AND WILDLIFE SERVICE **in the amount indicated on page 2.** Federal, tribal, State, and local government agencies, and those acting on behalf of such agencies, are exempt from the processing fee – ***attach documentation of fee exempt status as outlined in instructions.*** (50 CFR 13.11(d))

2. Do you currently have or have you ever had any Federal Fish and Wildlife permits?
Yes ☐ If yes, list the number of the most current permit you have held or that you are applying to renew/re-issue: _____
No ☒

3. Certification: I hereby certify that I have read and am familiar with the regulations contained in ***Title 50, Part 13 of the Code of Federal Regulations*** and the other ***applicable parts in subchapter B of Chapter I of Title 50***, and I certify that the information submitted in this application for a permit is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to the criminal penalties of 18 U.S.C. 1001.

Aliese P. Priddy — Signature (in blue ink) of applicant/person responsible for permit (No photocopied or stamped signatures)

05/23/2010 — Date of signature (mm/dd/yyyy)

Please continue to next page

** See page 14 for additional instructions on completing the above form. See page 15 for information on the Paperwork Reduction Act, Privacy Act, and Freedom of Information Act aspects of this application form.

Section E. **ALL APPLICANTS COMPLETE SECTION E.** Provide the information outlined in Section E. on the following pages. Be as complete and descriptive as possible. Please do not send pages that are over 8.5"X 11", videotapes, or DVDs.

INCIDENTAL TAKE PERMITS ASSOCIATED WITH A HABITAT CONSERVATION PLAN (HCP)

Have you obtained all required State, Federal or foreign government approval to conduct the activity you propose? Please be aware that there may be other requirements necessary to conduct this activity such as an import permit, collection permit, permission to work on Federal lands, Federal bird banding permit, Corps of Engineers permits, Environmental Protection Agency NPDES permits, State, county or local permits, etc.

☐ Yes. Provide a copy of the approval(s). List the State, Federal or foreign countries involved and type of document required. Include a copy of these documents with the application.

☐ I have applied. List the State, Federal or foreign countries involved and type of documents required. Provide the reasons why the permits have not been issued _____.

☒ Not required. ~~The proposed activity is not regulated.~~ Not required at this time. MSHCP precedes future activities.

Application Processing Fees

The application processing fee for a new Incidental Take permit, or to renew/re-issue an existing valid permit, is $100. If permit amendment is required at a time other than renewal/re-issuance, the processing fee is $50.

Check the appropriate box below and enclose check or money order payable to the *U.S. Fish and Wildlife Service* in the amount of

☒ $100 for a **new** permit

OR

☐ $100 to **renew/re-issue** my existing valid permit (with only *minor changes* such as updating my name and address) using my current application package on file.

OR

☐ $50 to make a **substantive amendment** (with *major changes*) to my existing valid permit [50 CFR 13.11(d)(2)].

If the information in your current application package on file has changed in a manner that triggers a major amendment or a change not otherwise specified in the permit, then you must apply for an amendment to your valid permit. For example, such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit. Please contact our Ecological Services Field Office located closest to your proposed activity for technical assistance in making this determination. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please check the **type of amendment** you are requesting --

☐ add species (specify) _____

☐ add a geographic area ☐ change in personnel

☐ other (specify) _____

If this application includes **transfer or succession** of a valid Incidental Take permit, please check the box below:

☐ Transfer or succession of a valid Incidental Take permit associated with a HCP using the current application package on file. No application fee is required.

Application Processing Time

To expedite a final decision on your application, you are urged to coordinate with us as soon as possible for guidance in assembling a complete application package. If you are renewing or amending a valid permit, your complete application package must be received at least 30 days prior to the expiration of the valid permit. This time period begins when we receive a complete permit application package and does not include any time required for requesting clarification or additional information about your application.

The time required to process an application for an Incidental Take permit will vary depending on the size, complexity, and impacts of the HCP involved. Procedurally, the most variable factor in application processing is the level of analysis required for the proposed HCP under the National Environmental Policy Act (e.g., whether an application requires preparation of an Environmental Impact Statement, Environmental Assessment, or whether a categorical exclusion applies), although other factors such as public controversy can also affect application processing times. The target processing timeline from when we receive a complete application package to our final decision on a permit application is: up to 3 months for low-effect HCPs, 4 to 6 months for HCPs with an Environmental Assessment, and up to 12 months for HCPs with a 90-day comment period and/or an Environmental Impact Statement. Although not mandated by law or regulation, these targets are adopted as U.S. Fish & Wildlife Service and National Marine Fisheries Service (NMFS/NOAA Fisheries) policy and all offices are expected to streamline their Incidental Take permit programs, and to meet these targets to the maximum extent practicable.

The information provided in your permit application will be used to evaluate your application for compliance with the Endangered Species Act, its implementing regulations (which may require a 30 day public comment period), and with U.S. Fish and Wildlife Service policy. Receipt and possession of a permit under the Endangered Species Act should be regarded as a privilege, as we must balance permit issuance with our duties to protect and recover listed species.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal, re-issuance or amendment.

If your activities may affect species under the authority of the National Marine Fisheries Service (NMFS/NOAA Fisheries), then you may need to obtain a separate permit from that agency. In addition we share jurisdiction with NMFS/NOAA Fisheries for sea turtles (e.g., we evaluate applications for permits to conduct activities impacting sea turtles on land, and NMFS/NOAA Fisheries evaluates applications for permits to conduct activities impacting sea turtles in the marine environment). To apply for a permit to conduct activities with sea turtles in the marine environment or other species under NMFS/NOAA Fisheries jurisdiction, please contact them via their permit web page at http://www.nmfs.noaa.gov/pr/permits/

We cannot issue an Incidental Take permit under Section 10(a)(2)(A)(i) of the Endangered Species Act unless you submit a conservation plan that specifies the impacts that are likely to result from the incidental take associated with your activity.

Our general permit regulations at 50 CFR 13.12(a)(9) allow us to collect such other information as we determine that is relevant to the processing of a permit application. Before you submit an application for an Incidental Take permit, we may require that you conduct biological surveys to determine which species and/or habitat would be impacted by the activities sought to be covered under the permit. Biological surveys provide information necessary to develop an adequate HCP, and to assess the biological impacts of the proposed activities. In addition, the information provided in a biological survey can reduce the applicant's risk of take under Section 9 of the Endangered Species Act by ensuring that affected species and/or habitat are identified and appropriately covered under the permit.

You are required to obtain a Scientific Purposes, Enhancement of Propagation or Survival permit (commonly called a Recovery permit) from us before engaging in any biological survey activities that would take listed species. Contact our Ecological Services Field Office closest to the location of your activity to obtain technical assistance in determining the need for both a biological survey and a Recovery permit for your survey activity. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

If a biological survey is required, you will need to send us your complete Recovery permit application package at least 3 months prior to commencement of survey activities to facilitate processing of your Recovery permit application. The Recovery permit application is designated as U.S. Fish & Wildlife Service form # 3-200-55 and can be found on our Endangered Species permit web page at http://www.fws.gov/forms/3-200-55.pdf.

We maintain a list of Recovery permittees (such as biological consultants) who have authorized the release of their contact information to third parties for conducting biological surveys on a contract basis. This list is provided to the public at the discretion of each U.S.

Fish and Wildlife Service Regional Office as time and workload allow. Please be aware that this list does not represent an endorsement by us of any particular permittee.

****

If you are not applying as an individual but as a business, corporation, institution, or non-Federal public agency (block B. on page 1 of the application), the person to whom the permit will be issued (e.g., the landowner, president, director, executive director, or executive officer) is legally responsible for implementing the permit. Although other people under the direct control of the permittee (e.g., employees, contractors, consultants) receive third party take authorization in their capacity as designees of the permittee, the individual named as the permittee ultimately is legally responsible for the permit and any activities carried out under the permit except as otherwise limited in the case of permits issued to State or local government entities under 50 CFR 13.25(e).

****

If you wish to coordinate the processing of this permit application through an **authorized agent**, and to have that agent represent you as the primary contact with us, check the box below. Sign (in blue ink) and date the authorization statement, and provide contact information for your authorized agent.

☒ I hereby authorize the following person to act as an authorized agent on my behalf in the processing of this permit application and to furnish, upon request, supplemental information in support of this permit application.

Aliese P. Priddy
signature (in blue ink)

5/23/10
date

Aliese P. Priddy
please print name legibly

Your Authorized Agent's Contact Information (please print legibly)

Name: Tom Jones

Address: 2600 Golden Gate Pkwy

City: Naples State: FL Zip Code: 34105

Telephone: 239-262-2600

Fax: 239-261-1797

E-Mail: TJones@barroncollier.com

INCIDENTAL TAKE PERMIT APPLICATION INSTRUCTIONS

You have 4 options for providing the required information for an Incidental Take permit application. Choose only one option.

Incidental Take Permit Application: Option I. Renewal of a Valid Incidental Take Permit.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal.

Sign the following statement if you are applying to renew an existing valid Incidental Take permit. If you are proposing major changes to your Incidental Take permit, you must use Option II.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct and hereby request renewal of that permit.
>
> _____ _____
> signature (in blue ink) date
>
> _____
> please print name legibly
>
> * Please note: If you have signed the above statement, then your renewal request is complete. Please submit completed pages 1 through 5 of this application to our Regional Office (see attached list) covering the location of your proposed activity. Requests for renewals must be received no later than 30 days prior to permit expiration to ensure that your current permit remains in effect while we process your renewal request.

Incidental Take Permit Application: Option II. Amended Incidental Take Permit (with *major changes*)

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for amendment.

Sign the following statement if you are proposing to amend a valid Incidental Take permit by making major changes. Such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct, except for the changes listed below, and hereby request amendment of that permit.

_____ _____

signature (in blue ink) date

_____

please print name legibly

Provide a brief description of the changes to your valid permit (answer the appropriate questions for these changes under Incidental Take Permit Application Option III. below). Please submit completed pages 1 through 6 of this application form (along with the changed information relative to Option III. below) to our Regional Office (see attached list) covering the location of your proposed activity.

Incidental Take Permit Application: Option III. New Incidental Take Permit & Supplementary Information for Amendment of a Valid Permit (with *major changes*).

General permit regulations for the U.S. Fish & Wildlife Service can be found at 50 CFR 13. Regulations for an Incidental Take permit under the Endangered Species Act can be found at 50 CFR 17.22(b)(1) for endangered wildlife species and 50 CFR 17.32(b)(1) for threatened wildlife species.

Each landowner who wishes to be covered under a new or amended Incidental Take permit associated with an HCP must sign (in blue ink) and date the Incidental Take Permit Application Certification Notice at the end of this application, unless the landowner will be covered under this U.S. Fish & Wildlife Service Incidental Take permit via another vehicle, such as a certificate of inclusion (50 CFR 13.25(d)). Any change in the language of the Certification Notice must be reviewed by the Department of Interior, Office of the Solicitor and approved by the U.S. Fish & Wildlife Service. The same person who signs in box D. on page 1 of the application should sign the certification.

If the information in items A. - D. below is already provided in your final HCP (or Implementing Agreement, if applicable), then you do not have to provide it here. Instead, check the box below and use the spaces provided in items A. - D. to indicate the page numbers in your HCP or Implementing Agreement that provide the requested information.

☒ I am not providing the following information for items A. - D. as part of my Incidental Take permit application, because it is already provided in my final HCP or Implementing Agreement (copy attached or already submitted).

If the requested information in items A. - D. is not provided in your final HCP or final Implementing Agreement, or you are using Option II. to amend your existing valid Incidental Take permit, then attach separate pages for the missing information. In order to assist us in processing your request, please provide the item number (A. 1.a., etc.) of the required information before each of your responses. Thank you.

Please ensure that your final HCP and Implementing Agreement (if applicable) are attached if it has not been previously submitted.

If you have previously submitted a final draft HCP or Implementing Agreement, please indicate the document's date.

Date of final draft HCP TBD (MSHCP summary attached.)

Date of final draft Implementing Agreement TBD

Applications for an Incidental Take permit associated with an HCP must provide the following specific information (relevant to the activity) under items A.- D. below in addition to the general information on page 1 of this application.

A. Identify species and activity:

1. For a new Incidental Take permit:

   a. Provide the common and scientific names of the species being requested for coverage in the permit and their status (endangered (E), threatened (T), proposed endangered (PE), proposed threatened (PT), candidate for listing (C), or species likely to become a candidate (LC)).

   b. Provide the number, age, and sex of such species to the extent known

   c. Quantify the anticipated effects to their habitat.

   d. Describe the land use or water management activity sought to be authorized for each species.

2. For an amended Incidental Take permit:

   a. Identify the species to be added to your valid permit (provide both the scientific, to the most specific taxonomic level, and common names), as well as the species status (see 1.a.. above).

   b. Provide the number, age and sex of such species to the extent known.

   c. If any activities requested in this application differ from those authorized in your valid permit, then for each

species state the currently authorized activity, the requested new activity, and how the new activity will impact each species.

d. Identify each activity associated with your project that would result in the incidental take of each species.

e. Quantify any anticipated effects to the habitat of each added species.

f. Identify species to be deleted from your valid permit and the reason(s) for the deletion.

Page(s) & source document : _____

B. Identify location of the proposed activity:

1. Provide the name of the State, county, and specific location of the proposed activity site(s). Include a formal legal description, section/township/range information, county tax parcel number, local address, or any other identifying property designation that will precisely place the location of the proposed activity site(s). Attach a location map and plat of the project site clearly depicting the project boundaries and the footprint and location of all portions of the property that would be affected by your proposed activities.

2. Provide the total number of acres covered by the HCP 177,000+/-

   Is this the total acreage of the parcel? (circle one) (yes) no

3. Provide the approximate number of acres to be impacted 45,000

4. Provide the approximate number of acres to be protected 132,000

5. Provide a complete description, including timeframes, for implementation of proposed voluntary management activities to enhance, restore, or maintain habitat benefiting federally listed, proposed or candidate species, or other species likely to become candidates. Include schedules for implementing these activities.

Page(s) & source document: See attached MSHCP summary.

C. Describe the proposed activities in the conservation plan:
You must submit a Habitat Conservation Plan. We strongly encourage you to ensure that your HCP is consistent with the Habitat Conservation Planning Handbook, subsequent Handbook addendums, and current policies to minimize delays in evaluating your application. The Handbook and other HCP information is available on the U.S. Fish & Wildlife Service's Endangered Species web page at http://www.fws.gov/endangered/hcp/index.html

Provide a complete description of activity(ies) to be authorized or reference the applicable HCP or Implementing Agreement page numbers identifying the subject information.

The HCP must specify:

1. The impact that will likely result from the incidental taking. A discussion of the impact that will likely result from the incidental take should include quantification of any anticipated effects to the habitat of the species sought to be covered by the permit.

2. The steps that will be taken to minimize and mitigate such impacts, the funding that will be available to implement such steps, and the procedures to deal with unforeseen circumstances.

3. The steps that will be taken to monitor and report on such impacts, including a copy of the monitoring plan. We are authorized to require reports of activities conducted under a permit per the U.S. Fish & Wildlife Service's general permit regulations at 50 CFR 13.45.

4. Alternative actions to such incidental taking that have been considered and the reasons why these alternatives are not proposed for use.

5. The biological goals(s) and objectives for the HCP.

6. The duration requested for the proposed permit.

Page(s) & source document : See attached HCP summary.

D. Implementing Agreement

An Implementing Agreement

is *is not* (FWS *Regional Office* to circle one)

required as part of the permit application for a Habitat Conservation Plan.

This Implementing Agreement must be signed at finalization of the HCP. Are you willing to commit to an Implementing Agreement at finalization of the HCP?

☒ Yes, I am willing to commit to an Implementing Agreement. Please submit any unsigned, draft Implementing Agreement that you have prepared with our Field Office.

☐ No, I am not willing to commit to an Implementing Agreement.

Incidental Take Permit Application: Option IV. Permit Transfer or Succession of a Permit

Complete the following if you are applying for transfer of a valid Incidental Take permit to you or obtaining rights of succession of a valid Incidental Take permit. In addition, you and the current permit holder may also need to sign an Assumption Agreement. Please contact our Ecological Services Field Office nearest your activity to determine whether you and the current permit holder need to execute an Assumption Agreement. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please indicate the name of the HCP to be transferred or succeeded and indicate the document's date.

Name of HCP _____

Date of HCP _____

An Assumption Agreement

is ***is not*** (FWS Ecological Services *Field Office* to circle one)

required as part of the transfer or succession permit application for the HCP.

Incidental Take Permit Application

Certification Notice

The same person who signs in box D. on page 1 of the application should sign (in blue ink) the following certification.

By submitting this application and receiving an Incidental Take permit pursuant to Section 10(a)(1)(B) of the Endangered Species Act, I

Aliese P. Priddy (print name(s)) attest that I/we own the lands indicated in this application, or have sufficient authority or rights over these lands to implement the measures of the Habitat Conservation Plan (and Implementing Agreement if applicable) covered by the Incidental Take permit. Further, upon receipt of the Incidental Take permit, I/we agree to conduct the activities as specified in the Habitat Conservation Plan (and Implementing Agreement if applicable) according to the terms and conditions of the Incidental Take permit and its supporting documents.

Aliese P. Priddy — signature (in blue ink)

05/23/2010 — date

Aliese P. Priddy — please print name legibly

_____ signature (in blue ink)

_____ date

_____ please print name legibly

****

The public reporting burden for completing this application for an Incidental Take permit is estimated to be 3 hours, including time for reviewing instructions, gathering and maintaining application data, and completing and reviewing the forms. Comments regarding the burden estimate or any other aspect of the reporting requirement(s) should be directed to the U.S. Fish & Wildlife Service Information Collection Clearance Officer, MS 222 ARLSQ, U.S. Fish and Wildlife Service, Washington, DC 20240.

An agency may not conduct and a person is not required to respond to a collection of information unless a currently valid OMB control number is displayed.

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USFWS Regional Contacts for Native Endangered & Threatened Species Permits

Pacific Region (Region 1): HI, ID, OR, WA, American Samoa, Commonwealth of the Northern Mariana Islands, Guam, and the Pacific Trust Territories

U.S. Fish and Wildlife Service
Endangered Species Permit Office
911 NE 11th Avenue
Portland, Oregon 97232-4181

Web: http://www.fws.gov/pacific/ecoservices/endangered/index.html
Phone: (503) 231-2071
email: permitsR1ES@fws.gov
Fax: (503) 231-6243

California & Nevada Region (Region 8): CA and NV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
2800 Cottage Way, Suite W-2606
Sacramento, California 95825 -1846

Web: http://www.fws.gov/cno/es/recovery.html
Phone: (916) 414-6464
email: permitsCNES@fws.gov
Fax: (916) 414-6486

Southwest Region (Region 2): AZ, NM, OK, and TX

U.S. Fish and Wildlife Service
Endangered Species Permit Office
500 Gold Avenue S.W. (street address)
P.O. Box 1306 (mailing address)
Albuquerque, New Mexico 87103-1306

Web: http://www.fws.gov/southwest/es/EndangeredSpecies/
Phone: (505) 248-6633
email: permitsR2ES@fws.gov
Fax: (505) 248-6788

Midwest Region (Region 3): IA, IL, IN, MI, MN, MO, OH, and WI

U.S. Fish and Wildlife Service
Endangered Species Permit Office
B.H. Whipple Federal Building
One Federal Drive
Fort Snelling, Minnesota 55111-4056

Web: http://www.fws.gov/midwest/Endangered/
Phone: (612) 713-5343
email: permitsR3ES@fws.gov
Fax: (612) 713-5292

Southeast Region (Region 4): AL, AR, FL, GA, KY, LA, MS, NC, PR, SC, TN, and U.S. Virgin Islands

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1875 Century Blvd., Suite 200
Atlanta, Georgia 30345

Web: http://www.fws.gov/southeast/es/#
Phone: (404) 679-7313
email: permitsR4ES@fws.gov
Fax: (404) 679-7081

Northeast Region (Region 5): CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, and WV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
300 Westgate Center Drive
Hadley, MA 01035-9589

Web: http://www.fws.gov/northeast/endangered/
Phone: (413) 253-8615
email: permitsR5ES@fws.gov
Fax: (413) 253-8482

Mountain-Prairie Region (Region 6): CO, KS, MT, NE, ND, SD, UT, and WY

U.S. Fish and Wildlife Service
Endangered Species Permit Office
Denver Federal Center
P.O. Box 25486
Denver, Colorado 80225-0489

Web: http://www.fws.gov/mountain%2Dprairie/endspp/
Phone: (303) 236-7400
email: permitsR6ES@fws.gov
Fax: (303) 236-0027

Alaska Region (Region 7): AK

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1011 E. Tudor Road
Anchorage, Alaska 99503-6199

Web: http://alaska.fws.gov/fisheries/endangered/index.htm
Phone: (907) 786-3323
email: permitsR7ES@fws.gov
Fax: (907) 786-3350

PERMIT APPLICATION FORM INSTRUCTIONS

The following instructions pertain to the standard permit form 3-200 that must be completed as an application for a U.S. Fish and Wildlife Service or CITES permit. The General Permit Procedures in 50 CFR 13 address the permitting process. For simplicity, all licenses, permits, registrations, and certificates will be referred to as a permit.

GENERAL INSTRUCTIONS:

- Complete all blocks/lines/questions in Sections A or B, and C and D. Complete all of Section E.
- **An incomplete application may cause delays in processing or may be returned to the applicant. Be sure you are filling in the appropriate application form for the proposed activity.**
- Print clearly or type in the information. Illegible applications may cause delays.
- Sign the application in blue ink. Faxes or copies of the original signature will not be accepted.
- Mail the original application to the address at the top of page one of the application or if applicable on the attached address list.
- **Keep a copy of your completed application.**
- **Please plan ahead. Allow at least 60 days for your application to be processed. Some applications may take longer than 90 days to process. (50 CFR 13.11)**
- Applications are processed in the order they are received.
- Additional forms and instructions are available from http://permits.fws.gov/ .

COMPLETE EITHER SECTION A OR SECTION B:

Section A. **Complete if applying as an individual:**

- Enter the complete name of the responsible individual who will be the permittee if a permit is issued. Enter personal information that identifies the applicant. ***Fax and e-mail are not required if not available.***
- If you are applying on behalf of a client, the personal information must pertain to the client, and a document evidencing power of attorney must be included with the application.
- **Affiliation/ Doing business as (dba):** business, agency, organizational, or institutional affiliation *directly* related to the activity requested in the application (e.g., a taxidermist is an individual whose business can *directly* relate to the requested activity). The Division of Management Authority (DMA) will **not** accept *doing business as* affiliations for individuals.

Section B. **Complete if applying as a business, corporation, public agency, or institution:**

- Enter the complete name of the business, agency or institution that will be the permittee if a permit is issued. Give a brief description of the type of business the applicant is engaged in. Provide contact phone number(s) of the business.
- **Principal Officer** is the person in charge of the listed business, corporation, public agency, or institution. The principal officer is the person responsible for the application and any permitted activities. Often the principal officer is a Director or President. **Primary Contact** is the person at the business, corporation, public agency, or institution who will be available to answer questions about the application or permitted activities. Often this is the preparer of the application.

ALL APPLICANTS COMPLETE SECTION C:

- For all applications submitted to the Division of Management Authority (DMA) a physical U.S. address is **required**. Province and Country blocks are provided for those USFWS programs which use foreign addresses and are not required by DMA..
- **Mailing address** is address where communications from USFWS should be mailed if different than applicant's physical address.

ALL APPLICANTS COMPLETE SECTION D:

Section D.1 **Application processing fee:**

- An application processing fee is required at the time of application; unless exempted under 50 CFR13.11(d)(3). The application processing fee is assessed to partially cover the cost of processing a request. **The fee does not guarantee the issuance of a permit. Fees will not be refunded for applications that are approved, abandoned, or denied.** We may return fees for withdrawn applications prior to any significant processing occurring.
- **Documentation of fee exempt status is not required for Federal, tribal, State, or local government agencies; but must be supplied by those applicants acting on behalf of such agencies.** Those applicants acting on behalf of such agencies must submit a letter on agency letterhead and signed by the head of the unit of government for which the applicant is acting on behalf, confirming that the applicant will be carrying out the permitted activity for the agency.

Section D.2 **Federal Fish and Wildlife permits:**

- List the number(s) of your most current FWS or CITES permit or the number of the most recent permit if none are currently valid. If applying for re-issuance of a CITES permit, the original permit must be returned with this application.

Section D.3 **CERTIFICATION:**

- **The individual identified in Section A, the principal officer named in Section B, or person with a valid power of attorney (documentation must be included in the application) must sign and date the application in blue ink.** This signature binds the applicant to the statement of certification. This means that you certify that you have read and understand the regulations that apply to the permit. You also certify that everything included in the application is true to the best of your knowledge. Be sure to read the statement and re-read the application and your answers before signing.

Please continue to next page

APPLICATION FOR A FEDERAL FISH AND WILDLIFE PERMIT

Paperwork Reduction Act, Privacy Act, and Freedom of Information Act – Notices

In accordance with the Paperwork Reduction Act of 1995 (44 U.S.C. 3501, *et seq.*) and the Privacy Act of 1974 (5 U.S.C. 552a), please be advised:

1. The gathering of information on fish and wildlife is authorized by:
   (Authorizing statutes can be found at: http://www.gpoaccess.gov/cfr/index.html and http://www.fws.gov/permits/ltr/ltr.shtml.)

   a. Bald and Golden Eagle Protection Act (16 U.S.C. 668), 50 CFR 22;
   b. Endangered Species Act of 1973 (16 U.S.C. 1531-1544), 50CFR 17;
   c. Migratory Bird Treaty Act (16 U.S.C. 703-712), 50 CFR 21;
   d. Marine Mammal Protection Act of 1972 (16 U.S.C. 1361, *et. seq.*), 50 CFR 18;
   e. Wild Bird Conservation Act (16 U.S.C. 4901-4916), 50 CFR 15;
   f. Lacey Act: Injurious Wildlife (18 U.S.C. 42), 50 CFR 16;
   g. Convention on International Trade in Endangered Species of Wild Fauna and Flora (TIAS 8249), http://www.cites.org/ , 50 CFR 23;
   h. General Provisions, 50 CFR 10;
   i. General Permit Procedures, 50 CFR 13; and
   j. Wildlife Provisions (Import/export/transport), 50 CFR 14.

2. Information requested in this form is purely voluntary. However, submission of requested information is required in order to process applications for permits authorized under the above laws. Failure to provide all requested information may be sufficient cause for the U.S. Fish and Wildlife Service to deny the request. Response is not required unless a currently valid Office of Management and Budget (OMB) control number is displayed on form.

3. Certain applications for permits authorized under the Endangered Species Act of 1973 (16 U.S.C. 1539) and the Marine Mammal Protection Act of 1972 (16 U.S.C. 1374) will be published in the **Federal Register** as required by the two laws.

4. Disclosures outside the Department of the Interior may be made without the consent of an individual under the routine uses listed below, if the disclosure is compatible with the purposes for which the record was collected. (Ref. 68 FR 52611, September 4, 2003)

   a. Routine disclosure to subject matter experts, and Federal, tribal, State, local, and foreign agencies, for the purpose of obtaining advice relevant to making a decision on an application for a permit or when necessary to accomplish a FWS function related to this system of records.
   b. Routine disclosure to the public as a result of publishing **Federal Register** notices announcing the receipt of permit applications for public comment or notice of the decision on a permit application.
   c. Routine disclosure to Federal, tribal, State, local, or foreign wildlife and plant agencies for the exchange of information on permits granted or denied to assure compliance with all applicable permitting requirements.
   d. Routine disclosure to Captive-bred Wildlife registrants under the Endangered Species Act for the exchange of authorized species, and to share information on the captive breeding of these species.
   e. Routine disclosure to Federal, tribal, State, and local authorities who need to know who is permitted to receive and rehabilitate sick, orphaned, and injured birds under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act; federally permitted rehabilitators; individuals seeking a permitted rehabilitator with whom to place a bird in need of care; and licensed veterinarians who receive, treat, or diagnose sick, orphaned, and injured birds.
   f. Routine disclosure to the Department of Justice, or a court, adjudicative, or other administrative body or to a party in litigation before a court or adjudicative or administrative body, under certain circumstances.
   g. Routine disclosure to the appropriate Federal, tribal, State, local, or foreign governmental agency responsible for investigating, prosecuting, enforcing, or implementing statutes, rules, or licenses, when we become aware of a violation or potential violation of such statutes, rules, or licenses, or when we need to monitor activities associated with a permit or regulated use.
   h. Routine disclosure to a congressional office in response to an inquiry to the office by the individual to whom the record pertains.
   i. Routine disclosure to the General Accounting Office or Congress when the information is required for the evaluation of the permit programs.
   j. Routine disclosure to provide addresses obtained from the Internal Revenue Service to debt collection agencies for purposes of locating a debtor to collect or compromise a Federal claim against the debtor or to consumer reporting agencies to prepare a commercial credit report for use by the FWS.

5. For individuals, personal information such as home address and telephone number, financial data, and personal identifiers (social security number, birth date, etc.) will be removed prior to any release of the application.

6. The public reporting burden on the applicant for information collection varies depending on the activity for which a permit is requested. The relevant burden for an **Incidental Take** permit application is **3 hours**. This burden estimate includes time for reviewing instructions, gathering and maintaining data and completing and reviewing the form. You may direct comments regarding the burden estimate or any other aspect of the form to the Service Information Clearance Officer, U.S. Fish and Wildlife Service, Mail Stop 222, Arlington Square, U.S. Department of the Interior, 1849 C Street, NW, Washington D.C. 20240.

Freedom of Information Act – Notice

For organizations, businesses, or individuals operating as a business (i.e., permittees not covered by the Privacy Act), we request that you identify any information that should be considered privileged and confidential business information to allow the Service to meet its responsibilities under FOIA. Confidential business information must be clearly marked "Business Confidential" at the top of the letter or page and each succeeding page and must be accompanied by a non-confidential summary of the confidential information. The non-confidential summary and remaining documents may be made available to the public under FOIA [43 CFR 2.13(c)(4), 43 CFR 2.15(d)(1)(i)].

Department of the Interior
U.S. Fish and Wildlife Service

Expires Nov. 30, 2010
OMB No. 1018-0094

Federal Fish and Wildlife Permit Application Form

Return to: U.S. Fish and Wildlife Service (USFWS)

Type of Activity: Native Endangered and Threatened Species – Incidental Take Permits Associated with a Habitat Conservation Plan (HCP)

Complete Sections A or B, and C, D, and E of this application. U.S. address may be required in Section C, see instructions for details.
See attached instruction pages for information on how to make your application complete and help avoid unnecessary delays.

A. Complete if applying as an individual

1.a. Last name	1.b. First name	1.c. Middle name or initial	1.d. Suffix

2. Date of birth (mm/dd/yyyy)	3. Social Security No.	4. Occupation	5. Affiliation/ Doing business as (see instructions)

6.a. Telephone number	6.b. Alternate telephone number	6.c. Fax number	6.d. E-mail address

B. Complete if applying on behalf of a business, corporation, public agency or institution

1.a. Name of business, agency, or institution	1.b. Doing business as (dba)
Pacific hand Ltd.	

2. Tax identification no.	3. Description of business, agency, or institution
59-2490438	Agriculture Farm hand

4.a. Principal officer Last name	4.b. Principal officer First name	4.c. Principal officer Middle name/ initial	4.d. Suffix
Heller	Billy	L.	

5. Principal officer title	6. Primary contact
Chief Executive Officer	Billy Heller

7.a. Business telephone number	7.b. Alternate telephone number	7.c. Business fax number	7.d. Business e-mail address
(941) 722-3291		(941) 729-5849	bheller@Sunripeproduce.com

C. All applicants complete address information

1.a. Physical address (Street address; Apartment #, Suite #, or Room #; no P.O. Boxes)
503 10th Street

1.b. City	1.c. State	1.d. Zip code/Postal code:	1.e. County/Province	1.f. Country
Palmetto	FL	34221	Manatee	USA

2.a. Mailing Address (include if different than physical address; include name of contact person if applicable)
P.O. Box 806

2.b. City	2.c. State	2.d. Zip code/Postal code:	2.e. County/Province	2.f. Country
Palmetto	FL	34220	Manatee	

D. All applicants MUST complete

1. Attach check or money order payable to the U.S. FISH AND WILDLIFE SERVICE **in the amount indicated on page 2**. Federal, tribal, State, and local government agencies, and those acting on behalf of such agencies, are exempt from the processing fee – ***attach documentation of fee exempt status as outlined in instructions.*** (50 CFR 13.11(d))

2. Do you currently have or have you ever had any Federal Fish and Wildlife permits?
   Yes ☐ If yes, list the number of the most current permit you have held or that you are applying to renew/re-issue: _____
   No ☒

3. Certification: I hereby certify that I have read and am familiar with the regulations contained in ***Title 50, Part 13 of the Code of Federal Regulations*** and the other ***applicable parts in subchapter B of Chapter I of Title 50***, and I certify that the information submitted in this application for a permit is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to the criminal penalties of 18 U.S.C. 1001.

Signature (in blue ink) of applicant/person responsible for permit (No photocopied or stamped signatures) — Date of signature (mm/dd/yyyy): 05/24/2010

Please continue to next page

** See page 14 for additional instructions on completing the above form. See page 15 for information on the Paperwork Reduction Act, Privacy Act, and Freedom of Information Act aspects of this application form.

Section E. **ALL APPLICANTS COMPLETE SECTION E.** Provide the information outlined in Section E. on the following pages. Be as complete and descriptive as possible. Please do not send pages that are over 8.5"X 11", videotapes, or DVDs.

INCIDENTAL TAKE PERMITS ASSOCIATED WITH A HABITAT CONSERVATION PLAN (HCP)

Have you obtained all required State, Federal or foreign government approval to conduct the activity you propose? Please be aware that there may be other requirements necessary to conduct this activity such as an import permit, collection permit, permission to work on Federal lands, Federal bird banding permit, Corps of Engineers permits, Environmental Protection Agency NPDES permits, State, county or local permits, etc.

☐ Yes. Provide a copy of the approval(s). List the State, Federal or foreign countries involved and type of document required. Include a copy of these documents with the application.

☐ I have applied. List the State, Federal or foreign countries involved and type of documents required. Provide the reasons why the permits have not been issued _____.

☒ Not required. ~~The proposed activity is not regulated.~~ Not required at this time. MSHCP precedes future activities.

Application Processing Fees

The application processing fee for a new Incidental Take permit, or to renew/re-issue an existing valid permit, is $100. If permit amendment is required at a time other than renewal/re-issuance, the processing fee is $50.

Check the appropriate box below and enclose check or money order payable to the *U.S. Fish and Wildlife Service* in the amount of

☒ $100 for a **new** permit

OR

☐ $100 to **renew/re-issue** my existing valid permit (with only *minor changes* such as updating my name and address) using my current application package on file.

OR

☐ $50 to make a **substantive amendment** (with *major changes*) to my existing valid permit [50 CFR 13.11(d)(2)].

If the information in your current application package on file has changed in a manner that triggers a major amendment or a change not otherwise specified in the permit, then you must apply for an amendment to your valid permit. For example, such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit. Please contact our Ecological Services Field Office located closest to your proposed activity for technical assistance in making this determination. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please check the **type of amendment** you are requesting --

☐ add species (specify) _____

☐ add a geographic area ☐ change in personnel

☐ other (specify) _____

If this application includes **transfer or succession** of a valid Incidental Take permit, please check the box below:

☐ Transfer or succession of a valid Incidental Take permit associated with a HCP using the current application package on file. No application fee is required.

Application Processing Time

To expedite a final decision on your application, you are urged to coordinate with us as soon as possible for guidance in assembling a complete application package. If you are renewing or amending a valid permit, your complete application package must be received at least 30 days prior to the expiration of the valid permit. This time period begins when we receive a complete permit application package and does not include any time required for requesting clarification or additional information about your application.

The time required to process an application for an Incidental Take permit will vary depending on the size, complexity, and impacts of the HCP involved. Procedurally, the most variable factor in application processing is the level of analysis required for the proposed HCP under the National Environmental Policy Act (e.g., whether an application requires preparation of an Environmental Impact Statement, Environmental Assessment, or whether a categorical exclusion applies), although other factors such as public controversy can also affect application processing times. The target processing timeline from when we receive a complete application package to our final decision on a permit application is: up to 3 months for low-effect HCPs, 4 to 6 months for HCPs with an Environmental Assessment, and up to 12 months for HCPs with a 90-day comment period and/or an Environmental Impact Statement. Although not mandated by law or regulation, these targets are adopted as U.S. Fish & Wildlife Service and National Marine Fisheries Service (NMFS/NOAA Fisheries) policy and all offices are expected to streamline their Incidental Take permit programs, and to meet these targets to the maximum extent practicable.

The information provided in your permit application will be used to evaluate your application for compliance with the Endangered Species Act, its implementing regulations (which may require a 30 day public comment period), and with U.S. Fish and Wildlife Service policy. Receipt and possession of a permit under the Endangered Species Act should be regarded as a privilege, as we must balance permit issuance with our duties to protect and recover listed species.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal, re-issuance or amendment.

If your activities may affect species under the authority of the National Marine Fisheries Service (NMFS/NOAA Fisheries), then you may need to obtain a separate permit from that agency. In addition we share jurisdiction with NMFS/NOAA Fisheries for sea turtles (e.g., we evaluate applications for permits to conduct activities impacting sea turtles on land, and NMFS/NOAA Fisheries evaluates applications for permits to conduct activities impacting sea turtles in the marine environment). To apply for a permit to conduct activities with sea turtles in the marine environment or other species under NMFS/NOAA Fisheries jurisdiction, please contact them via their permit web page at http://www.nmfs.noaa.gov/pr/permits/

We cannot issue an Incidental Take permit under Section 10(a)(2)(A)(i) of the Endangered Species Act unless you submit a conservation plan that specifies the impacts that are likely to result from the incidental take associated with your activity.

Our general permit regulations at 50 CFR 13.12(a)(9) allow us to collect such other information as we determine that is relevant to the processing of a permit application. Before you submit an application for an Incidental Take permit, we may require that you conduct biological surveys to determine which species and/or habitat would be impacted by the activities sought to be covered under the permit. Biological surveys provide information necessary to develop an adequate HCP, and to assess the biological impacts of the proposed activities. In addition, the information provided in a biological survey can reduce the applicant's risk of take under Section 9 of the Endangered Species Act by ensuring that affected species and/or habitat are identified and appropriately covered under the permit.

You are required to obtain a Scientific Purposes, Enhancement of Propagation or Survival permit (commonly called a Recovery permit) from us before engaging in any biological survey activities that would take listed species. Contact our Ecological Services Field Office closest to the location of your activity to obtain technical assistance in determining the need for both a biological survey and a Recovery permit for your survey activity. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

If a biological survey is required, you will need to send us your complete Recovery permit application package at least 3 months prior to commencement of survey activities to facilitate processing of your Recovery permit application. The Recovery permit application is designated as U.S. Fish & Wildlife Service form # 3-200-55 and can be found on our Endangered Species permit web page at http://www.fws.gov/forms/3-200-55.pdf.

We maintain a list of Recovery permittees (such as biological consultants) who have authorized the release of their contact information to third parties for conducting biological surveys on a contract basis. This list is provided to the public at the discretion of each U.S.

Fish and Wildlife Service Regional Office as time and workload allow. Please be aware that this list does not represent an endorsement by us of any particular permittee.

****

If you are not applying as an individual but as a business, corporation, institution, or non-Federal public agency (block B. on page 1 of the application), the person to whom the permit will be issued (e.g., the landowner, president, director, executive director, or executive officer) is legally responsible for implementing the permit. Although other people under the direct control of the permittee (e.g., employees, contractors, consultants) receive third party take authorization in their capacity as designees of the permittee, the individual named as the permittee ultimately is legally responsible for the permit and any activities carried out under the permit except as otherwise limited in the case of permits issued to State or local government entities under 50 CFR 13.25(e).

****

If you wish to coordinate the processing of this permit application through an **authorized agent**, and to have that agent represent you as the primary contact with us, check the box below. Sign (in blue ink) and date the authorization statement, and provide contact information for your authorized agent.

☒ I hereby authorize the following person to act as an authorized agent on my behalf in the processing of this permit application and to furnish, upon request, supplemental information in support of this permit application.

Billy L. Helfert Jr — 26 May 2010

signature (in blue ink) — date

Billy L. Helfert Jr

please print name legibly

Your Authorized Agent's Contact Information (please print legibly)

Name: Tom Jones

Address: 2600 Golden Gate Pkwy

City: Naples State: FL Zip Code: 34105-3227

Telephone: 239-262-2600

Fax: _____

E-Mail: TJones@barroncollier.com

INCIDENTAL TAKE PERMIT APPLICATION INSTRUCTIONS

You have 4 options for providing the required information for an Incidental Take permit application. Choose only one option.

Incidental Take Permit Application: Option I. Renewal of a Valid Incidental Take Permit.

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal.

Sign the following statement if you are applying to renew an existing valid Incidental Take permit. If you are proposing major changes to your Incidental Take permit, you must use Option II.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct and hereby request renewal of that permit.
>
> _____ _____
> signature (in blue ink) date
>
> _____
> please print name legibly
>
> * Please note: If you have signed the above statement, then your renewal request is complete. Please submit completed pages 1 through 5 of this application to our Regional Office (see attached list) covering the location of your proposed activity. Requests for renewals must be received no later than 30 days prior to permit expiration to ensure that your current permit remains in effect while we process your renewal request.

Incidental Take Permit Application: Option II. Amended Incidental Take Permit (with *major changes*)

Up-to-date annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for amendment.

Sign the following statement if you are proposing to amend a valid Incidental Take permit by making major changes. Such major changes may include changes in location, activity, amount or type of take, or species to be covered by the permit.

The individual signing box D. on page 1 of the application must also sign (in blue ink) the following statement. This certification language is required under 50 CFR 13.22(a).

> I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Incidental Take permit # _____ are still current and correct, except for the changes listed below, and hereby request amendment of that permit.

_____ _____

signature (in blue ink) date

_____

please print name legibly

Provide a brief description of the changes to your valid permit (answer the appropriate questions for these changes under Incidental Take Permit Application Option III. below). Please submit completed pages 1 through 6 of this application form (along with the changed information relative to Option III. below) to our Regional Office (see attached list) covering the location of your proposed activity.

Incidental Take Permit Application: Option III. New Incidental Take Permit & Supplementary Information for Amendment of a Valid Permit (with *major changes*).

General permit regulations for the U.S. Fish & Wildlife Service can be found at 50 CFR 13. Regulations for an Incidental Take permit under the Endangered Species Act can be found at 50 CFR 17.22(b)(1) for endangered wildlife species and 50 CFR 17.32(b)(1) for threatened wildlife species.

Each landowner who wishes to be covered under a new or amended Incidental Take permit associated with an HCP must sign (in blue ink) and date the Incidental Take Permit Application Certification Notice at the end of this application, unless the landowner will be covered under this U.S. Fish & Wildlife Service Incidental Take permit via another vehicle, such as a certificate of inclusion (50 CFR 13.25(d)). Any change in the language of the Certification Notice must be reviewed by the Department of Interior, Office of the Solicitor and approved by the U.S. Fish & Wildlife Service. The same person who signs in box D. on page 1 of the application should sign the certification.

If the information in items A. - D. below is already provided in your final HCP (or Implementing Agreement, if applicable), then you do not have to provide it here. Instead, check the box below and use the spaces provided in items A. - D. to indicate the page numbers in your HCP or Implementing Agreement that provide the requested information.

☒ I am not providing the following information for items A. - D. as part of my Incidental Take permit application, because it is already provided in my final HCP or Implementing Agreement (copy attached or already submitted).

If the requested information in items A. - D. is not provided in your final HCP or final Implementing Agreement, or you are using Option II. to amend your existing valid Incidental Take permit, then attach separate pages for the missing information. In order to assist us in processing your request, please provide the item number (A. 1.a., etc.) of the required information before each of your responses. Thank you.

Please ensure that your final HCP and Implementing Agreement (if applicable) are attached if it has not been previously submitted.

If you have previously submitted a final draft HCP or Implementing Agreement, please indicate the document's date.

Date of final draft HCP TBD (MSHCP summary attached.)

Date of final draft Implementing Agreement TBD

Applications for an Incidental Take permit associated with an HCP must provide the following specific information (relevant to the activity) under items A.- D. below in addition to the general information on page 1 of this application.

A. Identify species and activity:

1. For a new Incidental Take permit:

   a. Provide the common and scientific names of the species being requested for coverage in the permit and their status (endangered (E), threatened (T), proposed endangered (PE), proposed threatened (PT), candidate for listing (C), or species likely to become a candidate (LC)).

   b. Provide the number, age, and sex of such species to the extent known

   c. Quantify the anticipated effects to their habitat.

   d. Describe the land use or water management activity sought to be authorized for each species.

2. For an amended Incidental Take permit:

   a. Identify the species to be added to your valid permit (provide both the scientific, to the most specific taxonomic level, and common names), as well as the species status (see 1.a.. above).

   b. Provide the number, age and sex of such species to the extent known.

   c. If any activities requested in this application differ from those authorized in your valid permit, then for each

species state the currently authorized activity, the requested new activity, and how the new activity will impact each species.

d. Identify each activity associated with your project that would result in the incidental take of each species.

e. Quantify any anticipated effects to the habitat of each added species.

f. Identify species to be deleted from your valid permit and the reason(s) for the deletion.

Page(s) & source document : _____

B. Identify location of the proposed activity:

1. Provide the name of the State, county, and specific location of the proposed activity site(s). Include a formal legal description, section/township/range information, county tax parcel number, local address, or any other identifying property designation that will precisely place the location of the proposed activity site(s). Attach a location map and plat of the project site clearly depicting the project boundaries and the footprint and location of all portions of the property that would be affected by your proposed activities.

2. Provide the total number of acres covered by the HCP 177,000+/-

   Is this the total acreage of the parcel? (circle one) (yes) no

3. Provide the approximate number of acres to be impacted 45,000

4. Provide the approximate number of acres to be protected 132,000

5. Provide a complete description, including timeframes, for implementation of proposed voluntary management activities to enhance, restore, or maintain habitat benefiting federally listed, proposed or candidate species, or other species likely to become candidates. Include schedules for implementing these activities.

Page(s) & source document: See attached MSHCP summary.

C. Describe the proposed activities in the conservation plan:
You must submit a Habitat Conservation Plan. We strongly encourage you to ensure that your HCP is consistent with the Habitat Conservation Planning Handbook, subsequent Handbook addendums, and current policies to minimize delays in evaluating your application. The Handbook and other HCP information is available on the U.S. Fish & Wildlife Service's Endangered Species web page at http://www.fws.gov/endangered/hcp/index.html

Provide a complete description of activity(ies) to be authorized or reference the applicable HCP or Implementing Agreement page numbers identifying the subject information.

The HCP must specify:

1. The impact that will likely result from the incidental taking. A discussion of the impact that will likely result from the incidental take should include quantification of any anticipated effects to the habitat of the species sought to be covered by the permit.

2. The steps that will be taken to minimize and mitigate such impacts, the funding that will be available to implement such steps, and the procedures to deal with unforeseen circumstances.

3. The steps that will be taken to monitor and report on such impacts, including a copy of the monitoring plan. We are authorized to require reports of activities conducted under a permit per the U.S. Fish & Wildlife Service's general permit regulations at 50 CFR 13.45.

4. Alternative actions to such incidental taking that have been considered and the reasons why these alternatives are not proposed for use.

5. The biological goals(s) and objectives for the HCP.

6. The duration requested for the proposed permit.

Page(s) & source document: See attached HCP summary.

D. Implementing Agreement

An Implementing Agreement

is *is not* (FWS *Regional Office* to circle one)

required as part of the permit application for a Habitat Conservation Plan.

This Implementing Agreement must be signed at finalization of the HCP. Are you willing to commit to an Implementing Agreement at finalization of the HCP?

☒ Yes, I am willing to commit to an Implementing Agreement. Please submit any unsigned, draft Implementing Agreement that you have prepared with our Field Office.

☐ No, I am not willing to commit to an Implementing Agreement.

Incidental Take Permit Application: Option IV. Permit Transfer or Succession of a Permit

Complete the following if you are applying for transfer of a valid Incidental Take permit to you or obtaining rights of succession of a valid Incidental Take permit. In addition, you and the current permit holder may also need to sign an Assumption Agreement. Please contact our Ecological Services Field Office nearest your activity to determine whether you and the current permit holder need to execute an Assumption Agreement. The contact information for our Ecological Services Field Offices can be found on the U.S. Fish & Wildlife Service's office directory web page at http://www.fws.gov/offices/directory/listofficemap.html

Please indicate the name of the HCP to be transferred or succeeded and indicate the document's date.

Name of HCP _____

Date of HCP _____

An Assumption Agreement

is ***is not*** (FWS Ecological Services *Field Office* to circle one)

required as part of the transfer or succession permit application for the HCP.

Incidental Take Permit Application

Certification Notice

The same person who signs in box D. on page 1 of the application should sign (in blue ink) the following certification.

By submitting this application and receiving an Incidental Take permit pursuant to Section 10(a)(1)(B) of the Endangered Species Act, I

Billy L. Hellen Jr (print name(s)) attest that I/we own the lands indicated in this application, or have sufficient authority or rights over these lands to implement the measures of the Habitat Conservation Plan (and Implementing Agreement if applicable) covered by the Incidental Take permit. Further, upon receipt of the Incidental Take permit, I/we agree to conduct the activities as specified in the Habitat Conservation Plan (and Implementing Agreement if applicable) according to the terms and conditions of the Incidental Take permit and its supporting documents.

Billy L Hellen Jr — signature (in blue ink)

29 May 2010 — date

Billy L. Hellen, Jr — please print name legibly

signature (in blue ink)

date

please print name legibly

****

The public reporting burden for completing this application for an Incidental Take permit is estimated to be 3 hours, including time for reviewing instructions, gathering and maintaining application data, and completing and reviewing the forms. Comments regarding the burden estimate or any other aspect of the reporting requirement(s) should be directed to the U.S. Fish & Wildlife Service Information Collection Clearance Officer, MS 222 ARLSQ, U.S. Fish and Wildlife Service, Washington, DC 20240.

An agency may not conduct and a person is not required to respond to a collection of information unless a currently valid OMB control number is displayed.

****

USFWS Regional Contacts for Native Endangered & Threatened Species Permits

Pacific Region (Region 1): HI, ID, OR, WA, American Samoa, Commonwealth of the Northern Mariana Islands, Guam, and the Pacific Trust Territories

U.S. Fish and Wildlife Service
Endangered Species Permit Office
911 NE 11th Avenue
Portland, Oregon 97232-4181

Web: http://www.fws.gov/pacific/ecoservices/endangered/index.html
Phone: (503) 231-2071
email: permitsR1ES@fws.gov
Fax: (503) 231-6243

California & Nevada Region (Region 8): CA and NV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
2800 Cottage Way, Suite W-2606
Sacramento, California 95825 -1846

Web: http://www.fws.gov/cno/es/recovery.html
Phone: (916) 414-6464
email: permitsCNES@fws.gov
Fax: (916) 414-6486

Southwest Region (Region 2): AZ, NM, OK, and TX

U.S. Fish and Wildlife Service
Endangered Species Permit Office
500 Gold Avenue S.W. (street address)
P.O. Box 1306 (mailing address)
Albuquerque, New Mexico 87103-1306

Web: http://www.fws.gov/southwest/es/EndangeredSpecies/
Phone: (505) 248-6633
email: permitsR2ES@fws.gov
Fax: (505) 248-6788

Midwest Region (Region 3): IA, IL, IN, MI, MN, MO, OH, and WI

U.S. Fish and Wildlife Service
Endangered Species Permit Office
B.H. Whipple Federal Building
One Federal Drive
Fort Snelling, Minnesota 55111-4056

Web: http://www.fws.gov/midwest/Endangered/
Phone: (612) 713-5343
email: permitsR3ES@fws.gov
Fax: (612) 713-5292

Southeast Region (Region 4): AL, AR, FL, GA, KY, LA, MS, NC, PR, SC, TN, and U.S. Virgin Islands

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1875 Century Blvd., Suite 200
Atlanta, Georgia 30345

Web: http://www.fws.gov/southeast/es/#
Phone: (404) 679-7313
email: permitsR4ES@fws.gov
Fax: (404) 679-7081

Northeast Region (Region 5): CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, and WV

U.S. Fish and Wildlife Service
Endangered Species Permit Office
300 Westgate Center Drive
Hadley, MA 01035-9589

Web: http://www.fws.gov/northeast/endangered/
Phone: (413) 253-8615
email: permitsR5ES@fws.gov
Fax: (413) 253-8482

Mountain-Prairie Region (Region 6): CO, KS, MT, NE, ND, SD, UT, and WY

U.S. Fish and Wildlife Service
Endangered Species Permit Office
Denver Federal Center
P.O. Box 25486
Denver, Colorado 80225-0489

Web: http://www.fws.gov/mountain%2Dprairie/endspp/
Phone: (303) 236-7400
email: permitsR6ES@fws.gov
Fax: (303) 236-0027

Alaska Region (Region 7): AK

U.S. Fish and Wildlife Service
Endangered Species Permit Office
1011 E. Tudor Road
Anchorage, Alaska 99503-6199

Web: http://alaska.fws.gov/fisheries/endangered/index.htm
Phone: (907) 786-3323
email: permitsR7ES@fws.gov
Fax: (907) 786-3350

PERMIT APPLICATION FORM INSTRUCTIONS

The following instructions pertain to the standard permit form 3-200 that must be completed as an application for a U.S. Fish and Wildlife Service or CITES permit. The General Permit Procedures in 50 CFR 13 address the permitting process. For simplicity, all licenses, permits, registrations, and certificates will be referred to as a permit.

GENERAL INSTRUCTIONS:

- Complete all blocks/lines/questions in Sections A or B, and C and D. Complete all of Section E.
- **An incomplete application may cause delays in processing or may be returned to the applicant. Be sure you are filling in the appropriate application form for the proposed activity.**
- Print clearly or type in the information. Illegible applications may cause delays.
- Sign the application in blue ink. Faxes or copies of the original signature will not be accepted.
- Mail the original application to the address at the top of page one of the application or if applicable on the attached address list.
- **Keep a copy of your completed application.**
- **Please plan ahead. Allow at least 60 days for your application to be processed. Some applications may take longer than 90 days to process. (50 CFR 13.11)**
- Applications are processed in the order they are received.
- Additional forms and instructions are available from http://permits.fws.gov/ .

COMPLETE EITHER SECTION A OR SECTION B:

Section A. **Complete if applying as an individual:**

- Enter the complete name of the responsible individual who will be the permittee if a permit is issued. Enter personal information that identifies the applicant. ***Fax and e-mail are not required if not available.***
- If you are applying on behalf of a client, the personal information must pertain to the client, and a document evidencing power of attorney must be included with the application.
- **Affiliation/ Doing business as (dba)**: business, agency, organizational, or institutional affiliation *directly* related to the activity requested in the application (e.g., a taxidermist is an individual whose business can *directly* relate to the requested activity). The Division of Management Authority (DMA) will **not** accept *doing business as* affiliations for individuals.

Section B. **Complete if applying as a business, corporation, public agency, or institution:**

- Enter the complete name of the business, agency or institution that will be the permittee if a permit is issued. Give a brief description of the type of business the applicant is engaged in. Provide contact phone number(s) of the business.
- **Principal Officer** is the person in charge of the listed business, corporation, public agency, or institution. The principal officer is the person responsible for the application and any permitted activities. Often the principal officer is a Director or President. **Primary Contact** is the person at the business, corporation, public agency, or institution who will be available to answer questions about the application or permitted activities. Often this is the preparer of the application.

ALL APPLICANTS COMPLETE SECTION C:

- For all applications submitted to the Division of Management Authority (DMA) a physical U.S. address is **required.** Province and Country blocks are provided for those USFWS programs which use foreign addresses and are not required by DMA..
- **Mailing address** is address where communications from USFWS should be mailed if different than applicant's physical address.

ALL APPLICANTS COMPLETE SECTION D:

Section D.1 **Application processing fee:**

- An application processing fee is required at the time of application; unless exempted under 50 CFR13.11(d)(3). The application processing fee is assessed to partially cover the cost of processing a request. **The fee does not guarantee the issuance of a permit. Fees will not be refunded for applications that are approved, abandoned, or denied.** We may return fees for withdrawn applications prior to any significant processing occurring.
- **Documentation of fee exempt status is not required for Federal, tribal, State, or local government agencies; but must be supplied by those applicants acting on behalf of such agencies.** Those applicants acting on behalf of such agencies must submit a letter on agency letterhead and signed by the head of the unit of government for which the applicant is acting on behalf, confirming that the applicant will be carrying out the permitted activity for the agency.

Section D.2 **Federal Fish and Wildlife permits:**

- List the number(s) of your most current FWS or CITES permit or the number of the most recent permit if none are currently valid. If applying for re-issuance of a CITES permit, the original permit must be returned with this application.

Section D.3 **CERTIFICATION:**

- **The individual identified in Section A, the principal officer named in Section B, or person with a valid power of attorney (documentation must be included in the application) must sign and date the application in blue ink.** This signature binds the applicant to the statement of certification. This means that you certify that you have read and understand the regulations that apply to the permit. You also certify that everything included in the application is true to the best of your knowledge. Be sure to read the statement and re-read the application and your answers before signing.

Please continue to next page

APPLICATION FOR A FEDERAL FISH AND WILDLIFE PERMIT
Paperwork Reduction Act, Privacy Act, and Freedom of Information Act – Notices

In accordance with the Paperwork Reduction Act of 1995 (44 U.S.C. 3501, *et seq.*) and the Privacy Act of 1974 (5 U.S.C. 552a), please be advised:

1. The gathering of information on fish and wildlife is authorized by:
(Authorizing statutes can be found at: http://www.gpoaccess.gov/cfr/index.html and http://www.fws.gov/permits/ltr/ltr.shtml.)

   a. Bald and Golden Eagle Protection Act (16 U.S.C. 668), 50 CFR 22;
   b. Endangered Species Act of 1973 (16 U.S.C. 1531-1544), 50CFR 17;
   c. Migratory Bird Treaty Act (16 U.S.C. 703-712), 50 CFR 21;
   d. Marine Mammal Protection Act of 1972 (16 U.S.C. 1361, *et. seq.*), 50 CFR 18;
   e. Wild Bird Conservation Act (16 U.S.C. 4901-4916), 50 CFR 15;
   f. Lacey Act: Injurious Wildlife (18 U.S.C. 42), 50 CFR 16;
   g. Convention on International Trade in Endangered Species of Wild Fauna and Flora (TIAS 8249), http://www.cites.org/ , 50 CFR 23;
   h. General Provisions, 50 CFR 10;
   i. General Permit Procedures, 50 CFR 13; and
   j. Wildlife Provisions (Import/export/transport), 50 CFR 14.

2. Information requested in this form is purely voluntary. However, submission of requested information is required in order to process applications for permits authorized under the above laws. Failure to provide all requested information may be sufficient cause for the U.S. Fish and Wildlife Service to deny the request. Response is not required unless a currently valid Office of Management and Budget (OMB) control number is displayed on form.

3. Certain applications for permits authorized under the Endangered Species Act of 1973 (16 U.S.C. 1539) and the Marine Mammal Protection Act of 1972 (16 U.S.C. 1374) will be published in the **Federal Register** as required by the two laws.

4. Disclosures outside the Department of the Interior may be made without the consent of an individual under the routine uses listed below, if the disclosure is compatible with the purposes for which the record was collected. (Ref. 68 FR 52611, September 4, 2003)

   a. Routine disclosure to subject matter experts, and Federal, tribal, State, local, and foreign agencies, for the purpose of obtaining advice relevant to making a decision on an application for a permit or when necessary to accomplish a FWS function related to this system of records.
   b. Routine disclosure to the public as a result of publishing **Federal Register** notices announcing the receipt of permit applications for public comment or notice of the decision on a permit application.
   c. Routine disclosure to Federal, tribal, State, local, or foreign wildlife and plant agencies for the exchange of information on permits granted or denied to assure compliance with all applicable permitting requirements.
   d. Routine disclosure to Captive-bred Wildlife registrants under the Endangered Species Act for the exchange of authorized species, and to share information on the captive breeding of these species.
   e. Routine disclosure to Federal, tribal, State, and local authorities who need to know who is permitted to receive and rehabilitate sick, orphaned, and injured birds under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act; federally permitted rehabilitators; individuals seeking a permitted rehabilitator with whom to place a bird in need of care; and licensed veterinarians who receive, treat, or diagnose sick, orphaned, and injured birds.
   f. Routine disclosure to the Department of Justice, or a court, adjudicative, or other administrative body or to a party in litigation before a court or adjudicative or administrative body, under certain circumstances.
   g. Routine disclosure to the appropriate Federal, tribal, State, local, or foreign governmental agency responsible for investigating, prosecuting, enforcing, or implementing statutes, rules, or licenses, when we become aware of a violation or potential violation of such statutes, rules, or licenses, or when we need to monitor activities associated with a permit or regulated use.
   h. Routine disclosure to a congressional office in response to an inquiry to the office by the individual to whom the record pertains.
   i. Routine disclosure to the General Accounting Office or Congress when the information is required for the evaluation of the permit programs.
   j. Routine disclosure to provide addresses obtained from the Internal Revenue Service to debt collection agencies for purposes of locating a debtor to collect or compromise a Federal claim against the debtor or to consumer reporting agencies to prepare a commercial credit report for use by the FWS.

5. For individuals, personal information such as home address and telephone number, financial data, and personal identifiers (social security number, birth date, etc.) will be removed prior to any release of the application.

6. The public reporting burden on the applicant for information collection varies depending on the activity for which a permit is requested. The relevant burden for an **Incidental Take** permit application is **3 hours**. This burden estimate includes time for reviewing instructions, gathering and maintaining data and completing and reviewing the form. You may direct comments regarding the burden estimate or any other aspect of the form to the Service Information Clearance Officer, U.S. Fish and Wildlife Service, Mail Stop 222, Arlington Square, U.S. Department of the Interior, 1849 C Street, NW, Washington D.C. 20240.

Freedom of Information Act – Notice

For organizations, businesses, or individuals operating as a business (i.e., permittees not covered by the Privacy Act), we request that you identify any information that should be considered privileged and confidential business information to allow the Service to meet its responsibilities under FOIA. Confidential business information must be clearly marked "Business Confidential" at the top of the letter or page and each succeeding page and must be accompanied by a non-confidential summary of the confidential information. The non-confidential summary and remaining documents may be made available to the public under FOIA [43 CFR 2.13(c)(4), 43 CFR 2.15(d)(1)(i)].

From: Cassler, Constance
To: Kelso, Charles
Cc: Johnson, Bruce; Dell, David
Subject: Re: Traffic volume prediction from AECOMs traffic modelling.
Date: Tuesday, April 16, 2019 1:17:22 PM

Hi,

I'm going to call Bruce and see what else they are looking for.

Connie

Constance L. Cassler, Ph.D.
Supervisory Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
office: 772-469-4243
fax: 772-562-4288
email: constance_cassler@fws.gov

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Follow us on Facebook @USFWSSouthFlorida
Follow us on InstaGram @usfws_south_florida
Visit our web site at www.fws.gov/verobeach/

NOTE: All email correspondence and attachments received from or sent to me are subject to the Freedom of Information Act (FOIA) and may be disclosed to third parties

On Tue, Apr 16, 2019 at 1:15 PM Kelso, Charles <charles_kelso@fws.gov> wrote:

> Bruce,
> This was sent to Christian last week.
>
> ---------- Forwarded message ---------
> From: **Kelso, Charles** <charles_kelso@fws.gov>
> Date: Tue, Apr 9, 2019 at 4:39 PM
> Subject: Traffic volume prediction from AECOMs traffic modelling.
> To: Christian Spilker <cspilker@collierenterprises.com>
>
> Christian,
>
> I've attached a copy of the spreadsheet we received from AECOM which summarizes the predicted traffic volumes that would be produced in the action area (25-mile buffer) with ITP Issuance. I've also attached appendix F from the dEIS that describes the AECOM's traffic prediction model and it's assumptions. Feel free to contact us if you have any questions.
>
> --

Chuck Kelso
U.S. Fish and Wildlife Service
South Florida Ecological Services Field Office
1339 20th Street
Vero Beach, FL 32960-3559
(772)469-4241
Charles_Kelso@fws.gov

NOTE: All email correspondence and attachments received from or sent to me are subject to the Freedom of Information Act (FOIA) and may be disclosed to third parties

--

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People, predators and place: Rodenticide impacts in a wildland–urban interface

Article *in* Rural Society · April 2015

DOI: 10.1080/10371656.2014.1001478

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People, predators and place: rodenticide impacts in a wildland-urban interface

Rebecca M. Steinberg, Anita T. Morzillo, Seth P.D. Riley & Susan G. Clark

To cite this article: Rebecca M. Steinberg, Anita T. Morzillo, Seth P.D. Riley & Susan G. Clark (2015) People, predators and place: rodenticide impacts in a wildland-urban interface, Rural Society, 24:1, 1-23, DOI: 10.1080/10371656.2014.1001478

To link to this article: http://dx.doi.org/10.1080/10371656.2014.1001478

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Rural Society, 2015
Vol. 24, No. 1, 1–23, http://dx.doi.org/10.1080/10371656.2014.1001478

Routledge
Taylor & Francis Group

People, predators and place: rodenticide impacts in a wildland-urban interface

Rebecca M. Steinberg[a*], Anita T. Morzillo[b], Seth P.D. Riley[c] and Susan G. Clark[d]

[a]Yale School of Forestry & Environmental Studies, Yale University, New Haven, CT, USA; [b]Department of Natural Resources and the Environment, University of Connecticut, Storrs, CT, USA; [c]National Park Service, Santa Monica Mountains National Recreation Area, Thousand Oaks, CA, USA; [d]Yale School of Forestry & Environmental Studies and Fellow, Institution for Social and Policy Studies, Yale University, New Haven, CT, USA

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Human development near protected areas may pose challenges for carnivore conservation. In southern California, residential use of anticoagulant rodenticides is linked to non-target impacts on wild felids. We use an interdisciplinary policy sciences meta-framework and mixed methods to investigate landscape, social and policy factors affecting secondary rodenticide impacts on bobcats (*Lynx rufus*). Results suggest that landscape features, such as fruit trees and irrigation ditches are common locations for deploying anticoagulants. Residents construct a wildland-urban interface discourse that influences residential rodent control behaviour. Interviews with pest control operators and wildlife managers reveal a "scientized" management paradigm masking third-party residential anticoagulant use, which may have greater impacts on wild felids than residential use alone. The US Environmental Protection Agency may have reason to refocus anticoagulant use regulations to increase effectiveness in mitigating impacts on non-target wildlife. This study highlights the need for comprehensive, contextual policy to manage wildlife in the common interest.

Keywords: adaptive governance; anticoagulant rodenticides; discourse; interdisciplinary policy sciences; wild felids

Introduction

Protected areas are tangible and symbolic expressions of human values that promote conservation objectives (West, Igoe, & Brockington, 2006). The number of people living adjacent to some protected areas has increased as people are attracted by aesthetics, or recreational, cultural and economic opportunities (Joppa, Loarie, & Pimm, 2009; Wittemyer, Elsen, Bean, Burton, & Brashares,

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2008). Concurrently, many wide-ranging wildlife species traverse protected area boundaries, resulting in potential interaction and conflict with humans (Clark, Picard, & Hohl, 2010; Clark & Wallace, 2002; Hammer, Radeloff, Fried, & Stewart, 2007; Kellert, 1997; Mascia & Pailler, 2010; Radeloff et al., 2005). Within a mixed assortment of public protected areas and private lands, human activities can have both intended and unintended impacts on wildlife that may hinder wildlife management objectives (Ripple et al., 2014; Theobald, Miller, & Hobbs, 1997; Woodroffe, 2000; Woodroffe & Ginsberg, 1998).

The area where houses abut or are interspersed with undeveloped land is often referred to in scientific literature as the "wildland-urban interface" (WUI; Radeloff et al., 2005). This rural-urban transition area also exists between protected areas and private development. The distinction of these areas is a perceived boundary not only created as a physical space, but one constructed cognitively and socially in discourse from individual to community levels. Discourses through which management agencies and the public perceive, define and approach wildlife conservation issues along this transition are dynamic expressions of personal values (Bright & Burtz, 2006), policy references (Clark, 2002), nature values (Kellert, 1997), risk perceptions (Slovic, 2000) and a sense of responsibility (Mattson & Chambers, 2009). We will examine such discourses through narratives, behaviour and policy related to non-target rodenticide impacts on North American wild felids, including bobcats (*Lynx rufus*) and mountain lions (*Puma concolor*), with particular emphasis on bobcats.

We will focus on an area of expanding exurban and urban development in southern California, where people and wild felids exist in close contact. In this region, a WUI discourse is created, characterized and managed in multiple jurisdictions and by numerous participants, including residents, commercial pest control companies and federal, state, county and city natural resource managers. In 2001, US National Park Service biologists at Santa Monica Mountains National Recreation Area (SAMO; described in Research Methods section) began documenting notoedric mange in bobcats, which was linked to anticoagulant compound (that is, rodenticides) exposure (Riley et al., 2007). Anticoagulant rodenticides are products specifically designed to kill rodents through the biological mechanism that causes internal haemorrhaging. Although non-target exposure of wildlife to anticoagulant rodenticides has been documented worldwide (Brakes & Smith, 2005; Duckett, 1984; Eason, Murphy, Wright, & Spurr, 2002; Fournier-Chambrillon et al., 2004; Richards, Mineau, & Bird, 2004), this was the first case in a wild bobcat population (Riley et al., 2003, 2007). Subsequent studies in the SAMO area examined the resident characteristics that may influence rodenticide use (Bartos et al., 2012; Morzillo & Mertig, 2011a, 2011b), including housing density and proximity to open space (Morzillo & Schwartz, 2011).

In 2008, prompted by global cases of non-target impacts of anticoagulants on wildlife (see above) and children (Klein-Schwartz & Smith, 1997; Mullins,

Brands, & Daya, 2000; Watt, Proudfoot, Bradberry, & Vale, 2005), the US Environmental Protection Agency (US EPA) crafted the nationally prescribed *Risk Mitigation Decision for Ten Rodenticides* (hereafter "*Risk Mitigation Decision*") (US EPA, 2008). Partial implementation of this policy aims to broadly reduce non-target impacts of anticoagulants by restricting public sale of anticoagulant products (US EPA, 2008). Our data were collected before the *Risk Mitigation Decision* (US EPA, 2008) was formally adopted in 2011. In 2014, the California Department of Pesticide Regulation banned public purchase of anticoagulant rodenticides in retail stores state-wide (CDPR, 2014). Despite contention (Reckitt Benckiser, LLC, 2013), the US EPA reached agreement with pesticide manufacturers to cancel production of numerous anticoagulant products, with distribution to be extinguished by March 2015 (US EPA, 2014).

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Literature review and theory

Much of the focus on the WUI construct has related to fire risk and response based on physical delineations of private and public landownership (Alig, Kline, & Lichtenstein, 2004; Andersson, Eklund, Lehtola, & Salmi, 2009; Bright & Burtz, 2006; Gill & Stephens, 2009; Keeley, 2002; Radeloff et al., 2005; Weisshaupt, Jakes, Carroll, & Blatner, 2007; Winter, Vogt, & Fried, 2002). The word "wildland" has dualistic, culturally derived and subjective meanings of division between nature and people in both cognition and behaviour (Cadieux, 2011; Myers, Saunders, & Bexell, 2009). These meanings are strongly embedded within the Western discourse of protected areas (Clark & Milloy, 2014; Cronan, 1996). How such meaning is constructed in the WUI (itself a construction), and how it manifests in conservation discourses and people's behaviours are influenced, in part, by people's nature values (Kellert, 1997) and perceptions of risk (Myers et al., 2009; Slovic, 1999, 2000), such as risks related to living near open space (for example, wildfires, human-wildlife conflicts). In knowing that the terms "wildland" and "interface" are culturally constructed, we thus explore the premise of the WUI, and how its creation may influence people's perception and their role in wildlife conservation within the SAMO region.

Conventionally, wildlife management and policy within protected areas is based on the North American Model of Wildlife Conservation, a myth shaped by positivism and techno-scientific management (Clark & Milloy, 2014; Mattson & Chambers, 2009). A precept of this model is management of wildlife within the public trust, which is defined by a distribution of power over problem definition and problem-solving, and a trust in scientific knowledge (Brunner & Steelman, 2006; Brunner et al., 2006; Foucault, 1982; Habermas, 1975; Scott, 1998). Critique of conventional techno-scientific problem-solving as part of scientized management (Scott, 1998) converges with that of the North American Model of Wildlife Conservation (Clark & Milloy, 2014; Mattson & Chambers, 2009) whereby decision-making power is given to technical experts and agency personnel. This scientized model also sets a precedent for public

involvement in wildlife management. Results of scientized management have been criticized for overlooking constitutive issues such as governance in natural resource management (Brunner & Steelman, 2006; Clark, 2002; Decker, Kruger, Baer, Knuth, & Richmond, 1996).

A central tenet of the scientized management paradigm is a perceived direct link between science and policy where biophysical, data-directed policy is often unquestionably viewed as adequate to solve conservation problems (Pielke, 2007). The implementation of such policy has been referred to as a "black box" characterized as an unknown gap between policy and its effects (Mosse, 2004). The relationship between policy, practice and impacts is largely unexamined, especially at the national level. Yet, within this nexus lies an inherent and often invisible goal of legitimizing and distributing decision-making power (see Mattson, Byrd, Rutherford, Brown, & Clark, 2006; Mosse, 2004; Scott, 1998; Syring, 2007).

Discourses and paradigms between people and policy influence the way in which problems are perceived and addressed (Clark, Mattson, Reading, & Miller, 2001). The interdisciplinary policy sciences (IPS) meta-framework is a theory derived from post-positivism paradigms and doctrines (Clark, 2002). IPS is also a method implemented to approach, understand and work towards solving complex policy problems (Brunner & Steelman, 2006; Clark, 2001; Clark et al., 2010; Lasswell, 1971). IPS incorporates multiple disciplines and methods to conduct an integrative and comprehensive problem orientation and to recommend contextual alternatives to advance problem-solving efforts in wildlife conservation policy.

The SAMO case study we evaluate here initially followed traditional approaches of examining and managing threats to wild felids based within a positivist paradigm (Brunner & Steelman, 2006; Mattson & Clark, 2010; Zinn, Manfredo, Vaske, & Wittmann, 1998). Biological problems related to toxicology and exposure were assumed to have technical solutions (Riley et al., 2003, 2007). Although more recent research has examined the human dimensions of rodenticide use behaviour (Bartos et al., 2012; Morzillo & Mertig, 2011a, 2011b; Morzillo & Schwartz, 2011), no studies have examined the cultural discourse or constitutive (that is, decision-making) problems related to anticoagulant use and policy.

Research methods

Our objective was to use the IPS meta-framework to assess how contextual (that is, problem-oriented) and effective the *Risk Mitigation Decision* policy (US EPA, 2008) will be in mitigating secondary anticoagulant exposure of wild felids. First, we analysed bobcat movement data to describe habitat features that may coincide with contact between prey and rodenticides. We hypothesized that bobcat habitat use is likely to include particular landscape features (for example, dense vegetation) that may function as cover for predators and prey. Second, we assessed the rodenticide use characteristics and motivations of two groups,

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residents and professional pest control operators (PCOs) given the assumption that public use of anticoagulant products leads to non-target impacts on wildlife (US EPA, 2008). Based on this assumption, we hypothesized that resident rodenticide use, including outdoor use, is more common than use by PCOs. Third, to link people's behaviours with environmental policy, we explored resident and PCO knowledge systems, values and perceptions towards open space and wildlife that may influence their rodenticide use. We hypothesized that narratives centred on resident and PCO rodenticide use influence local discourse and national policy regarding non-target impacts on wildlife. We applied the IPS meta-framework and multiple methods to integrate relevant biological, social and policy data, and to examine the linkages among them (Clark, 2002; Clark & Ashton, 2004; Lasswell, 1971).

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Study area

SAMO is one of the world's largest urban national parks (61,947 ha) and spans eastern Ventura and western Los Angeles Counties in southern California, USA. SAMO is comprised of approximately 50% private lands and 50% public lands further divided into state and federally managed protected areas or open space. Historically, large ranchlands in this region have been converted to exurban and suburban areas surrounding SAMO (Jaffe, 2006; Morzillo & Schwartz, 2011). To the north, open space ranges from small town parks to larger preserves, which are growing increasingly fragmented as in-fill development occurs within the towns of Thousand Oaks, Camarillo (west), Simi Valley (north), Westlake Village (south) and Calabasas (east).

Landscape-level features associated with bobcat habitat use

To examine landscape features that may link bobcats to toxic prey, we examined bobcat habitat use patterns. Six bobcats observed during the mange study (Riley et al., 2007) were captured and fitted with either Global Positioning System (GPS) or very high frequency (VHF) radio collars. Using knowledge of movement patterns from past research (Riley et al., 2003), the collared animals were tracked between the hours of 2200 and 0500 for 30 days following methods used by Riley et al. (2007). LOCATE II (Nams, 1990) was used to estimate triangulated coordinates and the associated error for bobcat locations. Estimated bobcat locations were plotted onto Ortho images of the study area using ArcGIS 9.3.1 (Environmental Systems Research Institute, Redlands, California), and supplemented with previously collected locations (Riley et al., 2007). Hawth's Analysis Tools for ArcGIS (Beyer, 2004) were used to map a minimum convex polygon (MCP) for each bobcat home range and to determine the sampling frame for social science data collection (see below). IBM SPSS Statistics software (Norušis, 2011) was used to conduct discriminant analysis and analysis of variance (ANOVA).

Resident and professional rodenticide use

Qualitative assessment tools were used to collect rodenticide use data from residents and PCOs to link human rodenticide use with toxic prey. To determine the resident sampling frame, we followed methods used by Morzillo and Mertig (2011a) by overlaying the bobcat home range data (above) with a street map. The study area was divided into three potential sampling area polygons based on movement by the six bobcats. The resulting polygons were submitted to the Marketing Systems Group (Fort Washington, PA) to create lists of residents based on US Postal Service delivery route information. Thus, the list of resident addresses from the three polygons served as our sampling frame. A random sample of addresses was selected from each of the three sampling areas in proportion to the number of households in each area. Because one particular gated community was heavily used by three bobcats, a second and independent random sample was drawn for that area. The Yale University Human Research Protection Program's Human Investigation Committee approved the use of human subjects (HIC# 1006006932).

To complete an in-depth qualitative assessment of local residents, we mailed pre-notice postcards requesting voluntary participation in the study to the 1800 residences adjacent or in proximity to open space. Semi-structured questions were used to ascertain resident attitudes towards and experiences with wildlife and living near open space, their nature values (Kellert, 1997) and rodent control practices. Residents were asked to describe their perceptions of their closest open space and to use a five-point Likert scale (strongly favour to strongly oppose) to rate their perceptions of location or space-related risks of various rodent control methods. We used content analysis to analyse responses of qualitative data (Babbie, 2009). Although no mountain lion home ranges overlapped with the study area at the time (and therefore were excluded from data collection), questions about both bobcats and mountain lions were asked because of previously documented rodenticide impacts on mountain lions locally (Beier, Riley, & Sauvajot, 2010; Riley et al., 2007).

For our assessment of PCOs, we conducted an Internet and phonebook search to identify PCOs servicing the study area. Twenty of 24 PCOs contacted verified service in the study area. A letter of intent was mailed to each company detailing the study and requesting voluntary participation in a phone interview. After waiting approximately one week, each PCO was contacted by phone to verify the letter of intent was received and to request an interview. Pre-tested, semi-structured qualitative questions were administered to PCOs to determine characteristics of their pest control practices, including chemical products used, deployment locations, perceived differences between public and professional rodenticide use and knowledge of secondary impacts on local wild felids. Interview transcripts were coded and analysed using content analysis (Babbie, 2009).

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In addition to resident and PCO interviews, six anonymous key informants were identified using the snowball method (Babbie, 2009) and interviewed either in person or by telephone. These informants consisted of local wildlife biologists, wildlife rehabilitators, land managers and historians. Open-ended questions were used to ascertain the informants' knowledge and perspectives of wild felid management and of local governance in the study area. Content analysis was used to identify common themes (Babbie, 2009).

Analysis of the US EPA's Risk Mitigation Decision for Ten Rodenticides

We used content analysis (Babbie, 2009) to examine the US EPA's *Risk Mitigation Decision*'s prescriptions and assumptions according to the decision process standards outlined in the IPS meta-framework (Clark, 2002; US EPA, 2008). The bobcat habitat data and resident and professional rodenticide use data were then integrated with the policy content analysis to link biological, social and policy data and to evaluate the potential efficacy of the *Risk Mitigation Decision* in the study area.

Research limitations

Limitations existed in our analysis, three of which we describe here. First, examining the use of discourses assumes a cultural perspective and requires an ethnographic standpoint to deconstruct terms and minimize bias in data collection and interpretation. Terms such as "nature", "yard" and "natural area" are culturally derived, in this case from a Western worldview. Therefore, an ethnocentric bias may exist in our methods and results. A second limitation was the sample size of bobcats and relatively short-term night-time telemetry data collection period, which typically can last for several years. A third limitation was the low response rate among residents, which disallows us to assume representativeness of the larger population of residents in the study area.

Findings

Landscape-level features associated with bobcat habitat use

One hundred night-time bobcat locations were recorded during the tracking period (Figure 1). Forty out of 60 locations occurred in urban areas, defined as $\leq$ 40 m from a privately owned property or an urban feature, such as a road, building, golf course or fence. Results of discriminant analysis revealed key landscape-level habitat features to include fruit trees, fences, fire breaks, cement irrigation ditches and open space ($p < .05$). The first four are common at the residential-open space margin, and the last with the centre or core of bobcat home ranges.

Bait boxes designed to deploy rodenticides were observed along buildings, fences and in dense brush up to 50 m from residences and up to 125 m from

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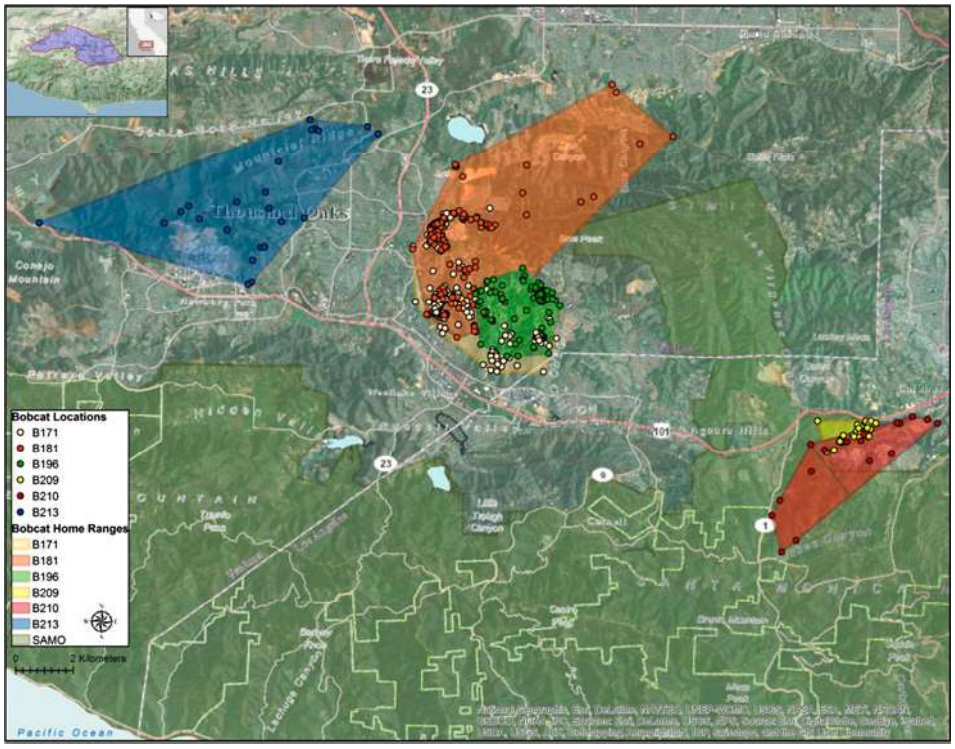

Figure 1. Urban bobcat home ranges.
Note: Santa Monica Mountains National Recreation Area (California, USA) is a complex landscape with patches of open space among low- to high-density residential areas that span multiple land management agencies. Coloured circles indicate estimated bobcat locations. Corresponding shaded polygons represent estimated bobcat home ranges.

assessed bobcat locations (Figure 2). Consequently, the key landscape features documented in the bobcat habitat use phase are also common locations for outdoor anticoagulant deployment, which was confirmed by subsequent resident and pest control operator interviews (see below). These particular landscape features in the residential-open space margin may be rodent attractants, indirect bobcat attractants, the sources of rodenticide use and locations of contact between wild felids and toxic prey.

Construction of the wildland-urban interface discourse

Resident perceptions of open space

Thirty-two people responded to the postcard solicitation and agreed to be interviewed (~1.8% response rate). Respondents were mostly female (72%), college graduates, White/Caucasian (91%) and had average incomes of $300,000–399,999. Resident perceptions of open space corresponded with

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Figure 2. Bobcat habitat use.
Note: Night-time bobcat locations commonly have sage species in the open space, mowed firebreaks and fences separating public open space from private property in residential areas.

nine nature values (Kellert, 1997). More than 50% of respondents reported having aesthetic, naturalistic and moralistic nature values (Table 1; Figure 3). Half of respondents reported rodents as being associated with their local open space, which was representative of the negativistic nature value. The only nature value not expressed by respondents was the dominionistic nature value (Kellert, 1997).

Of those who utilized their nearest open space, the most common activity reported was hiking or walking. The greatest benefits of living near open space were having privacy, space or quiet (53%), watching or hearing wildlife (41%) and having access to recreational opportunities (38%). According to respondents, the biggest problems experienced by living near open space were associated with specific wildlife (78%; for example, rattlesnakes, mice, rats, raccoons, rabbits, coyotes and insects), and the danger of wildfires (25%). Most respondents thought that open space should be managed primarily for wildlife but also people (53%), followed by both people and wildlife equally (34%), people primarily, but also for wildlife (9%) and people only (3%). No respondents thought that open space should be managed for wildlife only.

Responses to open-ended questions related to yards and adjacent open space revealed a distinction in language among how residents described this space. All residents used words such as being close to or being surrounded by "nature" to describe their physical space. They spoke of the many benefits of living in proximity to nature such as the quality of views and mental and physical benefits. One resident did not view his property or the nearest open space as being

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Table 1. Association between residents and nature values (Kellert, 1997) for open space adjoining their property (n = 32).

Perception	Value	Definition	Function	Association (%)
Aesthetically pleasing	Aesthetic	Physical attraction and appeal of nature	Harmony, security, creativity	91
Wildlife habitat	Naturalistic	Exploration and discovery of nature	Order, meaning, connection	84
Preservation/ conservation	Moralistic	Moral and spiritual relation to nature	Curiosity, exploration, discovery	75
Exploration or study of nature	Scientific	Systematic and empirical study of nature	Knowledge, understanding, critical thinking skills	63
Health and wellbeing	Humanistic	Emotional bonding with nature	Bonding, cooperation, companionship	63
Physical activity	Utilitarian	Material and physical use of nature	Physical sustenance, material productivity, survival skills	56
Rodents	Negativistic	Fear of and aversion to nature	Safety, protection	50

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distinct, but rather as one entity. Although 47% of people thought of their nearest open space as an extension of their backyards, resident descriptions generally constructed this region as a division between their yards and open space along a continuum of private/yard to public/open space. The psychological division between private land and open space matches the physically created delineations commonly marked by fences and fire breaks, thus forming the basis of the WUI discourse.

Resident values of bobcats and mountain lions

Residents strongly agreed with statements representing humanistic, scientific, aesthetic and moralistic nature values towards bobcats and mountain lions (Table 2). Negativistic and utilitarian nature values were moderate while the statement associated with the dominionistic nature value was ranked the lowest. Although generally valued, mountain lions were less likely than bobcats to be tolerated near houses.

Resident perceptions of rodents

The most common wildlife species reported by residents as being pests were rats, gophers, mice and squirrels. Resident tolerance of these species was low (Table 3). Twenty-five percent of residents reported targeting rats with rodenticides. The

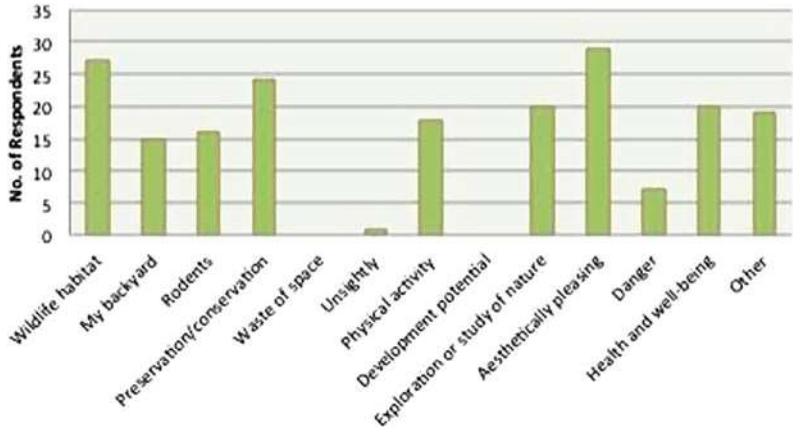

Figure 3. Resident perceptions of open space.
Note: Respondents commonly associated open space with being aesthetically pleasing, wildlife habitat and preservation/conservation. Half of respondents associated open space with rodents.

majority of residents had not heard of native wood rats, and did not distinguish between native and non-native rats when asked about what species they targeted.

Resident rodenticide use and risk perception

Forty-four percent of residents (n = 18) reported that they used anticoagulant rodenticides in or near their homes. Rats, gophers, mice and squirrels were the most targeted species, and tolerance varied across species including those most targeted (Table 3). Of those who used anticoagulant rodenticides, 29% reported self-application, whereas 57% reported PCO application of the products and 29% reported homeowner association (HOA) application. HOAs typically contracted out this work to PCOs.

Perceptions of rodent control methods varied among residents (that is, chemicals, snap traps, live traps and domestic cats) as did their use of these controls in immediate yards versus near adjacent open space (for example, along fences; Table 4). Use of mechanical traps was generally less favoured near open space. In particular, residents were more likely to oppose the use of snap traps ($p <$ 0.05) near open space than on their property. Residents favoured live trap usage closer to their houses more than near open space. Residents were less opposed to using chemical rodenticides in their yards than near open space. The perceived spatial difference in using chemical rodenticides and the risk of harm to wildlife between yard and open space suggests a cognitive distinction that mirrors the physical landscape along the private/yard–public/open space gradient.

Residents generally made a distinction between bait boxes and broadcasting pellets on the ground as different control methods. On average, stronger

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Table 2. Resident nature values (Kellert, 1997) for bobcats and mountain lions (n = 32).

Statement	Nature Value	Bobcats[a]	Mountain Lions[a]	F
I care about conserving ——— and their habitat.	Humanistic	4.72 ± .46	4.59 ± .50	40.078*
I am afraid of ——— near my home.	Negativistic	3.81 ± 1.33	3.19 ± 1.35	3.982*
——— are part of a healthy environment.	Naturalistic	4.50 ± .67	4.34 ± .70	23.746*
It is important for wildlife experts to study ——— behaviour.	Scientific	4.59 ± .62	4.72 ± .52	34.298*
——— are beautiful animals.	Aesthetic	4.78 ± .49	4.72 ± .58	30.648*
People should be allowed to hunt ———.	Dominionistic	1.38 ± .61	1.41 ± .62	51.989*
———near my home increase the quality of my life.	Utilitarian	3.63 ± .10	3.13 ± 1.07	9.060*
——— belong in parks and refuges and not in or near my backyard.	Symbolic	3.81 ± 1.03	2.56 ± 1.24	9.906*
———s have a right to exist.	Moralistic	4.88 ± .34	4.88 ± .34	1.000

[a]Based on Likert scale: 5 = strongly oppose; 4 = somewhat oppose; 3 = no opinion; 2 = somewhat favour; 1 = strongly favour.
An asterisk (*) denotes significant differences (ANOVA; $p < .05$) in values between the species.

Table 3. Perceptions of pest species, species targeted with rodenticides and the number of each species tolerated by residents in their yards (n = 32).

Species	Perceive as Pests (%)	Targeted (%)	Tolerance in Yard (#)
Rats	78	25	1
Gophers	69	19	1
Mice	59	9	2–5
Rabbits	38	0	6–10
Rattlesnakes	38	0	0
Rabbits	38	0	6–10
Raccoons	31	0	2–5
Moles	28	0	1
Wood rats	25	0	1
Coyotes	25	0	1
Squirrels	22	3	6–10
Mountain lions	22	0	1
Opossums	19	0	2–5
Bobcats	16	0	1
Birds of prey	3	0	6–10

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Table 4. Resident preferences of using rodent control methods as a function of space (n = 32).[a]

Rodent Control Method		Preference in yard (mean ± SD)	Preference near open space (mean ± SD)	ANOVA
Chemical	Broadcast pellets	4.63 ± .94	4.78 ± .61	0.4335
	Poison	4.00 ± 1.41	4.78 ± .61	0.0056*
	Bait box	3.53 ± 1.61	4.19 ± 1.51	0.09742
Mechanical	Glue board	3.94 ± 1.44	4.53 ± 1.11	0.06863
	Snap trap	2.91 ± 1.63	4.25 ± 1.34	0.00065*
	Live trap	1.53 ± .84	2.59 ± 1.72	0.0026
Predators	Domestic cats	2.22 ± 1.34	3.06 ± 1.68	0.03011*
	Wild cats	2.25 ± 1.44	1.81 ± 1.20	0.19149

[a]Based on Likert scale: 5 = strongly oppose; 4 = somewhat oppose; 3 = no opinion; 2 = somewhat favour; 1 = strongly favour.
An asterisk (*) denotes significant differences (p < .05) between yards versus near open space.

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opposition existed for the use of bait boxes near open space. Together, place-based risk perception of chemical rodenticide use, combined with resident perceptions of open space and nature values, suggest concern and protection for adjacent open space. However, cognitive perceptions, nature values and actual rodent control behaviour were not always aligned. Approximately 10% of residents expressed a sense of concern for open space and wild felids, but acknowledged frustration over rodent issues and knowingly, yet reluctantly, still used anticoagulant rodenticides. One respondent reported deploying open packets of anticoagulant bait in various outdoor locations of his property, including beyond the backyard fence. This resident knew that the fruit trees in his backyard were attracting rodents, but admittedly valued the fruit trees more and was willing to risk the occurrence of secondary impacts to non-target wildlife. Residents also stated concerns over human health, general cleanliness and property damage as reasons for using chemical rodenticides despite knowing the potential risk of non-target impacts. Others did not make a cognitive connection between rodenticide use and wildlife health.

Residents who used anticoagulant rodenticides predicted that they would hire a rodent control company if they were no longer able to buy these products at their local stores as a result of the EPA's *Risk Mitigation Decision* (US EPA, 2008). Residents who hired PCOs generally viewed this as a common household expense and, without question, viewed the PCOs as knowledgeable experts who provided a needed routine service. However, some residents expressed concern about their HOAs contracting PCOs to deploy anticoagulant products as routine maintenance. Among residents, there was a general public trust in PCOs.

Pest control operator rodenticide use and user knowledge

Of the 24 pest control companies servicing the study area, representatives from eight were interviewed (32% response rate; all male; average employment as a PCO = 14 years). Respondents ranged from self-employed one-person PCOs (50%) to those who worked for larger regionally or nationally based companies (50%). On average, 68% of total annual business activity and revenue came from residential contracts. All PCOs reported having contracts with HOAs or property management and real estate groups.

All PCOs reported servicing residences next to open space and using anticoagulant rodenticides. On only rare occasions would some PCOs deploy exposed bait on the ground. All PCOs primarily used bait boxes that they regularly checked and refilled with new bait when deemed necessary – on average once per month. In total, respondents estimated deploying an average of 276.1 kg of anticoagulant bait per month (range 3.4–708.7 kg). Each PCO used wide discretion in terms of where and how much anticoagulant rodent bait could be deployed within the general limits of the law. On average, PCOs typically placed rodenticides 6 m away from houses and in areas not easily visible, such as along fences, within bushes and near air conditioning units. Bait was placed up to 45 m from houses.

Content analysis of PCO interviews revealed themes of risk perception, safety, public competency, expertise and responsibility within the same wildland-urban discourse expressed by residents. The majority of PCOs spoke of open space as being the source of rodents and rodent-related problems. Many used the word rodent "pressure" to define the real or perceived movement of rodents from open space to houses along a distinct natural-residential continuum. Stating concerns over unchecked rodent population "explosions" and human safety, each PCO supported the outdoor use of anticoagulant rodenticides to reduce this outdoor rodent pressure and to avert threats to human safety. Any potential risk of secondary impacts on wildlife was either denied or considered a worthwhile risk to secure human health and safety.

When asked about differences between resident and PCO anticoagulant product use, PCOs stated that the public generally used these products incorrectly by broadcasting bait, using too much and using it in incorrect locations, such as indoors, away from buildings and in open spaces. This use is despite packaging instructions indicating these products are designed to be used in houses. Public use of these products was considered unsafe, while PCOs considered themselves to be knowledgeable and trained experts in conducting safe rodent control methods that avoid impacts on children, pets and wildlife. PCOs considered their products and use of them as "safe" in terms of how they took necessary precautions to deploy the products, such as by primarily using tamper-resistant bait boxes.

There appeared to be an inverse relationship between employment tenure, knowledge of the active ingredients in anticoagulant products used and awareness

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of risks to non-target wildlife. Those with shorter tenure tended to have more knowledge of their products and secondary effects, but a small sample size prevented statistical testing. Over a third of the PCOs interviewed could not report the active ingredients contained within their anticoagulant bait. PCOs bought their rodent control products from large, global industrial chemical distributors. In addition to selling products, distributors offer training and many respondents had taken part in such training. One respondent said that the distributors are "heavily involved in educating" PCOs. A second respondent noted that if secondary impacts on wildlife existed, he would have heard about it at one of these training sessions, but had not.

Half of PCOs had not personally heard of secondary impacts on wildlife, although most thought the potential existed for it to occur. No PCO had personal experience with non-target impacts. Some PCOs thought that their own practices, such as the use of bait boxes and a self-described minimal use of anticoagulants, were "safer" than public use of the same products. The majority of PCOs did not think that the use of anticoagulant rodenticides posed any risk nor contributed to non-target impacts. One respondent denied the potential for secondary impacts and denounced research linking anticoagulant products with carnivore mortality (see Riley et al., 2003, 2007). Other respondents suggested that it would be impossible for a large predator to consume a lethal dose of toxic rats in a short time period (for example, 60 rats in a 1–2 day period). One PCO indicated using difethialone because it was perceived as safer, effective and provided the "best balance of risks and benefits" among second-generation products. Respondents indicated that anticoagulant deployment could be "done safely" and that there were "no raptors falling over dead" in the area. In contrast, key informants reported observing and treating raptors likely exposed to anticoagulants.

Only two PCOs noted awareness of the *Risk Mitigation Decision* (US EPA, 2008). Like residents, most PCOs thought the policy was a good idea, but for different reasons. PCOs thought public use of anticoagulants was irresponsible and excessive, and that rodenticides should be used by only PCOs or other professionals. Despite some not agreeing with additional regulations, the majority believed that it was a good idea to limit public purchase of anticoagulants and that such a regulation may increase their client base.

Examination of the US EPA's Risk Mitigation Decision for Ten Rodenticides

Examining the *Risk Mitigation Decision* (US EPA, 2008) revealed two main prescriptions, each with an underlying assumption. The first prescription restricts public use of anticoagulant products by limiting their public sale and purchase. The underlying assumption is that non-target exposure of children and wildlife is due to public use of anticoagulant products. The second prescription requires

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PCOs to use bait boxes in product deployment. The underlying assumption is that bait boxes will reduce the risk of non-target impacts.

Discussion and conclusions

We used an interdisciplinary meta-framework to evaluate policy addressing non-target impacts of rodenticides on wild felids in California, USA. Our results confirm our first hypothesis and support earlier research (Morzillo & Schwartz, 2011; Riley et al., 2003) demonstrating bobcats utilize landscape features that may facilitate contact with rodenticide products and toxic prey. Resident perspectives of space were generally consistent with the WUI discourse. What is deemed as wild versus not-wild may manifest physically on the landscape in terms of rodent control behaviour and decision-making, which may enable wildlife exposure to toxins. Cognitive dissonance (Festinger, 1962) also may play a role in resident rodent control behaviour. Morzillo and Schwartz (2011) found that respondents closer to open space reported a greater importance of natural features to them personally than respondents further away, but were more likely to participate in rodent control. Consistent with Morzillo and Mertig (2011b), residents generally agreed that they would discontinue the use of chemical rodenticides if they learned it may impact wildlife. Yet, human values (Clark, 2002; Kellert, 1997) of power and wellbeing regarding personal and pet health and safety may be of greater concern than the wellbeing of wildlife (Wargo, 1998).

Our results suggest limited PCO knowledge of rodenticides, but that relatively long employment, reputation among clientele and training by chemical companies have crafted PCOs as experts. Creating experts suggests evidence of scientized management and a larger positivist paradigm (Brunner et al., 2006; Taylor & Clark, 2005). Converse to our second hypothesis, resident trust in PCOs may place significant power in the hands of PCOs (Foucault, 1982) at the local scale regardless of resident control behaviour and known risks to non-target wildlife. Similar to PCOs, interviewed wildlife and land managers also expressed the themes of public incompetency and irresponsibility as the expected source of non-target wildlife impacts. While some residents view PCOs as experts who use products safely, wildlife managers support their research with statistical tests and also perceive themselves as experts as part of the scientized management paradigm. Supporting our third hypothesis, PCO and wildlife manager knowledge and expertise is placed in direct competition within this WUI discourse (Brunner & Steelman, 2006; Brunner et al., 2006; Mattson & Chambers, 2009). Beyond the scope of our data, we postulate that any conflict between PCO and wildlife management expertise may be attributed to diverse human values (Mattson & Clark, 2010) or politicization of data that together mask constitutive problems of wildlife and environmental management (Brunner et al., 2006; Clark & Rutherford, 2005).

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Further challenges for the US EPA's *Risk Mitigation Decision* and its assumptions likely exist, three of which we highlight here. First, nationally based policies are sometimes criticized for their comprehensive scope but lack of effectiveness on a local scale (Mosse, 2004; Scott, 1998). For nationally based risk assessments, subjectivity exists in data collection, data analysis, acceptable levels of risk and how "safe" is defined and measured (Kasperson et al., 1988; Slovic, 1999, 2000). Despite the US EPA ruling (US EPA, 2008), and despite PCOs already using bait boxes, secondary impacts on wildlife are ongoing (Riley, Boydston, Crooks, & Lyren, 2010). Therefore the policy is practical to reduce exposure risk to children through use of bait boxes, but given the prescription and underlying assumption, it may not be as effective for non-target wildlife.

Another challenge is problem definition. Although our results suggest prevalence of PCO product use, ongoing resident and PCO use of these products may be influenced by the WUI discourse. Respondents perceived a separation of people and nature, which may influence rodent control decision-making and behaviour thus rendering non-target impacts invisible through cognitive dissonance (Morzillo & Schwartz, 2011). Therefore, the *Risk Mitigation Decision* (US EPA, 2008) may be effective when applied nationally, but it may not be contextual enough for this specific study area given the complexity of biological and social characteristics within the fragmented landscape. Additionally, our results highlight that the policy may not effectively target the intended user group, and that the general use of anticoagulant rodenticides may be more of a concern than the user group.

A third challenge is that the conventional approach to carnivore conservation is based on a scientized management paradigm. It focuses people in the biological frame of reference rather than on social values, decision-making and cultural or constitutive issues that remain invisible using this conventional approach. One participant group can challenge the expertise of another, such as between the PCOs and wildlife managers. The public may be viewed as incompetent by "experts", yet the "experts" may be trusted and respected by the public without question. Ultimately, the interaction of PCOs, wildlife managers and prescripts and assumptions of the US EPA policy contribute to the discourses of public incompetency and irresponsibility (Wilkinson, Clark, & Burch, 2007) and scientized management.

In the event of policy failure, other contextual approaches to mitigation have the potential to be crafted and implemented. For example, reforming the PCO training process so that third-party groups conduct these sessions (rather than the chemical companies themselves) may alleviate a potential conflict of interest. Opportunity exists for collaborative training for PCOs by wildlife managers, the pesticide industry and federal regulators. There also is potential to better inform consumers about product choices and uses regardless of incentives that exist (for example, financial incentives for chemical companies; Wargo, 1998). For example, ecologically based pest management (EBPM) practices focus on

practical rodent management rather than on unrealistic elimination. EBPM uses anticoagulant rodenticides only if other behavioural and mechanical methods prove ineffective (Paz et al., 2013; Puan, Baxter, Goldizen, Zakaria, & Hafidzi, 2012; Singleton, Leirs, Hinds, & Zhang, 1999). Therefore, EBPM emphasizes tolerance for rodent presence in tandem with preventative measures such as exclusion from structures and reducing possible attractants and refugia.

Wildlife managers and policymakers might also explore a management approach based on adaptive governance (Brunner & Steelman, 2006; Brunner et al., 2006), which incorporates governance principles that focus on finding and securing the common interest among participants and fosters creativity and civility (Mattson & Chambers, 2009). Creating a flexible and localized adaptive governance structure may allow wildlife and land managers and local policymakers to experiment with many methods for responding to wildlife conservation challenges in a timely and contextual manner. Non-target impacts of rodenticides on wildlife are a concern on many geographic scales, including globally. A problem-oriented analysis advances our understanding of how values, decisionmaking and cultural or constitutive problems affect wildlife management, and provides a starting point for creating more targeted and effective regulations.

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Acknowledgements

The authors wish to thank residents, pest control operators and key informants for their participation and contributions to this study. Sincere appreciation is expressed to C. Schoonmaker, J. Moriarty, J. Sikich, R. Sauvajot, C. Brigham and G. Elwood of Santa Monica Mountains National Recreation Area (SAMO) for their valuable knowledge and support. This article is dedicated to the life and legacy of Margot Feuer whose love of the Santa Monica Mountains, commitment to land conservation and tireless persistence helped lead to the creation and protection of SAMO.

Funding

Funding was provided by the Doris Duke Conservation Fellowship, Carpenter Sperry Award and the David Schiff wildlife grant.

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Cite this article: Serieys LEK *et al*. 2018 Urbanization and anticoagulant poisons promote immune dysfunction in bobcats. *Proc. R. Soc. B* **285**: 20172533.
http://dx.doi.org/10.1098/rspb.2017.2533

Received: 12 November 2017
Accepted: 8 December 2017

Subject Category:
Ecology

Subject Areas:
immunology, ecology, physiology

Keywords:
anticoagulant rodenticide, inflammation, immune suppression, bobcat, *Lynx rufus*, urbanization

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Electronic supplementary material is available online at https://dx.doi.org/10.6084/m9.figshare.c.3965397.

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Urbanization and anticoagulant poisons promote immune dysfunction in bobcats

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Understanding how human activities influence immune response to environmental stressors can support biodiversity conservation across increasingly urbanizing landscapes. We studied a bobcat (*Lynx rufus*) population in urban southern California that experienced a rapid population decline from 2002–2005 due to notoedric mange. Because anticoagulant rodenticide (AR) exposure was an underlying complication in mange deaths, we aimed to understand sublethal contributions of urbanization and ARs on 65 biochemical markers of immune and organ function. Variance in immunological variables was primarily associated with AR exposure and secondarily with urbanization. Use of urban habitat and AR exposure has pervasive, complex and predictable effects on biochemical markers of immune and organ function in free-ranging bobcats that include impacts on neutrophil, lymphocyte and cytokine populations, total bilirubin and phosphorus. We find evidence of both inflammatory response and immune suppression associated with urban land use and rat poison exposure that could influence susceptibility to opportunistic infections. Consequently, AR exposure may influence mortality and has population-level effects, as previous work in the focal population has revealed substantial mortality caused by mange infection. The secondary effects of anticoagulant exposure may be a worldwide, largely unrecognized problem affecting a variety of vertebrate species in human-dominated environments.

1. Introduction

Urbanization presents natural populations with evolutionarily novel stressors [1–4]. Although toxicant use is an inevitable consequence of urbanization, their impacts are often cryptic and may be more widespread than we realize. Toxicants directly kill wildlife [5–7] and cause population declines worldwide [8,9]. Yet their sublethal effects, which can include impaired immune competence [10,11] and increased disease susceptibility [3,12], are difficult to study in natural populations and are thus poorly understood [7].

Secondary toxicant exposure, when toxicants are transmitted among species, is common [7]. One example is when exposed rodents transfer

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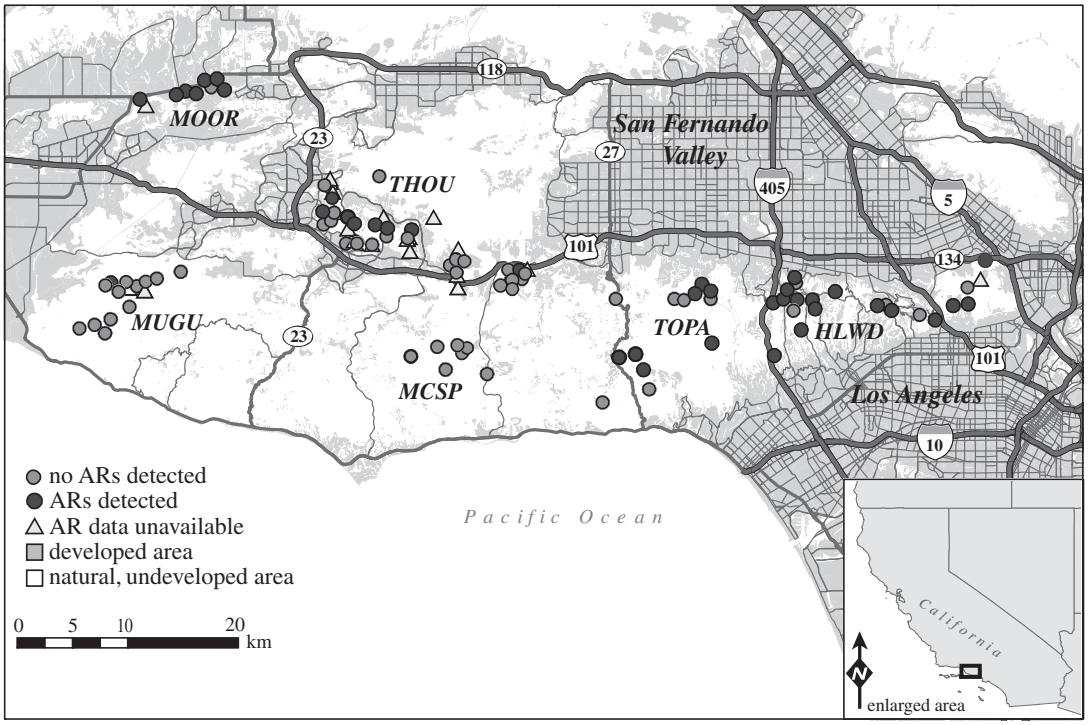

Figure 1. Map of sampling areas in Santa Monica Mountains National Recreation Area and the surrounding region. Circles and triangles represent capture locations for individuals for which health parameter data were available.

anticoagulant rodenticides (ARs) to their predators. Globally, non-target wildlife exhibits widespread secondary exposure to ARs [5,13–16]. In some populations, more than 80% of individuals test positive for ARs [5,13–17], pointing to the potential for ecosystem-wide effects. This secondary exposure can be directly lethal to some mammalian and avian predators [5,13–17], including endangered species [14,16].

As vitamin K antagonists, ARs are intended to disrupt coagulation and cause fatal haemorrhage [16]. The sensitivity of species to the vitamin K antagonistic effects can vary by orders of magnitude [18] and some species may tolerate long-term sublethal exposure. Yet, understanding the potential health effects of long-term sublethal exposure has been difficult, because doing so requires (i) long-term monitoring, (ii) methods to measure exposure, (iii) ability to sample both exposed and unexposed animals while they are alive and measure appropriate health biomarkers, and (iv) information to control for potential confounding variables such as age, sex or sampling conditions.

We assess the sublethal health effects of exposure to ARs in an urban bobcat (*Lynx rufus*) population that precipitously declined due to mange caused by the mite *Notoedres cati* (hereafter termed 'mange'). Although previously reported only in isolated cases in wild felids, mange was the greatest source of mortality for urban bobcats at Santa Monica Mountains National Recreation Area (SMMNRA), a national park in southern California, during 2002–2005 [17]. After mange was detected in 2001, average annual survival plummeted by 49%. In 2003, 51% of radio-collared animals died of mange and transect surveys showed a 90% decline in urban bobcat scats post-epizootic [17]. The epizootic caused a significant genetic bottleneck [4]. Necropsies of mange-infected bobcats showed 98% of individuals exposed to ARs, and to significantly greater amounts than bobcats that did not die with mange [17,19,20]. Severe mange in wildlife and domestic animals is often associated with decreased immune competence [21]. Carnivore exposure to toxicants other than ARs (including heavy metals) has rarely been documented in our study area or more broadly across the State of California (S. P. D. Riley 2017, unpublished data; S. McMillin 2017, unpublished data; R. Poppenga 2017, personal communication). Therefore, we hypothesized that urbanization exposes bobcats to novel immunotoxic effects, mediated principally by ARs that are widely used in nearby urban areas [19].

Here, we test for effects of AR exposure and proximity to urbanization on 65 measures of immune and organ function in a population of wild bobcats that has been the subject of long-term study. We used a battery of health assays to accomplish three objectives: (i) to identify individual markers of potential immune impairment or organ cellular damage that correlate with AR exposure or urban proximity (controlling for potential confounding variables in a linear model framework), (ii) to test whether there is a system-wide predictable relationship between ARs and health parameters such that immune and organ function parameters themselves can be used to indicate AR exposure (using a random forests classifier approach), and (iii) to propose a mechanism by which life at the urban edge could influence mange susceptibility in bobcats. Using this multifaceted approach, we provide new understanding of the cryptic threat toxicants pose at the urban–wildland interface.

2. Material and methods

See electronic supplementary material S1 for detailed methods.

(a) Study area and sample collection

Bobcats ($n = 124$) were sampled in and around SMMNRA (figure 1) in southern California during 2007–2012 as previously described [4,17,19,20]. Sampling occurred within fragmented natural habitat interspersed within urban areas (THOU, HLWD), fragmented natural habitat within a predominantly agricultural area (MOOR) and

Table 1. Sample sizes and information for use of the samples in varied tests.

data parameter	test (sample type)	*n*
anticoagulants	residue analysis for exposure (whole blood and serum)	99
	PIVKA clotting time (plasma)	50
	prothrombin clotting time (whole blood)	24
health parameters	general (whole blood and serum)	124
	immunophenotype (lymphocytes in whole blood profiled by flow cytometry)	64
	cytokine concentrations (serum)	93
	complete blood counts (whole blood)	118
	blood chemistries (serum)	116
B cell clonality	immunofixation (serum)	6
	PARR (whole blood)	7
pathogen infection or exposure	exposure/infection (whole blood and serum)	93
land use	percentage urban area (buffer zones)	118

unfragmented natural areas (protected state and national park lands; MUGU, MCSP). Bobcats were sexed, measured and classified as juveniles or adults [19]. Blood samples were collected in EDTA, serum separating and sodium citrate tubes via jugular, cephalic or saphenous venipuncture.

(b) Immune and organ measures

We measured a total of 71 blood cell properties (table 1). We used whole blood to measure complete blood counts (CBC; $n = 118$) and serum for serum chemistry ($n = 116$) as described in [20]. At the UCLA Center for AIDS Research (CFAR) ImmunoBioSpot Core we used serum to measure circulating cytokine levels ($n = 93$), using the 19 cytokine Feline Cytokine Panel (EMD Millipore, Billerica, MA). We isolated peripheral blood mononuclear cells for immunophenotyping and analysed the samples ($n = 64$) in the UCLA CFAR Flow Cytometry Core. We measured the absolute number and proportion of total T lymphocytes, helper and cytotoxic T lymphocytes, activated helper and cytotoxic T lymphocytes, natural killer cells, monocytes/macrophages, total B and CD5+ B lymphocytes and CD4 + CD8 + lymphocytes (electronic supplementary material, table S1). We removed health parameters with more than one-third of missing data from the dataset, leaving us with 65 measures of immune or organ function (hereafter 'health parameters'; electronic supplementary material, tables S2–S5). For reference comparison, we accessed CBC and serum chemistry values for captive bobcats using the International Species Information System (ISIS; 2011, Apple Valley, Minnesota 55124–8151, USA). Reference values for cytokines and immunophenotypes are not available because to our knowledge, we are the first to generate data on bobcat immune parameters.

(c) Pathogen surveys, anticoagulant rodenticide screening and land use

The presence of AR residues for warfarin, coumachlor, bromadiolone, brodifacoum, diphacinone, chlorophacinone and difethialone was assessed in whole blood or serum ($n = 99$) at the Center for Animal Health and Food Safety (CAHFS) as described in [19].

We assessed clotting times using two measures: prothrombin times (PT) [22] and the more sensitive proteins induced in vitamin K absence (PIVKA) [23]. We measured PT ($n = 24$) using the Coag DX machine according to the manufacturer's instructions (IDEXX, Irvine, CA). PIVKAs were assessed at CAHFS using plasma samples frozen in liquid nitrogen as described in [23].

In addition to testing the effects of AR exposure on our dataset of health measures, we also tested the potential effects of urban land use. We previously documented that testing blood only indicates recent AR exposure events, thus leading to frequent false negatives (approximately 62% of the time; see [19] for more detail) respective to an individual's history of exposure. Urbanization, therefore, is arguably a more sensitive measure of AR exposure than AR levels in the tissues we are able to sample (i.e. peripheral tissues such as blood) [19], but it can also reflect potential exposure to other toxicants from urban environments. To quantify 'urbanization' or 'land use' for each individual, we used a standardized metric previously described in [19]. We calculated the proportion of natural and developed area within a radius (buffer zone) approximating one home range (females 2.3 km^2; males 5.2 km^2) around each individual's capture location ($n = 118$).

We tested individuals ($n = 93$) for exposure (i.e. seropositivity) to the bacterial pathogen bartonella (*Bartonella* spp.), the protozoan *Toxoplasma gondii*, and the viral pathogens feline immunodeficiency virus, puma lentivirus, feline calicivirus and feline herpesvirus. We also tested for infection with bacterial pathogens *Mycoplasma haemofelis*, *M. haemominutum*, *Bartonella henselae* and *B. clarridgeaie*. All testing was done at the Center for Companion Animals Studies or in the Feline Retrovirus Research Laboratory at Colorado State University as described in [24]. All individuals were inspected for signs of clinical mange as described in [17,20]. Four bobcats were captured with clinical signs of mild-to-severe mange. We excluded these individuals from further analyses because our goal was to isolate the effects of ARs, without introducing the noise from immune response to mange.

(d) Statistical analyses

(i) Identifying individual immune measures associated with AR exposure or land use

Our primary goal was to identify individual immune or organ function parameters associated with AR exposure or land use. However, because demography (age class and sex), season of sample collection and disease exposure or infection status may also have strong effects on immunity, we first used principal components analysis (PCA) to determine which of these parameters explained significant variance in our dataset. To do so, we first imputed missing values in our dataset of 65 health measures (using a *k*-nearest-neighbours algorithm from the *impute* package [25]; $n = 75$ individuals), and used a Spearman's rank correlation to test for a relationship between each potential covariate and the

top 20 principal components (PCs). We identified three covariates—age class, *M. haemominutum* infection and *Bartonella* sp. exposure—that explained significant variance in the overall dataset (i.e. that correlated with one or more of the top 20 PCs at a 20% false discovery rate (FDR) threshold [26,27]). We controlled for these three parameters in all downstream analyses.

Next, we used linear models to test for a relationship between each of the 65 health parameters and AR exposure or urban land use, controlling for age class, *M. haemominutum* infection and *Bartonella* sp. infection. Each variable was normalized via *z*-score transformation prior to linear modelling using the 'scale' function in R. While AR exposure is the primary predictor of interest, we included urban land use in each of our linear models to capture the spectrum of health effects at the urban edge (see electronic supplementary material, S1 results and table S6 for analyses that test for effects of AR exposure and urban land use separately). For each model, we extracted the *p*-value associated with the AR exposure or urban land use effect and corrected for multiple hypothesis testing using an FDR approach [27] implemented in the R package 'qvalue' [26].

(ii) Testing for systemic, predictable differences between AR-exposed and unexposed individuals

We observed strong associations between AR exposure and many individual health parameters. We next wanted to test if these associations were system-wide and predictable, such that the health parameters themselves could be used to indicate AR exposure. To test this possibility, we used a random forests classifier (see [28–30] for information on random forests and their application to ecological datasets). This algorithm proceeds by randomly sampling a training set from the original data and a test set comprised the remaining individuals. The training set is used to grow a series of decision trees that accurately classify individuals with respect to the variable of interest, and the test set is used to test the predictive accuracy of the model. Further, this framework can be used to estimate the importance of individual variables by quantifying the mean decrease in accuracy for a random forests classifier that does versus does not include the focal variable. Importantly, for our purposes, a random forests approach allowed us to evaluate the importance of all 65 health parameters in one analysis simultaneously, using a method that is well-suited to handle a range of statistical relationships among predictor variables (e.g. correlation, interaction or context dependency [28–30]). Thus, while linear models allowed us to test for an association between each immune measure and AR exposure independently, random forests provide a complementary perspective by accounting for the complex relationships among the health parameters themselves.

To implement random forests, we first regressed out the effects of major covariates—age class, *M. haemominutum* infection and *Bartonella* sp. infection—from the filtered, imputed dataset of 65 health measures ($n = 75$ individuals; note that we again *z*-score normalized each measure prior to linear modelling). We used these residuals, combined initially with information on land use, to predict AR exposure, using the R package 'randomForest' [31] and default parameter settings; note that we also used the R package 'ROCR' to evaluate model sensitivity/specificity as quantified by area under the curve (AUC) [32]. To identify important variables, we used the package 'rfPermute' to quantify the mean decrease in accuracy associated with the removal of each predictor variable [33]. We considered variables to be significant if they passed a 10% FDR threshold. We also repeated these analyses without land use information in the model, and report those results in electronic supplementary material, table S7 and figure S1.

Testing blood for AR residues leads to 62% false negatives because blood measures only recent exposure [19]. We therefore hypothesized that (i) some individuals with no detectable levels of ARs in blood would be classified by the random forest as AR-exposed, and (ii) these individuals represent a set of truly AR-exposed individuals for whom the blood tests produced a false negative. If true, we would expect individuals living in more urbanized areas (where AR exposure is widespread) to fall into the misclassified group (i.e. to have immune profiles that are similar to known AR-exposed individuals, even though ARs were not detected in blood). To test this possibility, we used a Wilcoxon-signed rank test to ask whether individuals categorized as AR-exposed by random forests (but unexposed based on blood tests) had higher proportions of urbanization in their buffer zones than individuals classified as unexposed by both blood tests and random forests.

(iii) Hypergeometric assessment to assess overlap with model-organism studies

Finally, we used a hypergeometric test to ask whether our findings were in accordance with those from human or model-organism laboratory studies [34–46]. Specifically, we asked whether the set of immune measures we identified as (i) associated with AR exposure in our linear model analyses or (ii) important for predicting AR exposure in our random forests were significantly enriched for immune measures previously associated with therapeutic doses of anticoagulants. The list of immune measures previously reported to be associated with the anticoagulants that we examined in this study is provided in electronic supplementary material, table S8. All statistical analyses described here were performed in R v. 3.2.3 [47].

3. Results

(a) Sampling and measures of immune and organ function

Between 2007 and 2012, we collected samples from 124 apparently healthy bobcats (table 1) across a 1264 km^2 study area of natural, urban and agricultural land (figure 1). We report descriptive values for the 65 health parameters, sample sizes and comparative reference ISIS values in electronic supplementary material, tables S2–S5.

(b) AR exposure, land use and pathogens

Blood samples from 98 bobcats were available for anticoagulant residue testing of which 38 were positive in blood, indicating recent exposure [19]. Bobcats were exposed to 1–5 compounds (electronic supplementary material, table S9), and for 32 individuals, we detected only diphacinone. The proportion of urban land use (residential, agricultural or developed open space areas) near each individual's habitat ranged between 0% and 92% (mean = 28.13%, s.d. = 25.04%, median = 23.96%; $n = 118$). AR exposure detected in blood was significantly positively associated with urban proximity ($\beta = 1.57$, $p < 0.001$), but not individual age or sex.

We tested 93 individuals for exposure to or infection with nine common feline pathogens. Prevalences were generally low (less than 25%; electronic supplementary material, table S10), with the exceptions of *M. haemominutum* (55%) and *Bartonella henselae* (65%). No pathogen was associated with urban proximity.

(c) AR exposure rarely affects clotting factors

Neither PT ($t = -0.51$; $p = 0.307$) nor PIVKA clotting times ($t = -0.76$; $p = 0.227$) differed significantly between

AR-exposed or unexposed bobcats (electronic supplementary material, table S11), suggesting that bobcats are tolerant to vitamin K antagonistic effects of ARs at levels to which they were exposed.

(d) Analyses of individual variables reveal immune perturbations associated with urbanization and ARs

Linear models indicated associations between both AR exposure and urban proximity and multiple parameters reflective of immune and organ function (table 2; electronic supplementary material, table S6 and figure S1). Cell signalling proteins keratinocyte-derived chemokines (KC; $\beta = -1.1$; $p = 0.029$) were negatively associated with urbanization suggesting that as urban land use increases, there is a decrease in KC cytokines that mobilize granulocytic white blood cells (e.g. neutrophils) key to nonspecific immune responses. Although the association with AR exposure and KC was not significant, KC expression was 50% lower in AR-exposed bobcats (electronic supplementary material, table S5). By contrast, stem-cell factor (SCF; $\beta = 1.2$; $p = 0.019$) and interleukin (IL)-12p40 ($\beta = 1.1$; $p = 0.029$) were elevated in bobcats captured closer to the urban edge. Positive relationships with SCF and IL-12 indicate potential heightened activity of cytokines linked with the earliest stages of blood cell formation and development and differentiation of T lymphocytes in urban areas [48].

On a cellular level (table 2; electronic supplementary material , tables S2–S6 and figure S2), AR exposure and urban land use were similarly linked with both immune stimulatory and suppressive effects. Lymphocyte ($\beta = 0.7$; $p = 0.008$), basophil ($\beta = 0.7$; $p = 0.004$) and eosinophil ($\beta = 0.6$; $p = 0.016$) counts were positively associated with AR exposure. In particular, lymphocyte counts were on average 44% greater in AR-exposed bobcats, suggesting a link between AR exposure and generalized inflammation [48]. The fraction of neutrophils, relative to the distribution of other white blood cells, was suppressed by 10% in AR-exposed bobcats ($p = 0.004$). While mild suppression of neutrophils may not directly impede an ability to mount immune responses, the suppression may signal that larger autoimmune or cytokine-mediated inflammatory processes of concern are present [49].

We used immunophenotyping to identify and quantify specific lymphocyte populations central to the adaptive immune response (electronic supplementary material, tables S1, S4 and S6). CD4 + CD8 + T lymphocytes associated with cell-mediated immunity to tumour and viral-infected cells [48] decreased with urban land use ($\beta = -1.6$; $p = 0.019$). Urbanization was also associated with greater B lymphocyte activity ($\beta = 0.7$; $p = 0.039$), and was associated with AR exposure in joint AR and urban models, albeit not significantly (table 2); when we tested for association with AR exposure alone, B cells were significantly associated with AR exposure (electronic supplementary material, tables S4 and S6). Specifically, B cell counts were 48% higher in AR-exposed bobcats ($\beta = 0.9$; $p = 0.005$) and B cell fractions were 36% higher ($\beta = 0.7$; $p = 0.025$). B lymphocytes are the humoral adaptive immune component that targets invading pathogens [48]. We verified that B cells were polyclonal to rule out lymphocytic leukaemia (see electronic supplementary material, S1 methods).

AR exposure and urban proximity were also associated with anomalies in biochemical markers associated with organ function (table 2; electronic supplementary material, table S6 and figure S2). Creatinine, a protein indicator of kidney function, was negatively associated with AR exposure ($\beta = -0.5$; $p = 0.049$). The serum concentrations of the minerals calcium ($\beta = 0.8$; $p = 0.028$) and phosphorus ($\beta = 0.9$; $p = 0.007$) were positively associated with urbanization. Blood urea nitrogen ($\beta = -1.0$; $p = 0.046$), a marker of kidney function, was negatively associated with urban land use, whereas alkaline phosphatase, a marker of liver function, was positively associated with urban land use ($\beta = 0.9$; $p = 0.015$). The clinical implications of these associations are unknown, but highlight that ARs and urbanization may have system-wide physiological consequences for species that persist at the urban–wildland edge.

(e) Urbanization and ARs have systemic, predictable effects on health parameters

We used random forests to explore the cumulative, system-wide relationship between AR exposure and health effects. Random forests revealed that the differences between AR-exposed and unexposed individuals were systemic and predictable such that the parameters themselves can be used to predict an individual's exposure status (predictive accuracy = 67.3%, error rate = 32.7% and AUC = 0.68, electronic supplementary material, figure S2*a–b*; proportion of individuals correctly classified as exposed and unexposed = 18/29 and 31/46). The parameters important for predicting whether an animal was exposed to ARs were linked with both immune and organ function (figure 2*a;* electronic supplementary material, tables S7 and S11). For example, the number of activated helper T lymphocytes, the number and fraction of cytotoxic T cells and the fraction of B cells significantly contributed to model accuracy (figure 2*a;* electronic supplementary material, tables S7 and S11). These findings were similar across models that did not incorporate urban land use (electronic supplementary material, tables S7 and S11).

We predicted that systemic health parameter changes may be a better indicator of AR exposure than blood residue tests. Our random forests predicted that 11 bobcats testing negative for ARs in blood were actually AR-exposed; in support of the idea that these individuals represent false negatives for AR blood tests (and truly were exposed), these animals had greater urban proximity compared with individuals classified as unexposed to ARs by both random forest and blood tests (Wilcoxon rank sum test, $p = 0.001$; figure 2*b*).

(f) Bobcat response to ARs mirrors model-organism response to therapeutic anticoagulants

We tested whether our findings were in accordance with those from human and model-organism laboratory studies [34–39] (electronic supplementary material, table S8). For example, concordant with published studies, we found increased lymphocyte activity and a decrease in neutrophil fractions associated with anticoagulants (figure 3). The overlap we observe is more so than expected by chance ($p = 0.005$, hypergeometric test).

4. Discussion

Carnivores in SMMNRA are widely and chronically exposed to ARs [5,17,19,50], but the sublethal consequences of this exposure were unknown. Here, we focused our analyses directly on the

Table 2. Linear regression results. We present the β- and p-values for tests that were significant for one or both predictor variable, and the mean and standard errors (s.e.) for the parameters shown. NR indicates values not reported.

		urban proximity		AR exposure		mean value (s.e.)		
parameter	function	β	p[a]	β	p[a]	unexposed	AR-exposed	captive[b]
keratinocyte-derived chemokine	involved in chemotaxis and activation of neutrophils and monocytes/macrophages	−1.1	0.029*	−0.2	0.551	2058.2 (399.9)	979.6 (288.1)	NR
stem-cell factor	promotes cell survival, proliferation, and functional activation of cells during haematopoiesis	1.2	0.019*	−0.1	0.827	578.04 (28.3)	642.1 (28.9)	NR
interleukin-12p40	stimulates growth and functional differentiation of T lymphocytes	1.1	0.029*	0.0	0.285	807.2 (70.4)	885.5 (83.3)	NR
lymphocytes (k cells μl^{-1})	major cellular component of adaptive cell-mediated and humoral immunity	−0.6	0.194	0.7	0.008**	1.6 (0.1)	2.3 (0.3)	2.1 (0.2)
neutrophils (%)	first cells to respond to inflammation	0.4	0.366	−0.7	0.003**	79.7 (1.7)	73.4 (2.5)	62.3[c]
basophils (k cells μl^{-1})	responsible for inflammatory reactions; key role in acute and chronic alleric diseases	−1.3	0.007**	0.7	0.004**	0.0 (0.0)	0.01 (0.0)	0.3 (0.1)
basophils (%)		−1.2	0.009**	0.6	0.012*	0.02 (0.01)	0.1 (0.04)	4.3[c]
eosinophils (k cells μl^{-1})	target multicellular parasites; associated with allergic responses	−0.8	0.118	0.6	0.016*	0.5 (0.1)	1.0 (0.3)	0.5 (0.04)
eosinophils (%)		−0.6	0.207	0.6	0.024*	3.9 (0.6)	6.9 (1.6)	7.2[c]
B lymphocytes (cells μl^{-1})	humoral immune component of adaptive immune system; secrete antibodies and cytokines	0.7	0.039*	0.6	0.267	331.8 (39.2)	686.6 (122.2)	NR
CD4 + CD8 + T (cells μl^{-1})	T lymphocyte that targets viral-infected or damaged cells	−1.6	0.019*	0.7	0.057	25.1 (4.8)	30.5 (7.1)	NR
CD4 + CD8 + T lym. %		−1.6	0.021*	0.4	0.310	1.6 (0.2)	1.4 (0.2)	NR
haemoglobin	indicators of iron sufficiency, oxygen-carrying capacity of red blood cells	1.1	0.027*	−0.2	0.422	12.7 (0.2)	12.9 (0.2)	12.0 (0.2)
MCHC		1.3	0.011*	−0.5	0.043*	32.2 (0.4)	31.6 (0.4)	32.7 (0.2)
alkaline phosphatase	enzyme indicative of liver function	0.9	0.015*	−0.1	0.556	27.3 (3.8)	31.5 (8.3)	19.0 (1.9)
blood urea nitrogen	marker of kidney function	−1.0	0.046*	0.1	0.713	36.1 (1.6)	34.6 (1.5)	32.0 (0.9)
calcium	integral to bone, muscle, nerve function	0.8	0.028*	0.1	0.527	9.4 (0.1)	9.5 (0.1)	9.8 (0.1)
phosphorus	integral to bone, muscle, nerve, a kidney function; tissue repair and maintenance	0.9	0.007**	0.3	0.110	5.8 (0.2)	6.48 (0.2)	5.4 (0.1)
creatinine	protein indicator of kidney function	0.2	0.613	−0.5	0.049*	1.7 (0.1)	1.5 (0.1)	2.0 (0.1)

[a]False discovery rate-corrected p-values; *$p \leq 0.05$, **$p \leq 0.01$.
[b]2011, International Species Information System (ISIS), Apple Valley, Minnesota 55124–8151, USA.
[c]Values not available in ISIS records and so approximated using available data calculated with reported mean absolute cellular counts.

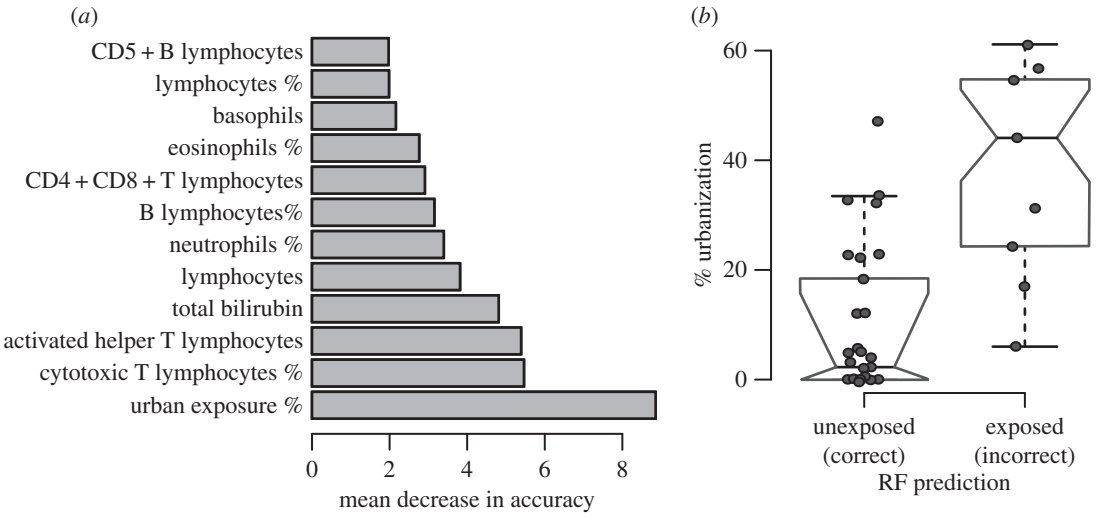

Figure 2. (*a*) Results of random forest analyses ranking variable importance scores for parameters key to predictive accuracy. All parameters are absolute counts unless indicated as a percentage. (*b*) Boxplot comparing land use info for individuals correctly classified versus misclassified individuals.

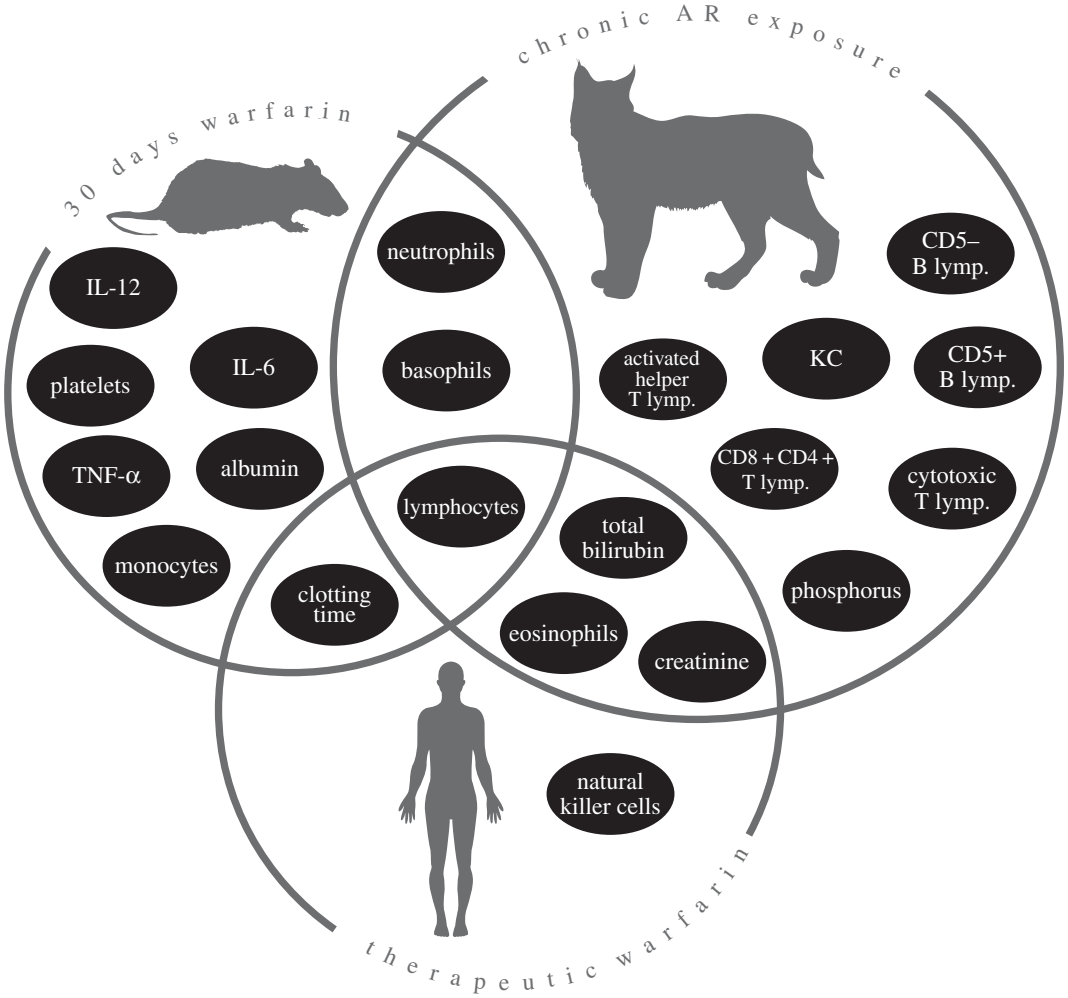

Figure 3. A Venn diagram illustration of significant health parameters that overlap with published rodent and human laboratory studies, as well as the novel parameters discovered in the bobcat population. See electronic supplementary material, table S8 for citations.

effects of ARs, while also incorporating the urban environmental conditions. We found that exposure to urbanization and ARs is associated with health parameter anomalies that range from subtle responses (i.e. 10% decrease in neutrophil fractions) to more pronounced associations with potential clinical implications (i.e. 50% elevated KC and lymphocytes). We posit that, cumulatively, these health parameter changes may increase bobcat vulnerability to environmental stressors such as

opportunistic notoedric mange. Our findings reveal a complex response to sublethal toxicosis, and underscore the harmful toxic effects associated with urbanization for natural populations at the urban–wildland interface.

We focused on a free-ranging, non-model organism to evaluate the immunotoxic effects of urbanization and ARs. While the immunotoxic effects of ARs were our primary interest, we also more broadly characterized the immunotoxic effects of urban proximity for three reasons: (i) it is impossible when studying free-ranging animals to control for every toxic component of the urban edge; (ii) analyses that rely on AR exposure in live-captured animals using blood vastly underestimate the true pervasiveness of AR exposure [19]; and (iii) we previously found that exposure to different individual AR compounds, the concentrations of compounds detected and exposure to multiple compounds (an indicator of repeat exposure events and thus likely chronic exposure) were strongly correlated with the percentage developed area in buffer zones [19]. Clotting times, the most frequent method of AR detection in controlled veterinary settings (e.g. [22]), were not prolonged in AR-exposed bobcats, confirming the difficulty of assessing AR exposure using conventional methods. We therefore conclude that the use of both blood residues and percentage urbanization more robustly evaluates the effects of AR exposure and including of chronic exposure, the latter being immeasurable without frequent sampling of the same individuals. Further, our random forest analyses suggest that the strength and characteristics of the physiological response itself may be more informative for identifying individuals who are truly AR-exposed in cases where blood tests fail to detect ARs.

Bobcats, like domestic cats [18], seem tolerant to the vitamin K antagonistic effects of ARs, as indicated by the normal clotting times in AR-exposed bobcats. However, this tolerance may lead to chronic sublethal exposure that influences other physiological parameters. Our findings related to AR impacts in free-ranging bobcats are remarkably consistent with other published studies (figure 3). Humans and laboratory rodents show simultaneous immunostimulatory and immunosuppressive effects of anticoagulants, such as increased lymphocyte, IL-12 and IL-6 activity, and decreased TNF-α and neutrophils. We document similar immune responses, but also novel systemic effects of AR exposure. These AR-induced changes were in a wide-range of immune parameters associated with responses to allergens (eosinophils and basophils), tumours and viral infections (CD4 + CD8 + T lymphocytes), and novel pathogens (helper T lymphocytes). Because the immune response is energetically costly, and non-target immune activation may impair organismal function, fitness may be reduced by regular immune stimulation [51–53]. Thus, understanding the role of ARs in regulating immunity is essential to the conservation of wild populations.

Bobcats living on the urban edge where they are chronically exposed to ARs may also experience persistent immune and organ perturbations. Chronic activation of immune function can lead to immune exhaustion, characterized by the dysfunction and depletion of immune cells [54,55]. This kind of activation increases susceptibility to opportunistic infections, accelerates disease progression, and even causes disease itself [54–56]. In a hallmark example, the mechanism by which human immunodeficiency virus infection causes acquired immunodeficiency is chronic immune activation that depletes helper T lymphocytes with time, and thus causes an erosion of immune function [57]. Within our study system, the association between AR exposure and immune discord may explain the mechanism linking chronic AR exposure to susceptibility to notoedric mange, which has precipitated regional declines in bobcat populations and decimated our focal population [17,20]. Similar cascading effects could occur in other species where ARs cause sublethal effects.

Given the observed immune system effects, the dearth of evidence of clinical disease related to any pathogens other than mange is surprising. However, when challenged with pathogens, the early activation of specific immune cells and proteins determines the rate of disease progression and outcome [58,59]. Although little is known about immune pathways associated with notoedric mange, the secretion of specific cytokines during early-stage infection is pivotal to disease progression in humans infected with the closely related mite, *Sarcoptes scabiei*. If helper T lymphocytes secrete IFN-γ and IL-2 in response to infection, the infection is overcome. However, if those same helper T lymphocytes secrete other cytokines IL-4, IL-5 and IL-13 [58], an uncontrolled response occurs. The broad-spectrum immune activation that we observe in AR-exposed bobcats may compromise the ability to mount specific immune responses to certain pathogens such as *N. cati*.

Bobcats may also encounter this mite more regularly than other pathogens. In general, we have found low levels of exposure (low seropositivity) to other common feline pathogens [24]. However, *N. cati* is present on other species in the ecosystem including rabbits and ground squirrels [60], and rabbits are the predominant prey item of bobcats in the study area [61]. In our study area overall, bobcats may simply be at risk of infection from *N. cati* more than from other pathogens, and if ARs increase their vulnerability to the pathogen, urban bobcats would be more likely to succumb to infection.

Exposure of non-target wildlife to ARs is increasingly recognized as a global conservation issue [16]. Within the bobcat population, we have also shown that AR exposure can begin during prenatal development, and persist for the duration of an individual's life [19]. While we have rarely documented direct AR toxicity mortality in bobcats ($n = 2$ over a 20-year period), AR toxicity was the second leading cause of death in coyotes over a 9-year study in SMMNRA [5]. These contrasting mortality findings show that toxicants produce myriad effects that differentially influence species within ecosystems. Toxicant exposure can indirectly have fatal impacts, even if it is not a source of direct mortality. Our analyses suggest that sublethal toxicant exposure may indirectly cause mortality by severely weakening the immune system in a free-ranging carnivore, and thus mitigation of the effects of mange will require reduction of ARs at the urban–wildlands interface. While evaluating the sublethal effects of toxicants on the health of free-ranging animals that may experience a lifetime of poisoning is difficult and complex, our findings of measurable and consequential sublethal effect of ARs in a wild population imply that environmental agencies must re-evaluate the harm these toxicants pose to wild species and the ecosystems they inhabit.

Ethics. Animal capture, handling and sample collection protocols were approved by the Office of Animal Research Oversight (UCLA: ARC#2007-167-12) and California Department of Fish and Wildlife (SC-9791).

Data accessibility. All data are available on Dryad: http://dx.doi.org/10.5061/dryad.36rf5 [62].

Authors' contributions. L.E.K.S. and A.J.L. wrote the manuscript and analysed data. M.E. and C.H.U. aided with the development, use and interpretation of immune assays. L.E.K.S., T.C.A., J.M., S.V. and S.C. generated data. J.F., R.K.W. and S.P.D.R. assisted L.E.K.S. with sampling design and manuscript preparation.

Competing interests. We declare we have no competing interests.

Funding. The research was supported by the NSF GRF, NSF EID 0723676 and 1413925, Summerlee Foundation, Christine Stevens Wildlife Award, Panthera, Santa Monica Bay Audubon Society, G2 Gallery, the NPS, SAMO Fund, Poison Free Malibu, HESKA Corporation. The UCLA Flow Cytometry and Immuno/BioSpot Cores are supported by NIH (AI-28697 and CA-16042) grants.

Acknowledgements. Special thanks to the many NPS biologists and interns that assisted with fieldwork. We thank S. Weldy, K. Krause, D. Tom, Fund for Animals, B. Gordon, M. A. Hausner, I. Schmid, J. Dow, M. Tompkins, L. Hutlin, P. Hutlin, W. Sprague, A. Aviary, S. Schlotmann, M. Lappin, CSU Center for Companion Animal Studies, and for their contribution to optimizing immunological assays. Thanks to J. Tung and M. S. Rogan for reviewing previous versions of this manuscript.

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Journal of Wildlife Diseases, 35(2), 1999, pp. 187–193
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POISONING OF WILDLIFE WITH ANTICOAGULANT RODENTICIDES IN NEW YORK

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ABSTRACT: From 1971 through 1997, we documented 51 cases (55 individual animals) of poisoning of non-target wildlife in New York (plus two cases in adjoining states) (USA) with anticoagulant rodenticides—all but two of these cases occurred in the last 8 yrs. Brodifacoum was implicated in 80% of the incidents. Diphacinone was identified in four cases, bromadiolone in three cases (once in combination with brodifacoum), and chlorophacinone and coumatetralyl were detected once each in the company of brodifacoum. Warfarin accounted for the three cases documented prior to 1989, and one case involving a bald eagle (*Haliaeetus leucocephalus*) in 1995. Secondary intoxication of raptors, principally great horned owls (*Bubo virginianus*) and red-tailed hawks (*Buteo jamaicensis*), comprised one-half of the cases. Gray squirrels (*Sciurus carolinensis*), raccoons (*Procyon lotor*) and white-tailed deer (*Odocoileus virginianus*) were the most frequently poisoned mammals. All of the deer originated from a rather unique situation on a barrier island off southern Long Island (New York). Restrictions on the use of brodifacoum appear warranted.

Key words: Anticoagulant rodenticide poisoning, brodifacoum, bromadiolone, *Bubo virginianus*, *Buteo jamaicensis*, diphacinone, great-horned owl, *Odocoileus virginianus*, raptor, red-tailed hawk, white-tailed deer, wildlife.

INTRODUCTION

Anticoagulant poisons interfere with the action of vitamin K in the production of clotting factors in the liver, and thereby kill by predisposing animals to fatal hemorrhage. They are presently the most commonly-used pesticides for the control rodent pests world-wide. The first anticoagulant synthesized for use as a pesticide was the coumarin-based compound warfarin, introduced in the 1940's (Osweiler et al., 1985). Other coumarin-based rodenticides were subsequently developed, as were indandione compounds like diphacinone which show similar anticoagulant activity. Emergence of rat populations with resistance to warfarin and some of the other early anticoagulants eventually led to the development of more potent compounds like brodifacoum and bromadiolone which, unlike the older compounds, will kill rodents after single feedings.

Toxicity data for a variety of domestic animals (Osweiler et al., 1985), suggest that anticoagulant rodenticides are no doubt a potential hazard to many wild mammals and birds. The degree of hazard would be expected to vary by compound, species, and type of application. Poisoning could occur by direct ingestion of bait (primary poisoning), or via consumption of poisoned rodents (secondary poisoning). Potential for the latter was demonstrated by Evans and Ward (1967) who fed anticoagulant-killed nutria (*Myocastor coypus*) to dogs and commercial mink, by Mendenhall and Pank (1980) who fed rats and mice killed with a variety of rodenticides to owls, and by Townsend et al. (1984) who fed warfarin-dosed mice to least weasels (*Mustela nivalis*).

In the United States, applications of brodifacoum in apple orchards resulted in the deaths of radio-marked screech owls (*Otus asio*) (Hegdal and Colvin, 1988). Littrel (1988) reported the diphacinone-caused deaths of a raccoon (*Procyon lotor*) and a mountain lion (*Felis concolor*) at a site in northern California under unknown circumstances. More recently, two barn owls were killed by brodifacoum near a poultry farm in Georgia (USA) in 1995 (C. F. Quist, pers. comm.).

In the UK, Shawyer (1987) reported a "mass mortality" involving tawny owl (*Strix aluco*), buzzard (*Buteo buteo*), magpie (*Pica pica*), and red fox (*Vulpes vulpes*) which followed baiting with brodifacoum at a Hampshire farm in 1981. Shawyer (1987) also reported suspected poisonings in barn owls (*Tyto alba*) associated with the use of brodifacoum (four cases), difenacoum (four cases) and bromadiolone (one case) between 1982 and 1985. Subsequently, about 10% of 145 barn owls found dead in Britain between 1983 and 1989 were found to contain detectable (>0.005 ppm) levels of brodifacoum, although only one owl was considered to have succumbed to poisoning (Newton et al., 1990). In France, a four-year study of possible anticoagulant poisonings of wildlife (Berny et al., 1997) yielded 59 confirmed diagnoses for bromadiolone and 41 for chlorophacinone. Twenty-eight animals, principally red foxes and buzzards, were recovered from a single area near the Swiss border where bromadiolone was applied to carrot baits for the control of voles (*Arvicola terrestris*). Similar use of bromadiolone in Switzerland itself was followed by a large kill of buzzards and kites (*Milvus milvus*). Several unspecified predatory mammals also were killed (Beguin, 1983 and Pedrolic, 1983, cited in Shawyer, 1987). In Malaysia, barn owls were reportedly decimated when brodifacoum and coumachlor replaced warfarin on a palm oil plantation (Duckett, 1984). In New Zealand, one magpie, one paradise duck (*Tadorna ferruginea*), two unidentified hawks, two unidentified gulls, one unidentified passerine, and one unidentified hare were found dead following experimental use of brodifacoum to control rabbits (*Oryctolagus cuniculus*) (Rammell et al., 1984). Other reports of avian mortality linked to brodifacoum use in New Zealand have been reviewed by Eason and Spurr (1995).

Given the experimental evidence, the magnitude of rodenticide use, some of the reports cited above, and our own data, we suspect that the poisoning of wildlife in the United States with anticoagulants is far more common than the published record suggests. The purpose of the present paper is to report both primary and secondary poisoning of non-target wildlife with anticoagulant rodenticides in New York (USA) from 1971 through 1997.

METHODS

Most of the cases included in this report were submitted for diagnosis directly or indirectly by the general public. Wildlife rehabilitators also contributed a significant number of specimens. When necropsies showed hemorrhage or anemia in the absence of traumatic injury or infectious or parasitic disease processes, the livers were collected, frozen, and shipped to an analytical laboratory. Analyses were completed at the New York State Police Laboratory (Albany, New York) prior to 1977, and subsequently at the WARF Institute and its successor, Raltech Scientific Services (Madison, Wisconsin, USA), through 1984. Since then, analyses were completed at the State of Illinois Animal Disease Laboratory (Centralia, Illinois, USA) using a high-performance liquid chromatography screening procedure. This method utilized a solid-phase cleanup to prepare small-sized samples (2g) for analysis (Chalermchaikit et al., 1993). Identification and quantitation of the 11 different anticoagulant rodenticides in the screen were achieved by reverse-phase separation using both UV and fluorescence detectors (Shimadzu models SPD-6AV and RF-535, Shimadzu Scientific Instruments, Inc., Columbia, Maryland, USA) in tandem to facilitate both the primary and confirmatory analysis (J. R. Stedelin, unpubl. data). When needed, particularly with indandione compounds, additional sensitivity and confirmation were attained with an ion-pairing method (Hunter, 1985). Detection limits at the Illinois Laboratory were 0.02 ppm for brodifacoum and bromadiolone; 0.03 ppm for difenacoum; 0.05 ppm for coumatetralyl; 0.1 ppm for warfarin, fumarin, and coumachlor; 0.02 ppm for diphacinone; 0.4 ppm for pindone and valone; and 0.5 for 4, 6, 7 and 8-OH warfarin.

RESULTS

Death from hemorrhage associated with anticoagulant rodenticides was confirmed in 51 cases (56 individual animals) over a 27 yr period (Table 1). Only three cases, all involving warfarin, were diagnosed pri-

TABLE 1. Anticoagulant rodenticide poisonings in wildlife in New York (USA) and adjoining states, 1971–1997.

Species[a]	Date (Mo/yr)	County[b]	Gross pathology[c]	Toxicant (ppm in liver)
Gray squirrel	10/71	Westchester	d	warfarin (not quantified)
Gray squirrel	9/81	Niagara	b, d, k	warfarin (0.228)
Peregrine falcon	10/86	Cape May	c, d, h	warfarin (1.48)
Great horned owl	3/89	Putnam	a, b	brodifacoum (0.01)
Great horned owl	10/89	Suffolk	a, b	brodifacoum (0.2)
Gray squirrel	6/90	Westchester	a, h	brodifacoum (0.7)
Gray squirrel	7/90	Monroe	b, l	brodifacoum (4.1)
Eastern chipmunk	6/92	Albany	a, b	brodifacoum (3.8)
Raccoon	6/92	Niagara	j	brodifacoum (1.8 in stomach contents)
Raccoons (3)	9/92	Nassau	c	brodifacoum (3.1, 5.3, 4.6)
Gray squirrel	8/93	Albany	a, d, h	brodifacoum (0.53), chlorofacinone (0.62)
Gray squirrel	9/93	Albany	a, d, j	brodifacoum (25.8 in colon contents)
Snowy owl	11/93	Dutchess	a, d	diphacinone (0.26)
Great horned owl	3/94	Niagara	b, h	brodifacoum (0.53)
Great horned owl	6/94	Albany	a, b, f, g	brodifacoum (0.64)
White-tailed deer	10/94	Suffolk	c, i	brodifacoum (0.38)
Great horned owl	10/94	Erie	a, b, f	brodifacoum (0.41)
Red-tailed hawk	11/94	Westchester	b, g, f	brodifacoum (0.41)
Great horned owl	11/94	Orleans	a, b, e, f, g	brodifacoum (0.73)
Great horned owl	12/94	Albany	a, b, d, f, g	brodifacoum (0.1)
Red-tailed hawk	12/94	Westchester	a, b, f	brodifacoum (0.23)
Red-tailed hawk	1/95	Richmond	b, h	brodifacoum (0.43)
Red-tailed hawk	3/95	Nassau	b, g	brodifacoum (0.76)
Bald eagle	4/95	Orleans	i	warfarin (1.4)
Great horned owl	8/95	Suffolk	a, d, h	brodifacoum (0.53), bromadiolone (0.14)
White-tailed deer	9/95	Suffolk	c, d, e	brodifacoum (0.37), coumatetralyl (0.5)
Red-tailed hawk	12/95	Suffolk	a, b, f, g	brodifacoum (1.6)
Great horned owl	2/96	Chenango	a, h, i	brodifacoum (0.36)
Raccoon	3/96	Suffolk	a, d, e, j	brodifacoum (1.0)
Red fox (2)			b, c, e	brodifacoum (1.32 and 4.01)
Skunks (3)	4/96	Westchester	a, c, e	bromadiolone (0.02, 0.28, 0.08)
Raven	4/96	Rensselaer	a, d, h	brodifacoum (1.04)
Golden eagle	4/96	Monroe	c	brodifacoum (0.03)
White-tailed deer	4/96	Suffolk	c, e	brodifacoum (0.12)
White-tailed deer	5/96	Suffolk	c, k	brodifacoum (0.41)
Red-tailed hawk	6/96	Onondaga	a, b, f, g	brodifacoum (0.65)
Great horned owl	6/96	Monroe	a, b, d, e, g	brodifacoum (0.35)
White-tailed deer	10/96	Suffolk	c, e	diphacinone (0.93)
Red-tailed hawk	10/96	Suffolk	b, i	brodifacoum (0.5)
Opossum	11/96	Albany	c	bromadiolone (0.8)
White-tailed deer	12/96	Suffolk	c	diphacinone (0.2)
Gray squirrel	12/96	Albany	a, b, d	brodifacoum (1.39)
Common crow	1/97	Fairfield	a, d, f, j	brodifacoum (1.34)
Screech owl	2/97	Suffolk	a, c	brodifacoum (0.34)
Great horned owl	2/97	Greene	a, b, f	brodifacoum (0.08)
Raccoon	3/97	Albany	a, d, f, l	brodifacoum (0.32)
Gray squirrel	4/97	Suffolk	a, e	diphacinone (2.0)
Opossum	4/97	Albany	e	brodifacoum (0.18)
Great horned owl	4/97	Niagara	i	brodifacoum (0.11)
Great horned owl	6/97	Dutchess	b, g	brodifacoum (0.22)
Screech owl	10/97	Erie	d	brodifacoum (0.80)
White-tailed deer	12/97	Suffolk	a, c, e	brodifacoum (0.16)

[a] See text for scientific names.

[b] All in New York except for Cape May (New Jersey) and Fairfield (Connecticut).

[c] a = subcutaneous hemorrhage; b = pallor of muscle and/or internal organs; c = hemorrhage in lungs; d = inter- and intramuscular hemorrhages; e = subcutaneous edema; f = low blood volume heart/major vessels; g = excessive hemorrhage from superficial wounds; h = free hemorrhage or bloody fluid in body cavity; i = hemorrhage into alimentary canal; j = dyed rodenticide bait in alimentary canal; k = hemorrhage and/or serum in pericardial sac; l = intrauterine hemorrhage.

or to 1989. Most of the poisonings originated in one of three regions in New York including (1) Long Island and the lower Hudson River Valley (40°30′ to 41°31′N and 72°50′ to 74°00′W), (2) within about 80km of our laboratory near Albany (42°35′N and 73°53′W), and (3) counties bordering the southwest shore of Lake Ontario and the Niagara River (42°25′ to 43°23′N and 77°37′ to 79°04′W).

Presumed secondary poisoning of raptors was documented in 26 cases, principally in great horned owls (13 cases) and red-tailed hawks (seven cases). Presumed primary intoxications were confirmed in 16 cases, primarily in gray squirrels and white-tailed deer. Rodenticide bait was visually identified in the alimentary canal in four of these cases: two raccoons, one squirrel, and one common crow (*Corvus brachyrhynchos*). The poisonings in the red foxes, skunks (*Mephitis mephitis*), opossums (*Didelphis virginiana*), and the other raccoons could have been primary or secondary in nature.

Brodifacoum was identified in the liver or alimentary canal in 41 cases (80%). Warfarin was identified in four cases, diaphacinone in four, and bromadiolone in three (once in combination with brodifacoum). Coumatetralyl and chlorophacinone were found (once each) in the company of brodifacoum.

Gross post-mortem findings (Table 2) typically included subcutaneous hemorrhage in both avian and mammalian specimens. Birds tended to show more noticeable overall pallor, frequently had a notably reduced volume of blood in the heart and associated large vessels, and about one-third showed excessive external hemorrhage from superficial wounds. Subcutaneous hemorrhage in raptors frequently included sites over the abdomen, including intense hemorrhage between the stomach and the abdominal wall in several specimens. Pulmonary hemorrhage was far more common in mammals. Also, mammals sometimes showed areas of subcutaneous edema. The edematous fluid was frequently blood-tinged and, in some cases, perhaps a sequel to earlier hemorrhage. In general, tentative diagnoses based on gross findings in birds were confirmed by analytical results in almost every case. However, the gross findings on mammals seem to be less pathognomonic, and confirmations were much less certain, particularily for carnivores and ungulates.

TABLE 2. Gross pathological findings in wildlife killed by anticoagulant rodenticides in New York.

Finding	Frequency[a] Birds (n = 25)	Mammals (n = 27)
Subcutaneous hemorrhage	+++	+++
Pallor	+++	++
Hemorrhage in lungs	+	+++
Inter/intra-muscular hemorrhage	++	++
Subcutaneous edema	+	++
Free hemorrhage in body cavity	++	+
Dyed bait in alimentary canal	+	++
Excessive bleeding from minor wounds	++	o
Low blood volume in heart/major vessels	++	o
Hemorrhage into alimentary canal	+	+
Hemorrhage/serum in pericardial sac	o	+
Intrauterine hemorrhage	NA	+

[a] Constructed from necropsy records, these frequencies should be considered conservative as records varied in degree of detail: +++ frequent (>50%), ++ occasional (10–50%), + infrequent (<10%), o not observed, NA not applicable.

We were able to link known anticoagulant use and raptor mortality to a particular site on only three occasions. In the first case, brodifacoum was employed in barns and sheds at a small farm outside of Albany (New York) where horses, goats, and llamas were kept. Availability of livestock food and an absence of barn cats combined to produce an enormous rat population. Despite the fact that a great horned owl had been repeatedly observed in the vicinity of the barnyard, brodifacoum-treated bait was used in the buildings. An

owl was eventually found near death at the site, having suffered near complete exsanguination from a small laceration on one toe.

The second case involved a red-tailed hawk in rehabilitation at our facility in Delmar (New York). The bird had been fed a rat found dead on the ground by an employee (counter to instructions never to utilize animals found dead for animal food) unaware that brodifacoum bait was being used at an adjoining residence. The hawk, kept in an outdoor flight cage not designed to exclude small animals, may have captured additional brodifacoum-exposed rodents on its own.

The third incident occurred at a lower Hudson Valley correctional facility where a rodent control program (using a tracking powder containing 0.2% diphacinone) coincided with presence of a snowy owl (*Nyctea scandiaca*) which had established a temporary residence at the site. The owl's stomach was full of rat remains.

The white-tailed deer poisonings with brodifacoum (4) and diphacinone (2) all occurred on Fire Island, a barrier island on the south shore of Long Island. No hunting is allowed and the deer population is large and food-limited. The deer are fed by some Fire Island residents and, as we observed on one field visit, have come to associate plastic bags with food opportunities. The remains of plastic bags or wrappers were occasionally found in the rumen of deer at necropsy. This situation is sometimes coupled with a heavy use of rodenticides in some of the small communities. Deer have been observed eating baits, even going to considerable effort to extract them from beneath buildings supported on low piers. Other deer we have examined in the past few years from this location may also have been poisoned by anticoagulants, but post-mortem scavenging and/or decay precluded or compromised confirming analyses. The most common gross finding in poisoned deer was extremely hemorrhagic lungs.

TABLE 3. Acute oral LD_{50} values[a] (mg/kg) for some common anticoagulant rodenticides in several species.

	LD^{50} (mg/kg)			
Species	Warfarin	Diphacinone	Bromadiolone	Brodifacoum
Rat	50–100	1.5	1.25	0.27
Mouse	374[b]	340	1.75	0.4
Rabbit	800[b]	35	1.0	0.29
Pig	3	—	—	0.5–2.0
Dog	50	3	11–15[c]	0.25–1.0
Cat	5–50	15	>25[c]	25
Chicken	1,000[b]	—	—	10–100

[a] As reported in Osweiler et al. (1985) unless otherwise indicated.
[b] Reported in Hagan and Radomski (1953).
[c] Reported in Felice and Murphy (1995).

DISCUSSION

Our data suggest that poisonings of nontarget wildlife with anticoagulant rodenticides may currently be widespread, largely due to the use of brodifacoum. More acutely toxic to most species tested than other commonly-used anticoagulants (Table 3), brodifacoum is also very persistent in the liver (Bachmann and Sullivan, 1983; Laas et al., 1985). For example, substantial amounts of brodifacoum were found in the livers of sublethally dosed possums (*Trichosurus vulpecula*) 8 mo after exposure, with little decline after the first week (Eason et al., 1996). Repeated sublethal exposures, even intermittent ones, may therefore be expected to eventually cause fatal hemorrhage. Not surprisingly, Mendenhall and Pank (1980) experimentally showed brodifacoum to be the most hazardous of six anticoagulants to barn owls fed poisoned rats.

Brodifacoum and other anticoagulants are not registered for field use in the USA. Some outdoor use may occur, however, as U.S. Environmental Protection Agency-approved label directions for commensal rodent control permit placement of bait "in and around" structures—the term "around" being unquantified. Extensive outdoor placement is probably rare in New York, however, as we have confirmed

relatively few primary anticoagulant poisonings in species that should be particularly vulnerable to outdoor baiting.

The toll on New York State wildlife is nonetheless impressive, particularly with respect to two raptor species. Since 1994, anticoagulant poisonings have comprised 17% (n = 59) of our diagnoses for great horned owls, and 6% (n = 114) of our diagnoses for red-tailed hawks. The actual rate of exposure of these raptors and other wildlife in New York to these anticoagulants is unknown as we have not screened the livers of animals found dead of other causes.

The poisoning of white-tailed deer on Fire Island raises some questions about human consumption of deer and other game. A common pattern of residential development in many areas of New York State at present is for houses to be erected on large (e.g., 0.4–2.0 ha) lots in prime wildlife habitat on the outskirts of cities and suburbs. White-tailed deer often continue to thrive in close proximity to these houses. Norway rats (*Rattus norwegicus*) also occasionally do well in some of these areas if birdseed or pet foods provide a food source. When the latter occurs, the use of rodenticides may be expected to increase, possibly exposing deer and other wildlife to poison bait. As long as sufficient natural foods persist, the likelihood of deer consuming bait is probably slight. However, as hunting is almost inevitably restricted to some extent in these areas, deer populations may become food limited (as on Fire Island) and bait consumption could become more common. Unlike Fire Island, however, some hunting, at least by archers, is likely to continue in or adjacent to these developments, potentially exposing hunters to contaminated flesh. It would be useful to survey deer livers for anticoagulants in some areas which currently approximate these circumstances. Surveys of livers of game species would also appear warranted in locations abroad where field applications of anticoagulants occur.

We recommend that physiologically persistent anticoagulants, particularly brodifacoum, should not be used if direct or indirect exposures to wildlife are likely to occur. Warfarin or a similarly non-persistent anticoagulant requiring multiple feedings should be considered in locations where warfarin-resistance has not been demonstrated. Rodenticides containing cholecalciferol, bromethalin or phosphide can be used if warfarin-resistance is known to be present, although these products can also present a serious direct threat to some wildlife species if placed outdoors. Appropriate regulatory agencies worldwide should consider additional restrictions on the use of brodifacoum.

ACKNOWLEDGMENTS

We wish to thank M. Beqaj for assistance in obtaining suspected poisoned deer on Fire Island, and V. Palmer for investigating rodenticide use at that location. We also thank Volunteers for Wildlife and other wildlife rehabilitators for providing specimens for examination.

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Received for publication 18 May 1998.

EPA 734-P-93-900
PB96-1 26 1

U.S. Fish and Wildlife Service Biological Opinion March, 1993

Effects of 16 Vertebrate Control Agents On Threatened and Endangered Species

REPRINTED BY EPA

Printed on Recycled Paper

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VERTEBRATE CONTROL AGENTS
BIOLOGICAL OPINION SUMMARY
(Jeopardy & No Jeopardy Calls)

CHEMICAL	CLASS											
	AMPHIBIANS		BIRDS		INSECTS		MAMMALS		REPTILES		TOTAL	
	J	NJ	J	NJ	J	NJ	J	NJ	J	NJ	J	NJ
Alum. & Mag. Phosphide	0	0	0	0	1	0	9	1	4	3	14	4
Brodifacoum	0	0	2	1	0	0	10	6	0	1	12	8
Bromadiolone	0	0	0	0	0	0	7	5	0	0	7	5
Bromethalin	0	0	0	0	0	0	10	4	0	0	10	4
Chlorophacinone	0	0	1	0	0	0	20	4	0	3	21	7
Diphacinone	0	0	1	0	0	0	29	1	0	3	30	4
Pival	0	0	1	0	0	0	24	2	0	1	25	3
Pot. & Sodium Nitrate	0	0	0	0	0	0	9	1	4	3	13	4
Sodium cyanide	0	0	1	2	0	0	5	2	0	0	6	4
Sodium fluroacetate	0	0	0	0	0	0	2	0	0	0	2	0
Vitamin D3	0	0	0	0	0	0	10	4	0	0	10	4
Warfarin	0	0	0	0	0	0	10	4	0	0	10	4
Zinc phosphide	0	0	9	2	0	0	20	4	0	0	29	6
TOTAL	0	0	15	5	1	0	165	38	8	14	189	57

March 2, 1993

SECTION I

INTRODUCTION

INTRODUCTION

RESPONSIBILITIES

Under the Endangered Species Act of 1973 (ESA), as amended, all federal agencies have responsibility to ensure that any action authorized, funded, or carried out by that agency is not likely to jeopardize the continued existence of any federally listed endangered or threatened species or result in the destruction or adverse modification of critical habitat. Furthermore, federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species.

The U. S. Environmental Protection Agency (EPA) is the federal agency authorized to regulate pesticide use through administration of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Under the ESA, the EPA must ensure that its activities in administering FIFRA are not likely to jeopardize the continued existence of any federally listed threatened or endangered species. The registration and reregistration of pesticides under Section 3 of FIFRA is considered an activity that may have possible impacts on threatened and endangered species, therefore it is subject to review by the U. S. Fish and Wildlife Service (Service).

Section 7 of the ESA requires that federal agencies "consult" with the Service on their actions. The federal agency initially determines if their action(s) "may affect" any listed species. If the agency determines that the proposed action may affect listed species it will formally request Section 7 consultation. The Service reviews information provided by that agency regarding the proposed action and decides whether or not it concurs with the federal agency's "may affect" determination. If the Service does not concur with the federal agency's may affect determination consultation is terminated, otherwise the Service must prepare a biological opinion. In this opinion, the Service determines if the proposed action is likely to jeopardize the continued existence of the listed species in question or is not likely to jeopardize the continued existence of the species. If the Service determines that a proposed action is likely to jeopardize the continued existence of the species, it must provide to the federal agency any available reasonable and prudent alternatives that preclude jeopardy yet still allow the proposed action to continue. The Service must also provide to the federal agency an incidental take statement and reasonable and prudent measures to minimize such take. These terms will be further defined in subsequent sections of the introduction.

PROPOSED ACTION

On April 15, 1991, EPA requested formal section 7 consultation with the Service on 31 registered chemicals that may affect threatened or endangered species. The consultation request addressed the effects of all registered uses of these chemicals on all domestically listed species (approximately 600). The 31 chemicals include 16 vertebrate control agents, 14 insecticides and one herbicide. The EPA selected these chemicals based on a thorough review of all listed species and their vulnerability to pesticides. An explanation of EPA's rationale for selecting these specific chemicals is presented in their February 26, 1991, consultation request.

Because of the size and complexity of this consultation, the Service found it necessary to divide the consultation into two parts. This portion of the consultation contains the biological opinions for the 16 vertebrate control agents. The Service has reviewed each of these pesticides for their impact to all federally listed threatened, endangered and proposed species. This consultation also considered all registered uses of the 16 vertebrate control agents. The second portion of the consultation will provide biological opinions for the remaining 15 chemicals and will be submitted at a later date.

CONSULTATION HISTORY

The Service has consulted with EPA on the registration of pesticides since 1977. Since that time, the Service has issued over 75 biological opinions. Some of these opinions were completed on a case-by-case basis while others were included in "cluster" opinions addressing all pesticides registered for specific uses. The most recent pesticide biological opinion, completed in July 1989, involved a reinitiation of consultation on 109 pesticides primarily for listed aquatic species. The results of this consultation supersede all previous biological opinions on these pesticides.

PROPOSED SPECIES

Due to the long timeframe attached to this consultation, many species proposed for federal listing at the beginning of the consultation will have subsequently been listed by the time this document is final. According to regulations set forth in 50 CFR Part 402.10, each Federal agency shall confer with the Service on any action which the Federal agency determines is likely to jeopardize the continued existence of any proposed species. The purpose of this requirement is to identify and resolve potential conflicts between an action and proposed species. These conferences are conducted on an informal basis with the Service providing the Federal agency with recommendations to minimize or avoid adverse effects of the action on proposed species. If the species is listed, the Federal agency must review its action to determine whether consultation is required. In certain instances, the Federal agency and the Service may conduct the conference in such a thorough manner that it would satisfy the consultation requirements of section 7(a)(2) if the proposed listing is subsequently completed.

In conducting this consultation, the Service treated proposed species as if they were already federally listed. All recommendations and alternatives satisfy the requirements of formal section 7 consultation. Until such time as the proposed species are officially listed, the Service requests that the EPA consider these recommendations as advisory in nature. When a proposed species covered in this opinion is officially listed the Service will inform the EPA and indicate that the reasonable and prudent measures or reasonable alternatives are to be implemented.

EVALUATION METHODOLOGY

On April 22, 1991 the Service convened a team of regional representatives to prepare this biological opinion. The team consisted of one biologist from each of the Service's regions. Each biologist was responsible for evaluating the impact of these chemicals on species within their jurisdiction. Team members used their broad knowledge of species biology and distribution along with the available toxicity information to evaluate the impacts of these chemicals on all listed species.

For the most part, the Service relied on information provided by EPA in the consultation request to make its determinations. However, in some cases, complete and consistent data were lacking from EPA's request. This lack of data was in part because some information was not readily available to EPA and partly because the Service did not always agree with EPA's no effect determinations and needed supporting data. As a result, in January 1992, the Service convened a team of environmental contaminant specialists to review the EPA data and gather additional information. In those cases where the Service obtained information contrary or additional to that provided by EPA, we have provided citations. A list of literature citations accompanies this introductory section and can be referred to when reviewing chemical information.

FORMAT OF THE OPINION

This biological opinion is organized into three sections. Section I contains the introduction and an explanation of terms and methodology. Section II contains chemical information, and the actual biological opinions for each of the 16 vertebrate control agents. Section III provides biological information on each "may affect" species considered in this portion of the consultation.
Section II is the main portion of this biological opinion. This section is subdivided into an additional 13 sub-sections corresponding to the 16 vertebrate control agents (some sections contain more than one chemical). The reference table included with each chemical provides a quick review of the Service's calls, recommendations and justifications for each "may affect" species. Further justification including reasonable and prudent alternatives, incidental take statements, reasonable and prudent measures and conservation recommendations is found by locating a particular species in the rationale section. The rationale section provides the necessary information to support the Service's biological opinion for each species. Additional species information can be found in Section III.

Section III contains biological information for each species considered in this portion of the consultation. The table that begins Section III includes all federally listed threatened, endangered and proposed species

listed prior to July 1, 1991. Any species listed or proposed after that date is not considered in this opinion. Following the table are profiles for each of the "may affect" species. These profiles contain biological information including species status and trends, cumulative effects and the potential for that species to be exposed to pesticides.

Cumulative effects are those effects of future non-federal (State, local government, private, or any other non-federal entity) activities on endangered or threatened species or critical habitat that are reasonably certain to occur in the action area. The Service must consider cumulative effects when conducting Section 7 consultations. Cumulative effects are addressed for each species in Section III - Species Profiles.

REASONABLE AND PRUDENT ALTERNATIVES

Regulations implementing Section 7 define reasonable and prudent alternatives as alternative actions identified during formal consultation that can be implemented in a manner consistent with the scope of the Federal agency's legal authority and jurisdiction, that are economically and technologically feasible, and that the Service believes would avoid the likelihood of jeopardizing the continued existence of listed species or avoid the destruction or adverse modification of critical habitat.

The Service has provided reasonable and prudent alternatives for every chemical that is likely to jeopardize the continued existence of a threatened or endangered species. These alternatives represent the Service's best professional judgement of the measures necessary to provide the appropriate level of protection to the species given the data currently available.

INCIDENTAL TAKE

Section 9 of the Act prohibits any taking (to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct) of listed species without a permit. Under the terms of Section 7(b)(4) and 7(o)(2) of the Act, taking that is incidental to and not intended as part of the agency action is not considered to be a prohibited taking provided that such taking is in compliance with the terms and conditions specified in the incidental take statement included in a biological opinion. If the specified level of incidental take is exceeded formal consultation must be reinitiated immediately.

In many situations the use of a particular chemical may result in the take of some listed species but not necessarily result in jeopardy to that species. In those instances, the Service must determine the anticipated level of take and provide reasonable and prudent measures for minimizing that take.

Usually, the likelihood of discovering an individual death attributable to pesticides is very small. In those situations where the Service anticipates that the discovery of a carcass of a particular species is likely, we have established a specific level of take which might occur as a result of the action (ie: number of individuals). In most instances however, the Service does not expect to discover a precise number of dead or sublethally affected species attributable to pesticides. Because of the small size, unique habitat and secretive nature of many listed species it is highly unlikely that the Service will ever discover individual deaths. Therefore, it is difficult to establish an anticipated level of take. In those situations where the Service believes take may occur but is not able to assign a specific number to that take, an "unquantifiable" level of take has been assigned. This indicates that the Service believes that take is unavoidable but unquantifiable.

In order to insure protection for species assigned a level of unquantifiable take, the Service must have a mechanism to reinitiate consultation. Since it is so unlikely that take resulting from pesticide use will ever be discovered, if even one dead specimen is discovered whose death is attributable to the legal use of pesticides, then use of that pesticide must cease in all occupied habitat of the species and consultation on that chemical for that species must be reinitiated. Take above the authorized level of one, if occurring in a single event (ie. fish kill), is not a violation of section 9 of the Act as long as the terms and conditions as specified in the reasonable and prudent measures are followed.

REASONABLE AND PRUDENT MEASURES/TERMS AND CONDITIONS

Specific reasonable and prudent measures that the Service considers necessary and appropriate to minimize incidental take and the terms and conditions to implement such measures are provided for those species receiving an incidental take statement. Reasonable and prudent measures are provided to minimize impacts to the individuals or habitat affected by the action. Such measures are designed to decrease the level of take to the maximum extent possible. Measures are determined to be reasonable and prudent when they are consistent with the basic design, location, scope, duration and timing of the action. These measures represent the Service's best professional judgement of the actions necessary to provide the appropriate level of protection to the species given the data currently available.

POSSIBLY EXTINCT SPECIES

There are several species still listed in the U.S. that have not been seen for many years. Those species, although not yet officially declared extinct, are nevertheless treated as extinct species. It is the Service's position that species such as those listed below could not be affected by pesticides since they are not expected to occur in areas of pesticide applications and are therefore not included in this consultation. However, if the Service receives documented evidence of any occurrence of these species, the Service believes this constitutes new information and requests reinitiation of consultation for those species on all chemicals.

Bridled white eye
Culebra Island giant anole
Guam broadbill
Little Mariana fruit bat
Scioto madtom
Caribbean monk seal
Eastern cougar
Ivory-billed woodpecker
Mariana mallard
Palos Verde blue butterfly

MONITORING AND ENFORCEMENT PROGRAM

The Service has determined, that for certain listed species considered in this opinion, an unquantifiable level of incidental take may occur even if the recommended reasonable and prudent alternatives to preclude jeopardy are followed. Examples of such species include many of the listed mussels, fish and selected small mammals. To minimize take in the above-mentioned scenarios, the Service is requiring, as a reasonable and prudent measure that EPA adopt a monitoring/enforcement program.

The Service believes that the likelihood of incidental take will be minimized if the EPA fully implements a monitoring/enforcement program. A monitoring program will alert both the Service and EPA to possible deficiencies in the reasonable and prudent alternatives and allow the Service to request reinitiation of consultation to modify those deficiencies before further take occurs. The location, nature and extent of this monitoring program should evolve through discussions between EPA and the Service.

The Service recommends that the monitoring program include but not be limited to the following actions. Selected field applications of certain chemicals should be monitored to determine: 1) compliance with label instructions, 2) compliance with recommended reasonable and prudent alternatives and reasonable and prudent measures, and 3) effectiveness of recommended buffer zones for both ground and aerial applications. In monitoring the effectiveness of recommended buffer zones, the Service suggests that field surveys (which should include the monitoring of water quality and the persistence and concentration of applied chemicals and their metabolites) be established as part of an efficient and regulated enforcement program. If, in the course of conducting their monitoring program, EPA determines that buffer zones recommended by the Service are insufficient to prevent incidental take, the Service requests that the Agency reinitiate consultation.

REPORTING REQUIREMENTS

If, in the course of conducting the required monitoring program, EPA (or individuals acting on behalf of EPA) discovers any moribund or dead listed species, the Service must be notified. This notification should occur within 3 working days and include the location of discovery, and suspected cause of death or illness. Service personnel will instruct the caller as to the proper actions necessary to prepare the dead or injured

specimen for pesticide analysis. If the Service suspects that a species has been taken in violation of label restrictions, such situations will be reported to the Service's Division of Law Enforcement and instructions for proper handling of such specimens will be given at that time. The following is a list of contacts for each Region.

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SECTION II

CHEMICAL PROFILES

Aluminum and Magnesium phosphide

CHEMICAL INFORMATION

TYPE: Insecticide, rodenticide

FORMULATION: Pellets, tablets, fumi-cel plate, and dust in gas exchange bags or other envelopes.

REGISTERED USES: Used inside enclosures to control insects in bulk grain and peanuts, processed food and animal feed, leaf tobacco stores, cottonseed, and a space fumigant in flour mills, warehouses, and rail cars. They are used as outdoor fumigants in controlling vertebrates that burrow or live in burrows. Specifically, outdoor use registration is limited to the control of marmot species - woodchucks and yellow-bellied marmots (rock chucks), prairie dogs (except Utah prairie dog), Norway and roof rats, house mice, ground squirrels, moles (except in North Carolina), and chipmunks (except in California).

BACKGROUND:

Mode of Action: Causes pulmonary edema or respiratory failure.

Aquatic toxicity : Aluminum and magnesium phosphide are both restricted use fumigant insecticides and vertebrate control agents. They are used inside enclosures which can be made more-or-less air tight to control insects, e.g. warehouses, grain storage, mills, rail cars, etc. They are also used as outdoor fumigants in controlling vertebrates that burrow or live in burrows. The vast majority are used for insect control in storage enclosures. Acute and chronic toxicity data are not applicable to these phosphides because they release deadly phosphine gas when exposed to air. The mechanisms of inhalation toxicity are not well understood, but pulmonary edema and respiratory failure is a common cause of death. Phosphine gas released by these chemicals is highly volatile, dissipates rapidly, and does not accumulate in carcasses of poisoned animals. The after-use residue, a hydroxide (a constituent of clay), is a relatively inert and innocuous material. The only outdoor use is in burrows, and because of their extreme volatility, neither compound has an opportunity to be released into an aquatic environment (and would dissipate almost immediately even if it occurred). Thus there is no effect on listed aquatic species.

Terrestrial toxicity: As indicated, both phosphides release deadly phosphine gas when exposed to air and should be considered as causing 100% mortality in burrows. Thus, the use of both chemicals "may effect" any listed species which might use burrows that may be treated for control of animals listed above. Secondary toxicity is not a concern, however, because toxicity results from inhalation.

Wildlife and Incidents: None reported.

BIOLOGICAL OPINION

CHEMICAL REFERENCE TABLE

(The following table contains only those species for which the Service provided a jeopardy or no jeopardy call. Species not included in this list are either not affected by the chemical or have no chance for exposure. For a complete list of all species considered in this opinion, refer to the master species list on page III-1 of the species profile section.)

Species Name	J/NJ	PAGE
MAMMALS		
Black-footed ferret	J	2
Fresno kangaroo rat	J	4
Giant kangaroo rat	J	4
Hualapai Mexican vole	J	4
Morro Bay kangaroo rat	J	5
Point Arena Mountain Beaver	J	5
San Joaquin kit fox	J	6
Stephen's kangaroo rat	J	6
Tipton kangaroo rat	J	4
Utah prairie dog	NJ	9
REPTILES		
Blunt-nosed leopard lizard	J	7
Coachella Valley fringe-toed lizard	NJ	9
Desert tortoise	NJ	10
Eastern indigo snake	J	8
Gopher tortoise	J	8
Island night lizard	NJ	10
San Francisco garter snake	J	7
INSECTS		
El Segundo blue butterfly	J	9

RATIONALE FOR JEOPARDY DETERMINATIONS

Black-footed ferret - These two pesticides will kill anything in a burrow including a black-footed ferret and their prey species the prairie dog. The likelihood of ferrets being found in the wild, while considered low, is still possible. The further loss or fragmentation of prairie dog habitat which has already been reduced by as much as 98 percent (from over 100 million acres to around 2 million acres) as well as the loss of a single ferret in the wild could result in the extinction of the species. Therefore, it is the Service's opinion that the use of aluminum phosphide and magnesium phosphide is likely to jeopardize the continued existence of the black-footed ferret.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the black-footed ferret:

1. A black-tailed prairie dog colony or complex of less than 80 acres having no neighboring prairie dog towns may be treated without a ferret survey. A midrange of 102 acres (61 to 294 acres) of occupied black-tailed prairie dog habitat is believed necessary to support a single ferret, so it is highly unlikely that a ferret would be found in an isolated colony of less than 80 acres. A neighboring prairie dog town is defined as a colony less than 7 kilometers (4.34 miles) from the town to be treated, based on the longest distance that the ferret has been observed to travel during the night.

2. A white-tailed prairie dog colony or complex of less than 200 acres having no neighboring prairie dog towns may be treated without a survey. It is estimated to require between 196 and 475 acres of white-tailed prairie dogs to support a single ferret.

3. Urban situations (e.g., playgrounds, golf courses, etc.) may be treated without conducting ferret surveys. The appropriate Service office will be contacted by the pesticide user in advance of any treatment to determine whether a proposed action fits this situation.

4. For black-tailed prairie dog colonies or complexes over 80 acres but less than 1,000 acres, and white-tailed prairie dog colonies or complexes over 200 acres but less than 1,000 acres, prairie dog control may be allowed after completing a black-footed ferret survey within 30 days of proposed treatments on colonies proposed for treatment, provided no ferrets or their sign are found. Prior to treatment, if all colonies in this complex are surveyed with no sign of ferrets, no future survey for ferrets would be recommended. These surveys will be coordinated with the appropriate State Office of the Fish and Wildlife Service.

5. For prairie dog complexes over 1,000 acres, no control shall be allowed until the complex has been evaluated by appropriate State and/or Federal Agencies (those agencies working on State working groups for ferret recovery) for its potential as a recovery site and until the complex has been block cleared. One thousand acres would be a minimum complex size for consideration as a black-footed ferret reintroduction site and would likely require intensive management of habitat for a ferret population.

6. The EPA shall maintain records which shall be provided to the Service on an annual basis. These records can include the amount of acres of prairie dog towns or complexes controlled (e.g., Federal lands, private lands on a volunteer basis), or the amount of the chemical sold including application rates. The latter could be obtained from either the manufacturer or the vender.

Surveys shall be supervised by biologists trained in ferret survey techniques and ferret biology at a Service-approved training workshop. Currently, only the University of Wyoming has such a course. Ferret surveys shall be reviewed by the Service for compliance with survey standards and Section 7 of the Endangered Species Act.

Incidental Take - With the implementation of the reasonable and prudent alternatives to preclude jeopardy of the black-footed ferret, no incidental take is anticipated and thus none is authorized.

Fresno kangaroo rat, giant kangaroo rat, Tipton kangaroo rat - The primary risk of aluminum and magnesium phosphide exposure for these species would result from registered uses of these compounds as burrow fumigants in the southern San Joaquin Valley, California. The most likely source of exposure would be inadvertent application to kangaroo rat burrows during control of field rodents (primarily ground squirrels and gophers) in occupied habitats. This risk may be minimized by the fact that kangaroo rat burrows differ substantially in appearance from burrows of target species. Nevertheless, adverse effects of aluminum and magnesium phosphide use on Fresno, giant, and Tipton kangaroo rats could be significant because of (1) their high toxicity (100 percent mortality in treated burrows is expected); (2) the frequency of ground squirrel control programs in areas occupied by these species; and (3) the fact that each of these kangaroo rats occupy habitats that are significantly restricted and/or fragmented. For these reasons, it is the Service's biological opinion that use of aluminum and magnesium phosphide is likely to jeopardize the continued existence of these species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Fresno kangaroo rat, giant kangaroo rat, and Tipton

kangaroo rat: To avoid application to kangaroo rat burrows, aluminum and magnesium phosphide shall be used within the occupied habitats of these species only by qualified individuals. Such persons shall be limited to wildlife biologists, certified applicators, or agents of county agricultural commissioner offices, university extension offices, or representatives of California State or Federal agencies, who are trained to distinguish dens and burrows of target species from those of non-target species.

Incidental Take - Despite the reasonable and prudent alternatives described above, the Service anticipates that an unquantifiable level of incidental take may occur as a result of aluminum and magnesium phosphide use within the occupied habitats of these species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Hualapai Mexican vole - The primary exposure of aluminum phosphide and magnesium phosphide to the Hualapai Mexican vole would be through its application to control ground squirrels in non-crop rights-of-way or recreational areas. Voles are one of a number of target organisms of aluminum phosphide and magnesium phosphide and also is highly toxic to small mammals. The likelihood that aluminum phosphide and magnesium phosphide would be used in the habitat of the vole is small but if it were used because of the very small number of known voles, the consequences would be severe. Therefore, it is the Service's biological opinion that the use of aluminum phosphide and magnesium phosphide is likely to jeopardize the continued existence of the Hualapai Mexican vole.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Hualapai Mexican vole: prohibit the use of aluminum phosphide and magnesium phosphide in occupied habitat of the Hualapai Mexican Vole.

Incidental Take - With the implementation of the reasonable and prudent alternatives to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Morro Bay kangaroo rat - The primary exposure of aluminum phosphide and magnesium phosphide from registered uses can occur when the Morro Bay kangaroo rat utilizes the burrows of targeted animals. The extremely limited range of this species and the presence of target control species places the Morro Bay kangaroo rat at risk. It is the biological opinion of the Service that use of aluminum and magnesium phosphide is likely to jeopardize the continued existence of the Morro Bay kangaroo rat.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit the use of aluminum and magnesium phosphide within the occupied habitat of this species.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

Point Arena mountain beaver - This species is vulnerable to aluminum and magnesium phosphide exposure during registered uses of these burrow fumigants in Mendocino County, California. The primary source of exposure would result from inadvertent application to mountain beaver burrows during control of field rodents, primarily ground squirrels, in occupied habitats. This risk may be especially high for this species because mountain beaver burrows and ground squirrel burrows often have similar dimensions at the ground surface. Adverse effects of aluminum and magnesium phosphide use on the Point Arena mountain beaver also could be significant because (1) of the high toxicity of these fumigants; (2) the frequency of ground squirrel control programs within the occupied habitat of this species; and (3) the fact that the mountain

beaver occupies highly restricted and fragmented habitats. For these reasons, it is the Service's biological opinion that use of aluminum and magnesium phosphide within the occupied habitat of the Point Arena mountain beaver is likely to jeopardize the continued existence of this species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Point Arena mountain beaver: To avoid application to mountain beaver burrows, aluminum and magnesium phosphide shall be used within the mountain beaver occupied habitat only by qualified individuals. Such persons shall be limited to wildlife biologists, certified applicators, or agents of county agricultural commissioner offices, university extension offices, or representatives of California State or Federal agencies, who are trained to distinguish dens and burrows of target species from those of non-target species.

Incidental Take - Because of the possibility of inadvertent application of these compounds to mountain beaver burrows despite the reasonable and prudent alternatives described above, the Service anticipates that an unquantifiable level of incidental take may occur as a result of aluminum and magnesium phosphide use within the occupied habitat of this species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

San Joaquin kit fox - The primary source of kit fox exposure to aluminum and magnesium phosphide would result from erroneous application of these fumigants to kit fox dens during control of rodents, primarily ground squirrels, in the San Joaquin Valley, California. The possibility of such error is especially high for kit foxes because kit fox dens and ground squirrel burrows often have similar dimensions at the ground surface. Although the kit fox is relatively wide-ranging, aluminum and magnesium phosphide use could have significant adverse effects on this species because of: (1) the high toxicity of these fumigants; (2) the frequency of ground squirrel control programs within the kit fox range; and (3) the fact that serious localized effects of aluminum and magnesium phosphide use could occur in areas where the kit fox range is geographically restricted (e.g., the north end of the range where kit foxes are confined to a narrow strip of rangelands, and the Santa Nella area where the range forms a "bottleneck"). For these reasons, it is the Service's biological opinion that aluminum and magnesium phosphide use within the San Joaquin kit fox occupied habitat is likely to jeopardize the continued existence of this species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the San Joaquin kit fox: To avoid application to kit fox dens, aluminum and magnesium phosphide shall be used within the San Joaquin kit fox occupied habitat only by qualified individuals. Such persons shall be limited to qualified wildlife biologists, certified applicators, or agents of county agricultural commissioner offices, university extension offices, or representatives of California State or Federal agencies, who are trained to distinguish dens and burrows of target species from those of non-target species.

Incidental Take - Because of the possibility of inadvertent application of these compounds to kit fox dens despite the reasonable and prudent alternatives described above, the Service anticipates that an unquantifiable level of incidental take of San Joaquin kit foxes may occur as a result of aluminum and magnesium phosphide use within the occupied habitat of this species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Stephen's kangaroo rat - The primary exposure of aluminum phosphide and magnesium phosphide from registered uses can occur when Stephen's kangaroo rat utilize the burrows of targeted animals. It is the biological opinion of the Service that use of aluminum and magnesium phosphide is likely to jeopardize the continued existence of the Stephen's kangaroo rat.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Stephen's kangaroo rat: aluminum and magnesium phosphide shall be used within the occupied habitat of the Stephen's kangaroo rat only by qualified individuals. Such persons shall be limited to qualified wildlife biologists, certified applicators, or agents of county agricultural commissioner offices, university extension offices, or representatives of California State or Federal agencies, who are trained to distinguish dens and burrows of target species from those of non-target species.

Incidental Take - Despite the reasonable and prudent alternatives described above, the service anticipates that an unquantifiable level of incidental take may occur as a result of aluminum and magnesium phosphide use within the occupied habitat of this species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section of page I-5.

Blunt-nosed leopard lizard, San Francisco garter snake - The blunt-nosed leopard lizard and San Francisco garter snake utilize burrows for all or part of their life cycle, and therefore are subject to aluminum and magnesium phosphide exposure during registered uses of these compounds as burrow fumigants. However, because leopard lizards and garter snakes do not construct their own burrows but utilize existing burrows of other species (usually mammals), avoidance of exposure to aluminum and magnesium phosphide through burrow identification is difficult. As a result, intended uses (as opposed to unintended uses) could result in inadvertent exposure. The leopard lizard is subject to such exposure year round, since it utilizes burrows during its activity and hibernation phases. The garter snake utilizes burrows only during its hibernation phase (approximately November through March) and is subject to exposure only during this period. Because of the high toxicity of these burrow fumigants, the likelihood of exposure, and the fact that the blunt-nosed leopard lizard and San Francisco garter snake occupy significantly restricted and/or fragmented habitats, it is the biological opinion of the Service that aluminum and magnesium phosphide use is likely to jeopardize the continued existence of these species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the blunt-nosed leopard lizard: (1) To avoid application to leopard lizard burrows, aluminum and magnesium phosphide shall be used within the blunt-nosed leopard lizard occupied habitat only by qualified individuals; such persons shall be limited to wildlife biologists, certified applicators, or agents of county agricultural commissioner offices, university extension offices, or representatives of California State or Federal agencies, who are trained to distinguish dens and burrows of target species from those of non-target species. (2) From April 15 to September 30, aluminum and magnesium phosphide use within the blunt-nosed leopard lizard occupied habitat shall be limited to daylight hours when air temperatures are between 77 and 95 degrees Fahrenheit (20 to 30 degrees Centigrade). Aluminum and magnesium phosphide use shall be prohibited within occupied leopard lizard habitat during the leopard lizard inactivity period, October 1 to April 14, unless a specific blunt-nosed leopard lizard protection program for this period, approved in writing by the Service, is implemented.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the San Francisco garter snake: (1) To avoid application to garter snake burrows, aluminum and magnesium phosphide shall be used within the San Francisco

garter snake occupied habitat only by individuals; such persons shall be limited to qualified wildlife biologists, certified applicators, or agents of county agricultural commissioner offices, university extension offices, or representatives of California State or Federal agencies, who are trained to distinguish dens and burrows of target species from those of non-target species. (2) Aluminum and magnesium phosphide use within occupied garter snake habitat shall be prohibited during the garter snake inactivity period, November 1 to March 30, unless a specific San Francisco garter snake protection program for this period, approved in writing by the Service, is implemented.

Incidental Take - Because of the possibility of inadvertent application of these compounds to burrows inhabited by leopard lizards and garter snakes despite the reasonable and prudent alternatives described above, the Service anticipates that an unquantifiable level of incidental take may occur as a result of aluminum and magnesium phosphide use within the occupied habitats of these species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Eastern indigo snake - The eastern indigo snake would primarily be exposed to aluminum phosphide and magnesium phosphide through the pesticide's registered uses as pest control in fumigating animal burrows and agricultural storage enclosures. Because indigo snakes inhabit burrows and frequent agricultural areas, exposure to the pesticide is likely to occur when such sites are fumigated. Aluminum and magnesium phosphide produces the deadly gas phosphene when exposed to air. Indigo snakes inhabiting burrows or an agricultural storage facility when the pesticide is used would be killed. Therefore, it is the Service's opinion that the use of aluminum phosphide and magnesium phosphide is likely to jeopardize the continued existence of the eastern indigo snake.

Reasonable and Prudent Alternative(s) - If implemented the following reasonable and prudent alternative would avoid jeopardy to the indigo snake: prohibit the use of these fumigants in animal burrows within habitat types and locales known to support indigo snake populations.

Incidental Take - The Service anticipates that an unquantifiable level of incidental take may occur as a result of the pesticides' use in areas frequented by the snake.

Reasonable and Prudent Measure(s) - To minimize incidental take, EPA must establish a monitoring/enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Gopher tortoise - Both aluminum phosphide and magnesium phosphide release deadly phosphine gas when exposed to air and should be considered as causing 100 percent mortality in burrows. Secondary toxicity is not a concern, however, because toxicity results from inhalation. The gopher tortoise is a burrowing species and may be affected by the use of these pesticides within its borrows. Therefore, it is the opinion of the Service that this pesticide is likely to jeopardize the continued existence of the gopher tortoise.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to this species: prohibit the use of aluminum phosphide and magnesium phosphide within the occupied habitat of this species west of the Mobile and Tombigbee Rivers, Alabama.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

El Segundo blue butterfly - The primary exposure of aluminum and magnesium phosphide and impact to the El Segundo Blue butterfly is its possible use against rodents such as ground squirrels and gophers. Mortality to larvae could occur due to the insecticide effect of the chemicals in the soil. These populations are very limited in their occupied habitat, one site being a two acre area set aside by a Chevron oil refinery and the other being a 300 acre area at the western end of the Los Angeles International Airport, both located in Los Angeles County. It is the biological opinion of the Service that use of aluminum and magnesium phosphide is likely to jeopardize the continued existence of the El Segundo blue butterfly.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit the use of aluminum phosphide and magnesium phosphide within the occupied habitat of El Segundo blue butterfly.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

RATIONALE FOR NO JEOPARDY DETERMINATIONS

Utah prairie dog - Both aluminum phosphide and magnesium phosphide are registered to control marmots, prairie dogs (except Utah prairie dogs), rats, house mice, ground squirrels, moles, and chipmunks. EPA states that existing labels specifically prohibit application of these two pesticides where the Utah prairie dog occurs. Provided this restriction remains and the use of these two pesticides are not allowed within the range of the Utah prairie dog, the Service believes that the use of aluminum phosphide and magnesium phosphide is not likely to jeopardize the continued existence of the Utah prairie dog.

Incidental Take - Because the use of aluminum phosphide and magnesium phosphide is prohibited within the occupied habitat of the Utah prairie dog, no incidental take is anticipated and thus none is authorized.

Coachella Valley fringe-toed lizard - There is potential exposure to this species by aluminum phosphide and magnesium phosphide from registered application for rodents due to the use of rodent burrows by the Coachella Valley fringe-toed lizard. It is the Service's biological opinion that use of aluminum phosphide and magnesium phosphide is not likely to jeopardize the continued existence of the Coachella Valley fringe-toed lizard.

Incidental Take - The service anticipates that an unquantifiable level of incidental take may occur as a result of aluminum and magnesium phosphide use within the occupied habitat of this species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the Coachella Valley fringe-toed lizard will be minimized: prohibit the use of aluminum phosphide and magnesium phosphide within the occupied habitat of the Coachella Valley fringe-toed lizard.

Desert tortoise - There is potential exposure of aluminum phosphide and magnesium phosphide from registered application for rodents since tortoise burrows, though they are much larger in size, may be accidentally treated. Given that this impact would be expected to be rare, it is the Service's biological opinion that use of aluminum phosphide and magnesium phosphide is not likely to jeopardize the continued existence of this species.

Incidental Take - The service anticipates that an unquantifiable level of incidental take may occur as a result of aluminum and magnesium phosphide use within the occupied habitat of this species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the desert tortoise will be minimized: aluminum and magnesium phosphide shall be used within the desert tortoise occupied habitat only by qualified individuals. Such persons shall be limited to wildlife biologists, certified applicators, or agents of county agricultural commissioner offices, university extension offices, or representatives of California State or Federal agencies, who are trained to distinguish dens and burrows of target species from those of non-target species.

Island night lizard - There is potential exposure to this species by aluminum phosphide and magnesium phosphide from registered application for rodents due to the use of rodent burrows by the island night lizard. It is the Service's biological opinion that use of aluminum phosphide and magnesium phosphide is not likely to jeopardize the continued existence of the island night lizard.

Incidental Take - The service anticipates that an unquantifiable level of incidental take may occur as a result of aluminum and magnesium phosphide use within the occupied habitat of this species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the island night lizard will be minimized: prohibit the use of aluminum and magnesium phosphide within the occupied habitat of this species.

Brodifacoum

CHEMICAL INFORMATION

TYPE: Rodenticide (coumarin anticoagulant)

FORMULATION: Ready-to-use grain-based pellets, minipellets, and wax blocks (Sine 1992).

REGISTERED USES: Control of Norway rats, roof rats and house mice in and around urban, industrial, commercial, agricultural and public buildings. Brodifacoum also may be used in and around transport vehicles (ships, trains, and aircraft) and related port buildings, but not in sewers. It must be placed in tamper proof bait boxes or in locations not accessible to children, pets, domestic animals or wildlife (d-CON 1989, ICI Americas 1988).

BACKGROUND:

Mode of action: Brodifacoum is a non-restricted anticoagulant rodenticide that acts by depressing the clotting capabilities of the blood while concurrently increasing the permeability of capillaries throughout the body. This action predisposes the exposed animal to widespread internal hemorrhage. Death generally occurs after several days of ingestion. However, as brodifacoum is more toxic than most anticoagulants, it may have lethal effects with only one feeding.

Aquatic toxicity: Brodifacoum is highly toxic to fish and aquatic invertebrates. Laboratory LC_{50} values for rainbow trout and bluegill are 0.045 and 0.089 ppm, respectively, and the *Daphnia magna* EC_{50} is 0.89 ppm. However, it is unlikely that normal use of brodifacoum would harm aquatic fauna, as its application methods (tamper-proof bait packets) and its characteristic of being essentially insoluble in water (Sine 1992) should preclude exposure. Therefore, brodifacoum should not be subject to runoff, leaching or drift.

Terrestrial toxicity: Brodifacoum has been shown to be highly toxic to birds and mammals under laboratory conditions. Reported LD_{50} for rat, opossum, mallard, ring-necked pheasant are 0.27, 0.17, 2.0, and 10.0 mg/kg respectively. Secondary field studies where fox, owls, golden eagles and red-shouldered hawks were fed rats that had died from brodifacoum indicate significant hazard to the predators and scavengers. Since the half-life of brodifacoum is 150 to 200 days in rat carcasses, acute and chronic secondary exposure is a major concern for listed scavengers and predators. These species may be exposed to brodifacoum either as a bait or by feeding on poisoned rodents. It is unlikely that listed plants or known plant pollinators will be affected by use of brodifacoum.

Wildlife incidents: EPA reported no wildlife poisoning incidents associated with brodifacoum. However, laboratory studies have demonstrated secondary poisoning of foxes and raptors. In addition, there are records indicating that a northern spotted owl in Washington may have died from brodifacoum exposure in April 1991 (Thomas 1991a and 1991b). The bird was alive and intoxicated when captured and died shortly thereafter. Laboratory analysis indicated massive hemorrhaging and brodifacoum residues in the liver.

BIOLOGICAL OPINION

CHEMICAL REFERENCE TABLE

(The following table contains only those species for which the Service provided a jeopardy or no jeopardy call. Species not included in this list are either not affected by the chemical or have no chance for exposure. For a complete list of all species considered in this opinion, refer to the master species list on page III-1 of the species profile section.)

Species Name	J/NJ	PAGE
MAMMALS		
Alabama beach mouse	J	12
Anastasia Island beach mouse	J	13
Carolina northern flying squirrel	J	13
Choctawhatchee beach mouse	J	12
Florida salt marsh vole	J	14
Fresno kangaroo rat	J	14
Giant kangaroo rat	NJ	16
Louisiana black bear	NJ	16
Morro Bay kangaroo rat	J	15
Perdido Key beach mouse	J	12
Point Arena mountain beaver	NJ	16
Salt marsh harvest mouse	J	14
San Joaquin kit fox	NJ	17
Southeastern beach mouse	J	13
Stephen's kangaroo rat	NJ	17
Tipton kangaroo rat	NJ	16
BIRDS		
Audubon's crested caracara	J	15
Hawaiian hawk	NJ	18
San Clemente loggerhead shrike	J	16
REPTILES		
Eastern indigo snake	NJ	18

RATIONALE FOR JEOPARDY DETERMINATIONS

Alabama beach mouse, Choctawhatchee beach mouse, and Perdido Key beach mouse - Exposure of these beach mice to brodifacoum could occur through consumption of poisoned baits when used to control rodents within or in close proximity to their occupied habitats. Since all three of these subspecies of beach mice occur in areas that are being encroached upon by various types of human development, there is a high possibility of brodifacoum being used where these mice could come in contact with it. All three mice are restricted to mature coastal barrier dune systems along the Gulf of Mexico. The Choctawhatchee beach mouse is presently known to occur only on Shell Island at St. Andrews Bay in Bay County, Florida, and on approximately 7.9 km of beach dune habitat (coastline up to 150 m inland) near Topsail Hill, from around Morrison Lake eastward to Stalworth Lake, Walton County, Florida. The Alabama beach mouse presently is surviving only on disjunct tracts of the sand dune system from Fort Morgan State Park to the Romar Beach area, Baldwin County, Alabama. The Perdido Key beach mouse occurs only on Perdido Key in Baldwin County, Alabama and Escambia County, Florida. The distance to which occupied habitat of these species extends inland from the beach varies depending upon the configuration of the sand dune system and the vegetation present. There are generally three types of microhabitats within the dune systems utilized by these three beach mice--frontal and primary dunes sparsely vegetated with grasses (dominated by sea oats and panic grasses), seaside rosemary, beach morning glory, and railroad vine; interdunal areas supporting sedges, rushes, cordgrass, and salt-grass; and dunes further inland (secondary and interior dunes) dominated

by growths of scrub oak, sand-live oak, seaside rosemary, and occasional patches of grasses and slash pine and sand pine. Because of the restricted distributions of these species, their limited populations and the likelihood of brodifacoum being used for rodent control within or adjacent to areas which they inhabit, it is the Service's biological opinion that the registered use of brodifacoum is likely to jeopardize the continued existence of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: Prohibit use of brodifacoum within 100 yards of occupied habitat of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Anastasia Island Beach Mouse and Southeastern Beach Mouse - These two beach mice are endemic to the east coast of Florida. The Anastasia Island beach mouse apparently once occurred from the St. Johns River south to Anastasia Island, St. Johns County, Florida, but the species is now believed to occur only on Anastasia Island. The historic range of the southeastern beach mouse was from Florida's Mosquito (Pounce) Inlet in Volusia County south to Hollywood Beach in Broward County. However, the southeastern beach mouse is believed to have been eliminated from the southern portion of its range and presently occurs only from Mosquito Inlet south to, and including, Hutchinson Island in St. Lucie County. Both subspecies inhabit sand dunes vegetated by sea oats and dune panic grass and the scrub adjoining these dunes, which is vegetated with oaks, sand pine, palmetto, sea grapes, and/or wax myrtle. Since the ranges of both species have been and continue to be encroached upon by human development of various types, it is likely that brodifacoum could be used for pest control in areas where both these beach mice occur. Exposure of these mice to brodifacoum would occur through ingestion of poison baits, which would result in direct mortality of individuals of the species. Accordingly, it is the Service's biological opinion that the registered use of brodifacoum is likely to jeopardize the continued existence of the Anastasia Island beach mouse or the southeastern beach mouse.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: Prohibit use of brodifacoum within 100 yards of occupied habitat of the Anastasia Island beach mouse and the southeastern beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Carolina northern flying squirrel - This species may be directly exposed to brodifacoum poisoning from its registered use to control rats and mice around agricultural buildings and structures. The Carolina northern flying squirrel occurs in coniferous and northern hardwood forests, and may occasionally forage on the ground. Where land use changes and development encroach on the species' habitat there is a potential risk of the squirrel coming in contact with brodifacoum bait that is placed outside of buildings (e.g., storage sheds and barns). Brodifacoum is toxic to rodents and would most likely kill a northern flying squirrel if it consumed the bait. Due to the restricted range and small population of the Carolina northern flying squirrel, any poisoning of individuals could threaten the survival of the species. Therefore, it is the Service's opinion that the use of brodifacoum is likely to jeopardize the continued existence of the Carolina northern flying squirrel.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Carolina northern flying squirrel: prohibit the outdoor use of the chemical within the species' occupied habitat.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Florida salt marsh vole - Exposure of the vole to brodifacoum could occur through consumption of poisoned baits when used to control rodents in close proximity to the vole's occupied marsh habitat. There is a possibility of brodifacoum being used around buildings or other structures adjacent to salt marsh where the vole could come in contact with it. The vole is restricted to a single known site in the salt marsh of Waccasassa Bay, Levy County, Florida. Because of the restricted distribution of the species, its limited population, and the likelihood of brodifacoum being used for rodent control adjacent to areas which the vole inhabits, it is the Service's biological opinion that the registered use of brodifacoum is likely to jeopardize the continued existence of the Florida salt marsh vole.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: Prohibit use of brodifacoum within 100 yards of the landward edge of the species' habitat in Levy County, Florida.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Fresno kangaroo rat, salt marsh harvest mouse - Despite the relatively restricted patterns of brodifacoum uses (registered for control of domestic rats and mice in an around urban and agricultural buildings), Fresno kangaroo rats and salt marsh harvest mice are vulnerable to brodifacoum exposure because: (1) both species occupy areas of high human activity in which
man-made structures exist near or adjacent to their habitats (agricultural areas in the San Joaquin Valley, California, and the San Francisco Bay area, respectively); (2) both species occupy highly restricted and fragmented habitats, which increases both the risks and potential effects of brodifacoum exposure; (3) some formulations of this compound (bait packs and grain based pellets) could be attractive to kangaroo rats and harvest mice; and (4) brodifacoum is highly toxic to all rodents. Based on these considerations, it is the Service's biological opinion that brodifacoum use within the range of the Fresno kangaroo rat and salt marsh harvest mouse is likely to jeopardize the continued existence of these species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Fresno kangaroo rat and salt marsh harvest mouse: Prohibit outdoor brodifacoum use within 100 yards of these species' occupied habitats.

Incidental Take - Although possible exposure of the Fresno kangaroo rat and salt marsh harvest mouse to brodifacoum is probably minimal, the Service anticipates that an unquantifiable level of incidental take may occur as a result of brodifacoum use within the ranges of these species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Morro Bay kangaroo rat - The primary exposure of brodifacoum from registered uses can occur when the Morro Bay kangaroo rat ingests treated bait. The extremely limited range of this species, the presence of target rodents, and the interspersion of this species habitat with urban, agricultural, and commercial buildings place the Morro Bay kangaroo rat at risk. While it is required to place the bait boxes in areas not frequented by wildlife, it is probable that this species could access the bait. It is the biological opinion of the Service that use of brodifacoum is likely to jeopardize the continued existence of the Morro Bay kangaroo rat.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Morro Bay kangaroo rat: prohibit the use of brodifacoum within 100 yards of the occupied habitat of the Morro Bay kangaroo rat.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

Audubon's crested caracara - The caracara would be exposed to brodifacoum by consuming a mouse, rat or other animal that had been poisoned by the rodenticide. EPA data indicates that this rodenticide would cause lethal secondary poisoning in birds of prey. Hawks and owls have died, and eagles have suffered sub-lethal effects, from having consumed brodifacoum poisoned rats. The caracara feeds on live prey, as well as, feeding on carrion in areas where the rodenticide may be used. Because of the caracara's small population size, any rodenticide induced mortality could threaten the survival of the species. Therefore, it is the Service's opinion that the use of brodifacoum is likely to jeopardize the continued existence of the Audubon's crested caracara.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Audubon's crested caracara: prohibit the use of the pesticide within the occupied habitat of the species.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

San Clemente Loggerhead Shrike - San Clemente loggerhead shrikes may be exposed secondarily to brodifacoum if they consume rodents that have ingested this chemical from registered rodent control activities. Brodifacoum is highly toxic to birds both directly and secondarily. San Clemente Island contains buildings where brodifacoum can be used and shrikes could then contact dosed rodents. There are less than 20 pairs of these bird in the wild and in captivity. Based on these considerations, it is the Service's biological opinion that brodifacoum use on San Clemente Island is likely to jeopardize the continued existence of the San Clemente loggerhead shrike.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the San Clemente loggerhead shrike: Prohibit the use of brodifacoum on San Clemente Island, California.

Incidental Take - With implementation of the reasonable and prudent alternative(s) to preclude jeopardy to this species, no incidental take is anticipated and therefore none is authorized.

RATIONALE FOR NO JEOPARDY DETERMINATIONS

Giant kangaroo rat, Point Arena mountain beaver, and Tipton kangaroo rat - Despite relatively restricted brodifacoum use patterns (registered for control of domestic rats and mice in an around urban and agricultural buildings), giant kangaroo rats, Point Arena mountain beaver, and Tipton kangaroo rats may be subject to periodic brodifacoum exposure because they sometimes occupy habitats that are adjacent to human activities and structures. Tipton kangaroo rats may be found near residential, agricultural, and commercial buildings in the southern San Joaquin Valley of California; mountain beavers near municipal and communication structures in the Point Arena vicinity; and giant kangaroo rats in oil fields and rangelands in the southwest and west central portions of the San Joaquin Valley where industrial and ranch buildings are present. However, both kangaroo rat species occupy a more widespread range than the Fresno kangaroo rat discussed above and much of their ranges are far removed from anticipated brodifacoum use areas. Furthermore, restriction of this compound to use in bait boxes eliminates

most avenues of exposure to mountain beaver. Therefore, it is the Services' biological opinion that brodifacoum use within the ranges of the Tipton kangaroo rat, Point Arena mountain beaver, and giant kangaroo rat is not likely to jeopardize the continued existence of these species.

Incidental Take - Although possible exposure of the Tipton kangaroo rat, Point Arena mountain beaver, and giant kangaroo rat to brodifacoum is probably minimal, the Service anticipates that an unquantifiable level of incidental take may occur as a result of brodifacoum use within the ranges of these species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the giant and Tipton kangaroo rat will be minimized: Prohibit outdoor brodifacoum use within 100 yards of these species' occupied habitats.

Louisiana black bear - The Louisiana black bear would likely only be exposed to brodifacoum by consuming a mouse, rat or other animal that had been poisoned by the rodenticide. Black bears occasionally venture into agricultural areas where the rodenticide may be used. Although brodifacoum is extremely toxic to mammals, based on EPA data it is very unlikely that a mammal as large a bear would consume enough poisoned rodents to cause lethal secondary poisoning. Therefore, it is the Service's opinion that the use of brodifacoum is not likely to jeopardize the continued existence of the Louisiana black bear.

Incidental Take - Although the chance of exposure and hazard are considered minimal, because of the high toxicity of brodifacoum to mammals, it is still a matter of concern. Thus, the Service anticipates that an unquantifiable level of incidental take may occur as a result of this chemical's use in areas of or adjacent to bear habitat.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measure for minimizing incidental take must be adopted: prohibit the use of the chemical within the occupied habitat of the Louisiana black bear.

San Joaquin kit fox - Despite the restricted pattern of brodifacoum use (registered for control of domestic rats and mice in and around urban and agricultural buildings), San Joaquin kit foxes may be subject to periodic brodifacoum exposure because they occupy some habitats adjacent to human activities and structures. The kit fox may be found around military structures at Camp Roberts and Fort Hunter-Liggett (Monterey County, California); commercial and residential structures in urban and municipal areas (e.g., Bakersfield, California); industrial structures in the Kern County oil fields; and agricultural and ranch buildings throughout its range. There are two potential sources of kit fox exposure to brodifacoum: (1) direct consumption of brodifacoum baits (possible especially for pellet baits); and (2) secondary poisoning by consuming small mammals killed or incapacitated by brodifacoum exposure. However, because this species has a relatively large range and many of its habitats are far removed from anticipated brodifacoum uses, it is the Service's biological opinion that brodifacoum use is not likely to jeopardize the continued existence of the San Joaquin kit fox.

Incidental Take - Although possible exposure of the San Joaquin kit fox to brodifacoum is probably minimal, the Service anticipates that an unquantifiable level of incidental take may occur as a result of brodifacoum use within the range of this species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the San Joaquin kit fox will be minimized: Outdoor application of brodifacoum baits within the range of the San Joaquin kit fox shall be placed in tamper resistant bait boxes and shall not be placed in areas accessible to wildlife.

Stephen's kangaroo rat - The primary exposure of brodifacoum from registered uses can occur when Stephen's kangaroo rat ingests treated bait. Exposure to the chemical can occur from its registered use

around agricultural, commercial, industrial buildings, residences, that are interspersed with the habitat of this species. The use of bait boxes placed in areas not usually accessible to wildlife and the large range of the species reduces, but does not eliminate the risk to the Stephen's kangaroo rat. It is the biological opinion of the Service that use of brodifacoum is not likely to jeopardize the continued existence of the Stephen's kangaroo rat.

Incidental Take - The service anticipates that an unquantifiable level of incidental take may occur as a result of brodifacoum use within the occupied habitat of this species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the Stephen's kangaroo rat will be minimized: prohibit the use of brodifacoum within 100 yards of occupied habitat.

Hawaiian hawk - Hawaiian hawks range throughout most of the Island of Hawaii below 7000 feet elevation, preferring open, non-urban areas. These raptors feed on birds, insects, reptiles and small mammals (including rats, mice and mongooses). While it is possible that hawks may be exposed to this rodenticide through secondary routes, limitations on the use of brodifacoum to buildings and tamper-proof packets greatly diminish the chances of exposure. Consequently, it is the Service's biological opinion that use of brodifacoum as described above within habitat occupied by the Hawaiian hawk is not likely to jeopardize the continued existence of this species.

Incidental Take- Although the possible exposure of the Hawaiian hawk to brodifacoum is probably minimal, the Service anticipates an unquantifiable level of incidental take may occur as a result of this chemical's use within or adjacent to occupied habitat.

Reasonable and Prudent Measure(s)-The following reasonable and prudent measures for minimizing incidental take must be adopted: prohibit the use of brodifacoum within 100 yards of the Hawaiian hawk's occupied habitat.

Eastern indigo snake - The eastern indigo snake would only be exposed to brodifacoum by eating an animal such as a mouse or rat that had been poisoned by the rodenticide. Indigo snakes occasionally occur in agricultural areas where rodenticides are likely to be used. Although EPA has no toxicity data for reptiles, the data on birds is considered applicable to reptiles. Laboratory studies indicate that brodifacoum poses a lethal secondary poisoning hazard to birds of prey. However, the snake's potential for exposure to poisoned prey is considered minimal. Therefore, it is the Service's opinion that the use of brodifacoum is not likely to jeopardize the continued existence of the eastern indigo snake.

Incidental Take - Although the chance of exposure is considered minimal, because of the high toxicity of brodifacoum, it is still a matter of concern. Thus, the Service anticipates that an unquantifiable level of incidental take may occur as a result of this chemical's use in areas where the eastern indigo snake may occur.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measure for minimizing incidental take should be adopted: conduct laboratory studies using surrogate snake species to obtain toxicity data on the chemical's secondary poisoning hazard to snakes.

Bromadiolone

CHEMICAL INFORMATION

TYPE: Rodenticide

FORMULATION: Concentrates, liquid baits, meal baits, paraffin blocks, ready-to-use grain-based bait pellets and minipellets (Sine 1992).

REGISTERED USES: Control of Norway rats, roof rats, and house mice in urban areas in and around the periphery of homes, industrial, commercial and public buildings, alleys and cargo areas of ships, trains, and aircraft. Bromadiolone can be used in official establishments operating under the Federal meat, poultry, shell egg grading, and egg product inspection program. Use in sewers or public parks is prohibited (Sine 1992).

BACKGROUND:

Mode of action: Bromadiolone is a general use anticoagulant rodenticide that acts by depressing the clotting capabilities of the blood while concurrently increasing the permeability of capillaries throughout the body. This action predisposes the exposed animal to widespread internal hemorrhage. Death generally occurs after several days of ingestion.

Aquatic toxicity: Bromadiolone is highly toxic to fish and aquatic invertebrates. Laboratory LC_{50} values for rainbow trout and bluegill are 1.4 and 3.0 ppm, respectively, and the *Daphnia magna* EC_{50} is 0.24 ppm. However, it is unlikely that normal use of bromadiolone would harm aquatic fauna, as its formulations, application methods, characteristic of being essentially insoluble in water (Sine 1992) should preclude exposure. Therefore, bromadiolone should not be subject to runoff, leaching, or drift.

Terrestrial toxicity: Laboratory data indicate that bromadiolone's LD_{50} for rats is 1.125 mg/kg for the pure compound. However, the rat LD_{50} is 200 g/kg at the 0.005% concentration (the standard bait formulation). Therefore, formulated products containing bromadiolone are only slightly toxic to rodents. The LD_{50} for the northern bobwhite is 100 mg/kg. There are no definitive environmental fate data available for bromadiolone. However, the compound likely persists in carcasses of poisoned rodents. Therefore, potential exposure of listed scavengers and predators to bromadiolone is a significant concern. These species may be exposed to the rodenticide either as a bait or by feeding on poisoned rodents. Bromadiolone is nontoxic to bees (Sine 1992). It is unlikely that listed plants or known plant pollinators will be affected by use of bromadiolone.

Wildlife incidents: EPA reported no known incidents of wildlife poisoning associated with bromadiolone.

BIOLOGICAL OPINION

CHEMICAL REFERENCE TABLE

(The following table contains only those species for which the Service provided a jeopardy or no jeopardy call. Species not included in this list are either not affected by the chemical or have no chance for exposure. For a complete list of all species considered in this opinion, refer to the master species list on page III-1 of the species profile section.)

Species Name	J/NJ	PAGE
MAMMALS		
Alabama beach mouse	J	20
Anastasia Island beach mouse	J	21
Choctawhatchee beach mouse	J	20
Fresno kangaroo rat	NJ	22
Morro Bay kangaroo rat	J	21
Perdido Key beach mouse	J	20
Point Arena mountain beaver	NJ	22
Salt marsh harvest mouse	J	21
San Joaquin kit fox	NJ	22
Southeastern beach mouse	J	21
Stephen's kangaroo rat	NJ	23
Tipton kangaroo rat	NJ	22

RATIONALE FOR JEOPARDY DETERMINATIONS

Alabama Beach Mouse, Choctawhatchee Beach Mouse, and Perdido Key beach mouse - Exposure of these three beach mice to the rodenticide bromadiolone could occur through direct contact with poisoned baits when used within or in close proximity to their occupied habitats. All three subspecies are restricted to mature coastal barrier dune systems along the Gulf of Mexico and occur in areas that are being encroached upon by human development. Therefore, there is a possibility of exposure to bromadiolone. The Choctawhatchee beach mouse is presently known to occur only on Shell Island at St. Andrews Bay in Bay County, Florida, and on approximately 7.9 km of beach dune habitat (coastline up to 150 m inland) near Topsail Hill, from around Morrison Lake eastward to Stalworth Lake, Walton County, Florida. The Alabama beach mouse presently is surviving only on disjunct tracts of the sand dune system from Fort Morgan State Park to the Romar Beach area, Baldwin County, Alabama. The Perdido Key beach mouse occurs only on Perdido Key in Baldwin County, Alabama and Escambia County, Florida. The distance to which occupied habitat of these mice extends inland from the beach varies depending upon the configuration of the sand dune system and the vegetation present. All three beach mice utilize portions of the frontal or primary dunes; interdunal areas; and dunes further inland (secondary or interior dunes). Because of the restricted distributions of these species and the likelihood of bromadiolone being used for rodent control within or adjacent to areas which they inhabit, it is the Service's biological opinion that the registered use of bromadiolone is likely to jeopardize the continued existence of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Reasonable and Prudent Alternative(s) - If implemented the following reasonable and prudent alternatives would avoid jeopardy to the species: Prohibit use of bromadiolone within 100 yards of occupied habitat of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Anastasia Island Beach Mouse and Southeastern Beach Mouse - These two beach mice are endemic to the east coast of Florida. The Anastasia Island beach mouse is presently believed to occur only on Anastasia Island, St. Johns County, Florida. The southeastern beach mouse is believed to presently occur only from Florida's Mosquito (Pounce) Inlet in Volusia County south to Hutchinson Island in St. Lucie County, Florida. Both species inhabit sand dunes vegetated by sea oats and dune panic grass and the scrub adjoining these dunes, which is vegetated with oaks, sand pine, palmetto, sea grapes, and/or wax myrtle. It is likely that bromadiolone could be used for pest control in areas where both these beach mice occur, since the ranges of both species have been and continue to be encroached upon by human development. Exposure of the mice to bromadiolone would occur through consumption of poison baits, which would result in direct mortality of individuals of the species. Accordingly, it is the Service's biological opinion that the registered use of bromadiolone is likely to jeopardize the continued existence of the Anastasia Island beach mouse and the southeastern beach mouse.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: Prohibit use of bromadiolone within 100 yards of occupied habitat of the Anastasia Island beach mouse and the southeastern beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Morro Bay kangaroo rat - The primary exposure of bromadiolone from registered uses can occur when the Morro Bay kangaroo rats ingest treated bait. The presence of urban development would allow placement of bait outside of buildings adjacent to occupied habitat where the rat could access the treated bait. The extremely limited range of this species combined with the interspersion of building and urban development with occupied habitat, place the species at risk. It is the biological opinion of the Service that use of bromadiolone is likely to jeopardize the continued existence of the Morro Bay kangaroo rat.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Morro Bay kangaroo rat: prohibit the use of bromadiolone within 100 yards of the occupied habitat of the Morro Bay kangaroo rat.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

Salt marsh harvest mouse - Despite the relatively restricted patterns of bromadiolone uses (registered for outdoor use in urban areas only), the salt marsh harvest mouse could be vulnerable to bromadiolone exposure because: (1) this species occupies areas of high human activity (the San Francisco Bay area) in which man-made equipment and structures exist near or adjacent to occupied habitats; (2) the species occupies highly restricted and fragmented habitats, which increases both the risks and potential effects of bromadiolone exposure; and (3) bromadiolone is highly toxic to all rodents. Based on these considerations, it is the Service's biological opinion that bromadiolone use within the range of the salt marsh harvest mouse is likely to jeopardize the continued existence of this species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the salt marsh harvest mouse: prohibit outdoor bromadiolone use within 100 yards of all habitats known to be occupied by this species.

Incidental Take - Although possible exposure of the salt marsh harvest mouse to bromadiolone is probably minimal, the Service anticipates that an unquantifiable level of incidental take may occur as a result of bromadiolone use within the occupied habitat of this species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

RATIONALE FOR NO JEOPARDY DETERMINATIONS

Fresno kangaroo rat, Point Arena mountain beaver, and Tipton kangaroo rat - Despite restricted bromadiolone use patterns (registered for use in pellet baits and for outdoor use in urban areas only), the above species may be subject to periodic bromadiolone exposure where they occupy urban or municipal areas in which this compound may be used--e.g., in a few municipal areas in the San Joaquin Valley (Fresno and Tipton kangaroo rats) and in Mendocino County, California (Point Arena mountain beaver). However, exposure of these species to bromadiolone is considered to be unlikely, since relatively few occurrences of these animals in urban or municipal areas are known. It is the Service's biological opinion that bromadiolone use is not likely to jeopardize the continued existence of the Fresno kangaroo rat, Point Arena mountain beaver, or Tipton kangaroo rat.

Incidental Take - Although possible exposure of the Fresno kangaroo rat, Point Arena mountain beaver, and Tipton kangaroo rat to bromadiolone probably is minimal, the Service anticipates that an unquantifiable level of incidental take may occur as a result of bromadiolone use within the ranges of these species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the Fresno kangaroo rat, Point Arena mountain beaver, and Tipton kangaroo rat will be minimized: Prohibit outdoor bromadiolone use within 100 yards of all habitats occupied by these species.

San Joaquin kit fox - Despite the restricted pattern of bromadiolone use (registered in pellet baits and for outdoor use in urban areas only), San Joaquin kit foxes may be subject to periodic bromadiolone exposure because they occupy some habitats that are urban or quasi-urban and are adjacent to human structures. Kit foxes may be found around military structures at Camp Roberts and Fort Hunter-Liggett (Monterey County, California), and around commercial and residential structures in urban and municipal areas (e.g., Bakersfield, California). There are two potential sources of kit fox exposure to bromadiolone: (1) direct consumption of bromadiolone baits (possible especially for pellet formulations); and (2) secondary poisoning by consuming small mammals killed or incapacitated by bromadiolone exposure. However, because this species has a relatively large range and many of its habitats are far removed from anticipated bromadiolone uses, it is the Service's biological opinion that bromadiolone use is not likely to jeopardize the continued existence of the San Joaquin kit fox.

Incidental Take - Although possible exposure of the San Joaquin kit fox to bromadiolone is probably minimal, the Service anticipates that an unquantifiable level of incidental take may occur as a result of bromadiolone use within the range of this species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the San Joaquin kit fox will be minimized: Outdoor application of bromadiolone baits within the range of the San Joaquin kit fox shall be placed in tamper resistant bait boxes and shall not be placed in areas accessible to wildlife

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Stephen's kangaroo rat - The primary exposure of bromadiolone from registered uses can occur when Stephen's kangaroo rat ingests treated bait. It is the biological opinion of the Service that use of bromadiolone is not likely to jeopardize the continued existence of the Stephen's kangaroo rat.

Incidental Take - The service anticipates that an unquantifiable level of incidental take may occur as a result of bromadiolone use within the occupied habitat of this species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the Stephen's kangaroo rat will be minimized: prohibit the use of bromadiolone within 100 yards of occupied habitat.

Bromethalin

CHEMICAL INFORMATION

TYPE: Rodenticide

FORMULATION: 0.005% to 0.01% bait concentration applied in tamper proof bait boxes or in locations inaccessible to children, domestic animals and wildlife.

REGISTERED USES: Control of Norway rats, roof rats and house mice in and around homes, commercial, industrial and agricultural buildings. Also airports, landing strips and urban alleys.

BACKGROUND:

Mode of action: Bromethalin is a rodenticide completely unlike anticoagulants. It is a neurotoxin that increases cerebral pressure blocking off nerve transmission to the lungs resulting in general paralysis and suffocation.

Aquatic toxicity: Bromethalin is almost insoluble in water [<0.01 ppm]. Bromethalin is very highly toxic to fish and aquatic invertebrates. Laboratory tests demonstrated bromethalin LC_{50}s of 0.053 and 0.027 ppm for rainbow trout and *Daphnia magna*, respectively. EPA did not report any aquatic field studies or testing with marine or estuarine organisms. It is highly unlikely that bromethalin will effect listed aquatic species, as the pesticide's use in bait boxes precludes run-off into aquatic systems.

Terrestrial toxicity: Bromethalin has been shown to be highly toxic to birds and mammals under laboratory feeding studies. LD_{50} values for mouse, rat, rabbit, cat, dog, and northern bobwhite are 5.3, 9.1, 2, 18, 4.8, and 4.66 mg/kg, respectively. However, due to the use pattern for this chemical, no impact is expected on birds. However, certain listed species of mammals [rodents] are at risk if their habitat is adjacent to buildings where bromethalin might be used and they are inclined to feed on the bait attractant. No secondary toxicity is possible since bromethalin does not accumulate in bodies of poisoned rodents. There would be no direct or indirect impact on plants and/or pollinators considered in this consultation.

Wildlife incidents: EPA reported no wildlife poisoning incidents associated with bromethalin.

BIOLOGICAL OPINION

CHEMICAL REFERENCE TABLE

(The following table contains only those species for which the Service provided a jeopardy or no jeopardy call. Species not included in this list are either not affected by the chemical or have no chance for exposure. For a complete list of all species considered in this opinion, refer to the master species list on page III-1 of the species profile section.)

Species Name	J/NJ	PAGE
MAMMALS		
Alabama beach mouse	J	27
Anastasia Island beach mouse	J	28
Carolina northern flying squirrel	J	28
Choctawhatchee beach mouse	J	27
Florida salt marsh vole	J	28
Fresno kangaroo rat	J	29
Giant kangaroo rat	NJ	30
Morro Bay kangaroo rat	J	29
Perdido Key beach mouse	J	27
Point Arena mountain beaver	NJ	30
Salt marsh harvest mouse	J	29
Southeastern beach mouse	J	28
Stephen's kangaroo rat	NJ	30
Tipton kangaroo rat	NJ	30

RATIONALE FOR JEOPARDY DETERMINATIONS

Alabama Beach Mouse, Choctawhatchee Beach Mouse, and Perdido Key Beach Mouse - Exposure of these beach mice to the rodenticide bromethalin could occur through direct contact with poisoned baits when used within or in close proximity to their occupied habitats. Since, all three subspecies occur in areas that are being encroached upon by various types of human development, there is a high possibility of this pesticide being used where these mice could come in contact with it. All three subspecies are restricted to mature coastal barrier dune systems along the Gulf of Mexico and The Choctawhatchee beach mouse is presently known to occur only on Shell Island at St. Andrews Bay in Bay County, Florida, and on approximately 7.9 km of beach dune habitat (coastline up to 150 m inland) near Topsail Hill, from around Morrison Lake eastward to Stalworth Lake, Walton County, Florida. The Alabama beach mouse presently is surviving only on disjunct tracts of the sand dune system from Fort Morgan State Park to the Romar Beach area in Baldwin County, Alabama. The Perdido Key beach mouse occurs only on Perdido Key in Baldwin County, Alabama and Escambia County, Florida. The distance to which occupied habitat of these species extends inland from the beach varies depending upon the configuration of the sand dune system and the vegetation present. Both subspecies utilize portions of the frontal or primary dunes; interdunal areas; and dunes further inland (secondary or interior dunes). Because of the restricted distributions and limited populations of these species, and the likelihood of bromethalin being used for rodent control within or adjacent to areas which they inhabit, it is the Service's biological opinion that the registered use of bromethalin is likely to jeopardize the continued existence of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: Prohibit use of bromethalin within 100 yards of occupied habitat of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Anastasia Island Beach Mouse and Southeastern Beach Mouse - These two beach mice are endemic to the east coast of Florida. The Anastasia Island beach mouse is presently believed to occur only on Anastasia Island, St. Johns County, Florida. The southeastern beach mouse is believed to presently occur only from Florida's Mosquito (Pounce) Inlet in Volusia County south to Hutchinson Island in St. Lucie County, Florida. Both subspecies inhabit sand dunes vegetated by sea oats and dune panic grass and the scrub adjoining these dunes, which is vegetated with oaks, sand pine, palmetto, sea grapes, and/or wax myrtle. Since the ranges of both species have been and continue to be encroached upon by human development, it is likely that bromethalin could be used for pest control in areas where both these beach mice occur. Exposure of the mice to bromethalin would occur through consumption of poison baits, which would result in direct mortality of individuals of the species. Accordingly, it is the Service's biological opinion that the registered use of bromethalin is likely to jeopardize the continued existence of the Anastasia Island beach mouse or the southeastern beach mouse.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: Prohibit use of bromethalin within 100 yards of occupied habitat of the Anastasia Island beach mouse and the southeastern beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Carolina northern flying squirrel - This species may be directly exposed to bromethalin poisoning from its registered use to control rats and mice around agricultural buildings and structures. The Carolina northern flying squirrel occurs in coniferous and northern hardwood forests, and may occasionally forage on the ground. Where land use changes and development encroach on the species' habitat there is a potential risk of the squirrel coming in contact with bromethalin bait that is placed outside of buildings (e.g., storage sheds and barns). Bromethalin is toxic to rodents and would most likely kill a northern flying squirrel if it consumed the bait. Due to the restricted range and small population of the Carolina northern flying squirrel, any poisoning of individuals could threaten the survival of the species. Therefore, it is the Service's opinion that the use of bromethalin is likely to jeopardize the continued existence of the Carolina northern flying squirrel.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Carolina northern flying squirrel: prohibit the outdoor use of bromethalin within the species' occupied habitat.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Florida salt marsh vole - Exposure of the salt marsh vole to bromethalin could occur through consumption of poisoned baits used to control rodents in close proximity to the vole's occupied marsh habitat. There is a possibility of the rodenticide being used around buildings or other structures adjacent to salt marsh habitat where the vole could come in contact with it. The vole is restricted to a single known area in the salt marsh of Waccasassa Bay, Levy County, Florida. This rodenticide is highly toxic to mammals. Because of the restricted distribution of the species, its limited population, and the likelihood of this rodenticide being used for rodent control adjacent to areas in which the vole occurs, it is the Service's biological opinion that the use of bromethalin is likely to jeopardize the continued existence of the Florida salt marsh vole.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit use of bromethalin within 100 yards of the landward edge of the species' salt marsh habitat in Levy County, Florida.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Fresno kangaroo rat, salt marsh harvest mouse - Despite the relatively restricted patterns of bromethalin uses (registered for use in bait boxes in and around human structures only), Fresno kangaroo rats and salt marsh harvest mice are vulnerable to bromethalin exposure because: (1) both species occupy areas of high human activity in which man-made structures exist near or adjacent to their habitats (agricultural areas in the San Joaquin Valley, California, and the San Francisco Bay area, respectively); (2) both species occupy highly restricted and fragmented habitats, which increases both the risks and potential effects of bromethalin exposure; and (3) bromethalin is highly toxic to all rodents. Based on these considerations, it is the Service's biological opinion that bromethalin use within the range of the Fresno kangaroo rat and salt marsh harvest mouse is likely to jeopardize the continued existence of these species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Fresno kangaroo rat and salt marsh harvest mouse: prohibit outdoor bromethalin use within 100 yards of habitats occupied by these species.

Incidental Take - Although possible exposure of the Fresno kangaroo rat and salt marsh harvest mouse to bromethalin probably is minimal, the Service anticipates that an unquantifiable level of incidental take may occur as a result of bromethalin use within the ranges of these species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Morro Bay kangaroo rat - The primary exposure of bromethalin from registered uses can occur when the Morro Bay kangaroo rat ingests treated bait. The extremely limited range of this species, the presence of target rodents, and the interspersion of this species habitat with urban, agricultural, and commercial buildings place the Morro Bay kangaroo rat at risk. It is the biological opinion of the Service that use of bromethalin is likely to jeopardize the continued existence of the Morro Bay kangaroo rat.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Morro Bay kangaroo rat: prohibit the use of bromethalin within 100 yards of the occupied habitat of the Morro Bay kangaroo rat.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

RATIONALE FOR NO JEOPARDY DETERMINATIONS

Giant kangaroo rat, Tipton kangaroo rat, Point Arena mountain beaver - Despite relatively restricted bromethalin use patterns (registered for use in bait boxes in an around human structures only), giant kangaroo rats, Tipton kangaroo rats, and Point Arena mountain beaver may be subject to periodic bromethalin exposure because they sometimes occupy habitats that are adjacent to human activities and structures. Tipton kangaroo rats may be found near residential, agricultural, and commercial buildings in the southern San Joaquin Valley of California; giant kangaroo rats in oil fields and rangelands in the southwest and west central portions of the San Joaquin Valley where industrial and ranch building are present; and mountain beaver near municipal and communication structures in the Point Arena vicinity. However, both kangaroo rat species occupy a more widespread range than the Fresno kangaroo rat discussed above and much of their ranges are far removed from anticipated bromethalin use areas. Furthermore, restriction of this compound to use in bait boxes eliminates most avenues of exposure to mountain beaver. It is the Service's biological opinion that bromethalin use within the ranges of the giant kangaroo rat, Tipton

kangaroo rat, and Point Arena mountain beaver is not likely to jeopardize the continued existence of these species.

Incidental Take - Although possible exposure of the giant kangaroo rat, Tipton kangaroo rat, and Point Arena mountain beaver to bromethalin is probably minimal, the Service anticipates that an unquantifiable level of incidental take may occur as a result of bromethalin use within the ranges of these species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the Tipton and giant kangaroo rat will be minimized: Prohibit outdoor bromethalin use within 100 yards of habitat occupied by these species.

Stephen's kangaroo rat - The primary exposure of bromethalin from registered uses can occur when Stephen's kangaroo rat ingests treated bait. Although this species will likely occasionally contact baits that are located adjacent to agricultural, domestic, commercial, and industrial buildings; also airports and landing strips, its large range and distribution reduce overall risk. It is the biological opinion of the Service that use of bromethalin is not likely to jeopardize the continued existence of the Stephen's kangaroo rat.

Incidental Take - The service anticipates that an unquantifiable level of incidental take may occur as a result of bromethalin use within the occupied habitat of this species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the Stephen's kangaroo rat will be minimized: prohibit the use of bromethalin within 100 yards of this specie's occupied habitat.

Chlorophacinone

CHEMICAL INFORMATION

TYPE: Rodenticide (indandione)

FORMULATION: Tracking powder (nuisance baits - can only be used in buildings), pellet-baits (mice/voles/cotton rats/field mice/house mice/pocket gophers), and concentrate ground spray (orchard mice).

REGISTERED USES: Registered for control of Norway rats, roof rats and house mice in and around homes, industrial and agricultural buildings; and for pocket gophers applied as bait in underground runways; also registered for control of mice and voles in Idaho and Delaware; orchard mice in Delaware, Connecticut and Arizona; control of deer mice in non-crop areas in Florida; ground squirrel control in Arizona; control of deer mice, house mice and pocket gophers in California and nuisance bats in Georgia, Connecticut and Colorado, but the last formulation is restricted to domiciles and other buildings.

BACKGROUND:

Mode of action: An anticoagulant, chlorophacinone is in a class of rodenticides known as indandiones. Unlike the coumarin compounds, indandiones may cause symptoms and signs of neurologic and cardiopulmonary injury leading to death before hemorrhage occurs. Death usually occurs after several days ingestion.

Aquatic toxicity: Chlorophacinone is very toxic to fish and other aquatic invertebrates and the use of ground liquid sprays poses a hazard to listed species if applied within or adjacent to their habitat where runoff or drift can occur. Available data indicate chlorophacinone LC_{50} values of 0.252, 0.692, and 0.426 for rainbow trout, bluegill sunfish, and *Daphnia magna*, respectively. However, this applies only to Arizona, Connecticut and Delaware for ground sprays since Chlorophacinone will have no effect on listed aquatic species when used as a bait.

Terrestrial toxicity: Toxicity varies widely among the indandiones and among species, with some birds and mammals being highly sensitive and others fairly resistant. Massive single exposure or repeated low dosages may cause poisoning (Buck et al. 1982). Total dosage to death will be much lower in anticoagulants with repeated exposures over an extended period than in acute exposures, and the majority of mortalities will occur during or after the second week of exposure (Mendenhall and Pank 1980). Single dose toxicity may be 5-100 times the multiple dose toxicity, depending on species (Jones 1977). The amount of data describing toxicity of indandiones to terrestrial taxa varies, with pival being the least tested compound and diphacinone perhaps the most tested, and most toxic, compound. Laboratory data for chlorophacinone provide avian LD_{50} values of >100, >100, 430, and 495 mg/kg for mallard, ring-necked pheasant, red-winged blackbird, and northern bobwhite, respectively. Studies described below suggest that raptors are more sensitive to chlorophacinone than those species mentioned above.

Radvanyi et al. (1988) demonstrated that American kestrels treated with chlorophacinone for 21 days showed physical and behavioral changes, including massive internal hemorrhaging. Wing drooping was the first observed sign. Adult and juvenile kestrels subjected to 53.0 mg chlorophacinone/day died after a mean of 16.5 and 10.3 days, respectively. In the 18 mg/day juvenile group, three of the four birds died after a mean of 11 days of treatment. The surviving bird in this low dose group manifested signs consistent with anticoagulant poisoning, but recovered within ten days of removal from the treatment. In the wild, however, a ten day recovery period is likely to result in eventual mortality.

Mendenhall and Pank (1980) describe a study whereby barn owls were fed one of several anticoagulants including the indandiones diphacinone and chlorophacinone. Barn owls exposed to these compounds via treated rats did not die. These findings suggest that barn owls may be less sensitive to indandiones than are other raptors. However, sample sizes were small and interspecific differences in toxicity remain poorly quantified. Mendenhall and Pank (1980) noted that more severe effects may be expected under field conditions because of potential stress, changes in diet, increased activity, or high susceptibility to injuries. These studies suggest that, under some circumstances, indandiones may present a hazard to raptors that consume poisoned rodents.

Available data indicate chlorophacinone LD_{50} values of 0.49 and 7.5 mg/kg for deer mouse and vampire bat, respectively. While diphacinone generally appears to be more toxic to dogs than chlorophacinone, there are insufficient data to generalize about the relative toxicity of different indandiones to raptors.

Wildlife incidents: Documented deaths - 4 San Joaquin kit foxes

BIOLOGICAL OPINION

CHEMICAL REFERENCE TABLE

(The following table contains only those species for which the Service provided a jeopardy or no jeopardy call. Species not included in this list are either not affected by the chemical or have no chance for exposure. For a complete list of all species considered in this opinion, refer to the master species list on page III-1 of the species profile section.)

Species Name	J/NJ	PAGE
MAMMALS		
Alabama beach mouse	J	31
Amargosa vole	J	32
Anastasia Island beach mouse	J	32
Carolina northern flying squirrel	J	32
Choctawhatchee beach mouse	J	31
Florida panther	J	33
Florida salt marsh vole	J	33
Fresno kangaroo rat	J	34
Giant kangaroo rat	J	34
Gray wolf	NJ	38
Grizzly bear	NJ	38
Hualapai Mexican vole	J	34
Jaguarundi	J	35
Louisiana black bear	NJ	38
Morro Bay kangaroo rat	J	35
Ocelot	J	35
Perdido Key beach mouse	J	31
Point Arena mountain beaver	J	36
Salt marsh harvest mouse	J	36
San Joaquin kit fox	J	36
Southeastern beach mouse	J	32
Stephen's kangaroo rat	J	37
Tipton kangaroo rat	J	34
Utah prairie dog	NJ	39
BIRDS		
Audubon's crested caracara	J	37
REPTILES		
Eastern indigo snake	NJ	39
Puerto Rican boa	NJ	39
Virgin Islands tree boa	NJ	40

RATIONALE FOR JEOPARDY DETERMINATIONS

Alabama beach mouse, Choctawhatchee beach mouse, and Perdido Key beach mouse - Exposure of these beach mice to the chlorophacinone could occur through direct contact with the chemical when used within or in close proximity to their occupied habitats. All three subspecies are restricted to mature coastal barrier dune systems along the Gulf of Mexico and occur in areas that are being encroached upon by various types human development. Therefore, there is a high possibility of chlorophacinone being used where these mice could come in contact with it. The Choctawhatchee beach mouse is presently known to occur only on Shell Island at St. Andrews Bay in Bay County, Florida, and on approximately 5 miles of beach dune habitat (coastline up to 500 feet inland) near Topsail Hill, from around Morrison Lake eastward to Stalworth Lake, Walton County, Florida. The Alabama beach mouse presently is surviving only on disjunct tracts of the sand dune system from Fort Morgan State Park to the Romar Beach area in Baldwin County, Alabama. The

Perdido Key beach mouse occurs only on Perdido Key in Baldwin County, Alabama and Escambia County, Florida. The distance to which occupied habitat of these mice extends inland from the beach varies depending upon the configuration of the sand dune system and the vegetation present. All three subspecies utilize portions of the frontal or primary dunes; interdunal areas; and dunes further inland (secondary or interior dunes). Because of the restricted distributions of these species and the likelihood of chlorophacinone being used for rodent control within or adjacent to areas which they inhabit, it is the Service's biological opinion that the registered use of chlorophacinone is likely to jeopardize the continued existence of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Reasonable and Prudent Alternative(s) - If implemented the following reasonable and prudent alternatives would avoid jeopardy to the species: Prohibit use of chlorophacinone within 100 yards of occupied habitat of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Amargosa vole - The primary exposure of chlorophacinone from registered uses can occur when the Amargosa vole consumes bait from bait boxes used for muskrat control. it is the Service's biological opinion that use of chlorophacinone is likely to jeopardize the continued existence of the Amargosa vole.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Amargosa vole: prohibit the use of chlorophacinone within 100 yards of the occupied habitat of the Amargosa vole.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

Anastasia Island beach mouse and Southeastern beach mouse - These two beach mice are endemic to the east coast of Florida. The Anastasia Island beach mouse is presently believed to occur only on Anastasia Island, St. Johns County, Florida. The southeastern beach mouse is believed to presently occur only from Florida's Mosquito (Pounce) Inlet in Volusia County south to Hutchinson Island in St. Lucie County, Florida. Both subspecies inhabit sand dunes vegetated by sea oats and dune panic grass and the scrub adjoining these dunes, which is vegetated with oaks, sand pine, palmetto, sea grapes, and/or wax myrtle. It is likely that chlorophacinone could be used for pest control in areas where both these beach mice occur, since the ranges of both species have been and continue to be encroached upon by human development. Exposure of the mice to chlorophacinone would occur through ingestion of poison baits, which would result in direct mortality of individuals of the species. Accordingly, it is the Service's biological opinion that the registered use of chlorophacinone is likely to jeopardize the continued existence of the Anastasia Island beach mouse or the southeastern beach mouse.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: Prohibit use of chlorophacinone within 100 yards of occupied habitat of the Anastasia Island beach mouse and the southeastern beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Carolina northern flying squirrel - This species may be directly exposed to chlorophacinone poisoning from its registered use to control rats and mice around agricultural buildings. The Carolina northern flying squirrel occurs in coniferous and northern hardwood forests, and may occasionally forage on the ground. Where land use changes and development encroach on the species' habitat there is a potential risk of the

squirrel coming in contact with chlorophacinone bait that is placed outside of buildings (e.g., storage sheds and barns). Chlorophacinone is toxic to rodents and would most likely kill a northern flying squirrel if it consumed the bait. Due to the restricted range and small population of the Carolina northern flying squirrel, any poisoning of individuals could threaten the survival of the species. Therefore, it is the Service's opinion that the use of chlorophacinone is likely to jeopardize the continued existence of the Carolina northern flying squirrel.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Carolina northern flying squirrel: prohibit the outdoor use of the chemical within the species' occupied habitat.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Florida panther - The Florida panther may be exposed to chlorophacinone by feeding on rodents that are dead or incapacitated from this rodenticide poison. Panthers on occasion venture into agricultural areas where rodenticides are likely used and poisoned target animals would be found. In mammals, following oral administration of chlorophacinone which is an anticoagulant, 90 percent of the rodenticide is eliminated in the feces within 48 hours in the form of metabolites. Although EPA provided no hazard ratios for mammals of any size, they concluded that secondary poisoning mortality of larger mammals may not occur because large quantities of contaminated prey items would have to be consumed to produce a significant adverse effect. However, rodenticide induced internal hemorrhaging could weaken a panther to the degree that the animal would be very susceptible to disease and fatal infections. Because of the critically small panther population, the loss of even one panther could threaten the survival of the species. Therefore, it is the opinion of the Service that the use of chlorophacinone is likely to jeopardize the continued existence of the Florida panther.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Florida panther: prohibit the use of the chemical within 20 miles of the boundary of any Federal and State lands (e.g., National Wildlife Refuge, National Park, National Preserve, State Park, State Preserve, State Wildlife Management Areas, etc.) and Indian Reservations that provide suitable panther habitat south of Charlotte, Glades and Martin counties, Florida.

Incidental Take - Although the chance of exposure is considered minimal, because individuals of the species may disperse beyond a given home range, the use and toxicity of the pesticide is still a concern. Consequently the Service anticipates that an unquantifiable level of incidental take may occur as a result of sub-lethal or lethal effects following the use of the pesticide outside of the prohibited use zone.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measure for minimizing incidental take must be adopted and implemented: within and including the area extending 5 miles from the edge of the prohibited use zone, the user should remove and properly dispose of any dead or incapacitated animal likely to have been poisoned during the period of rodenticide use.

Florida salt marsh vole - Exposure of the salt marsh vole to chlorophacinone could occur through consumption of poisoned baits used to control rodents in close proximity to the vole's occupied marsh habitat. There is a possibility of the rodenticide being used around buildings or other structures adjacent to salt marsh habitat where the vole could come in contact with it. The vole is restricted to a single known area in the salt marsh of Waccasassa Bay, Levy County, Florida. This rodenticide is highly toxic to mammals. Because of the restricted distribution of the species, its limited population, and the likelihood of this rodenticide being used for rodent control adjacent to areas in which the vole occurs, it is the Service's

biological opinion that the use of chlorophacinone is likely to jeopardize the continued existence of the Florida salt marsh vole.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit use of chlorophacinone within 100 yards of the landward edge of the species' salt marsh habitat in Levy County, Florida.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Fresno kangaroo rat, giant kangaroo rat, Tipton kangaroo rat - These species are highly susceptible to chlorophacinone exposure because of the wide variety of registered uses of this compound, and the high likelihood of such uses in and around kangaroo rat habitats in the San Joaquin Valley, California. The primary exposure risk for kangaroo rats would occur during chlorophacinone use to control field rodents, such as ground squirrels, pocket gophers, and deer mice. Kangaroo rats could encounter chlorophacinone during use within their habitats (e.g., grasslands, saltbush scrub, fallow agricultural lands); in agricultural lands adjacent to their habitats; in bait boxes or as spillage from baitboxes; and when broadcast on the ground or inadvertently applied to their burrows. Furthermore, some chlorophacinone formulations would be highly attractive to kangaroo rats if encountered, especially grain baits. Exposure also could occur during chlorophacinone use to control domestic rodents around agricultural buildings and industrial structures (e.g., in the Kern County oil fields), though these risks are considered less likely than field exposure. Because of these numerous exposure factors, the high toxicity of this compound to rodents, and the fact that these species occupy significantly restricted and fragmented habitats, it is the biological opinion of the Service that chlorophacinone use within the ranges of the Fresno kangaroo rat, giant kangaroo rat, and Tipton kangaroo rat is likely to jeopardize the continued existence of these species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Fresno, giant, and Tipton kangaroo rat: Prohibit outdoor chlorophacinone use within 100 yards of the occupied habitat of these species unless specific kangaroo rat protection programs for chlorophacinone use are implemented. Such programs shall integrate San Joaquin kit fox protection measures and shall be approved by the Service in writing.

Incidental Take - If the reasonable and prudent alternatives described above are implemented, no incidental take of these species is anticipated and therefore none is authorized.

Hualapai Mexican vole - The primary exposure of chlorophacinone to the Hualapai Mexican vole would be through its application to control ground squirrels in non-crop rights-of-way or recreational areas. Voles are one of a number of target organisms of chlorophacinone and also highly toxic to small mammals. The likelihood that chlorophacinone would be used in the habitat of the vole is small but if it were used because of the very small number of known voles the consequences would be severe. Therefore, it is the Service's biological opinion that the use of chlorophacinone is likely to jeopardize the continued existence of the Hualapai Mexican vole.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Hualapai Mexican vole: prohibit the use of chlorophacinone within 100 yards of known Hualapai Mexican vole occupied habitat.

Incidental Take - With the implementation of the reasonable and prudent alternatives to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Jaguarundi and Ocelot - The primary exposure of chlorophacinone to the jaguarundi and ocelot is through its use to control field rodents in orchards, cropland, pasture, rangeland and ditch banks and rights-of-way. There is little probability of the ocelot or jaguarundi directly consuming the chlorophacinone baits, however

it is probable that secondary poisoning may occur as a result of these species consuming target rodents that have ingested chlorophacinone. This chemical is used in areas that are adjacent to or interspersed with known ocelot and jaguarundi habitat. Therefore, it is the Service's opinion that the use of chlorophacinone is likely to jeopardize the continued existence of these species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative will avoid jeopardy to the ocelot and jaguarundi: prohibit use within three miles of occupied habitat.

Incidental Take - Despite the implementation of the reasonable and prudent alternatives described above, the Service anticipates that an unquantifiable level of incidental take of ocelot and jaguarundi may occur as a result of chlorophacinone use within the range of these species.

Reasonable and Prudent Measure(s) - If implemented, the following reasonable and prudent measures will minimize incidental take: prior to use of chlorophacinone in potential ocelot ~~or~~ jaguarundi habitat, conduct survey to determine if habitat is occupied. If habitat is unoccupied, no further restrictions are applicable. If habitat is occupied, prohibit use within three miles.

Morro Bay kangaroo rat - The primary exposure of chlorophacinone from registered uses can occur when the Morro Bay kangaroo rat ingests treated bait. The extremely limited range of this species, the presence of target rodents, and the interspersion of this species habitat with urban, agricultural, and commercial buildings place the Morro Bay kangaroo rat at risk. It is the biological opinion of the Service that use of chlorophacinone is likely to jeopardize the continued existence of the Morro Bay kangaroo rat.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Morro Bay kangaroo rat: prohibit the use of chlorophacinone within 100 yards of the occupied habitat of the Morro Bay kangaroo rat.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

Point Arena mountain beaver, salt marsh harvest mouse - The primary risk of exposure of these species to chlorophacinone would occur during registered uses of this compound to control rodent pests within or adjacent to occupied habitats. Mountain beaver exposure to this compound might occur during control of most target species for which chlorophacinone is registered--both domestic and non-domestic--since this species occupies a variety of habitats within their coastal range in Mendocino County, California, including natural lands, disturbed sites, and some areas adjacent to residences. The harvest mouse is limited to remaining salt marshes in the San Francisco Bay area, where adjacent man-made structures may exist; therefore, exposure of this species to chlorophacinone primarily would occur during control of domestic rodents. Because of these exposure factors, and the fact that the Point Arena mountain beaver and salt marsh harvest mouse occupy highly restricted and fragmented habitats, it is the biological opinion of the Service that chlorophacinone use is likely to jeopardize the continued existence of these species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the salt marsh harvest mouse and Point Arena mountain beaver: prohibit outdoor chlorophacinone use within 100 yards of the occupied habitats of these species, unless specific salt marsh harvest mouse and Point Arena mountain beaver protection programs for chlorophacinone use, approved by the Service in writing, are implemented.

Incidental Take - If the reasonable and prudent alternatives described above are implemented, no incidental take of these species is anticipated and therefore none is authorized.

San Joaquin kit fox - The San Joaquin kit fox likely would be subject to chlorophacinone exposure during numerous registered uses of this compound to control a variety of rodent pests within and adjacent to occupied habitats in the San Joaquin Valley, California. The primary exposure risk for kit foxes would occur during control of field rodents, especially California ground squirrels; though control of domestic rodents around industrial, residential, and agricultural sites also poses an exposure risk. The most likely source of exposure is expected to be secondary poisoning should kit foxes feed on rodents killed or incapacitated by chlorophacinone poisoning. However, kit foxes also may consume chlorophacinone baits directly, and intensive rodent control programs utilizing chlorophacinone (as well as other compounds) also may adversely affect kit foxes through depletion of prey species. Adverse effects of chlorophacinone use on the San Joaquin kit fox could be highly deleterious to this species for the following reasons: (1) chlorophacinone is extremely toxic to mammals; (2) it is used in numerous areas occupied or frequented by kit foxes, including rangelands, agricultural areas, and the banks of aqueducts, canals, and levees; (3) the opportunistic feeding habits of kit foxes increase the likelihood of both primary and secondary poisoning; (4) serious localized effects of chlorophacinone use could occur in areas where the kit fox range is geographically restricted; (5) current chlorophacinone use restrictions are difficult to implement and enforce; and (6) several incidents of kit fox deaths from chlorophacinone use have been documented. For these reasons, it is the Service's biological opinion that chlorophacinone use within the range of the San Joaquin kit fox is likely to jeopardize the continued existence of this species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the San Joaquin kit fox: Prohibit chlorophacinone use within the kit fox range as determined by the Service. Exceptions to this prohibition are as follows: (1) Agricultural areas that are one mile or more from any kit fox habitat, such areas to be determined and mapped by the California Environmental Protection Agency in consultation with the Service, or to be determined by the Service; OR (2) Areas for which kit fox surveys have been conducted within a one mile radius of proposed treatment sites and have yielded negative results, provided such surveys are conducted by qualified individuals utilizing methods acceptable to the Service, and that such results are submitted to the Service for review and approval.

Incidental Take - Despite the reasonable and prudent alternatives described above, the Service anticipates that an unquantifiable level of incidental take of the San Joaquin kit fox may occur as a result of chlorophacinone use within the range of this species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Stephen's kangaroo rat - The primary exposure of the Stephen's kangaroo rat to chlorophacinone is the ingestion of the many bait formulations. It is the biological opinion of the Service that use of chlorophacinone is likely to jeopardize the continued existence of the Stephen's kangaroo rat.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Stephen's kangaroo rat: prohibit the use of chlorophacinone within 100 yards of the occupied habitat of this species.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

Audubon's crested caracara - Audubon's crested caracara would be exposed to chlorophacinone by secondary poisoning from consuming contaminated rodents. Caracaras feed both on carrion and live prey. Studies document secondary poisoning of raptors that were fed chlorophacinone contaminated rodents. Chlorophacinone is registered for control of deer mice in non-crop areas of Florida. Caracaras occur in open prairies and frequently use improved pastures. Since it takes several days for death to occur from

Chlorophacinone ingestion, it is conceivable that poisoned rodents may travel away from the baited area to die. Because of the caracara's small population size, any rodenticide induced mortality could threaten the survival of the species. Therefore, it is the Service's opinion that the use of chlorophacinone is likely to jeopardize the continued existence of the Audubon's crested caracara.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Audubon's crested caracara: prohibit the use of the pesticide within the occupied habitat of the species.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

RATIONALE FOR NO JEOPARDY DETERMINATIONS

Gray wolf - Chlorophacinone is an anticoagulant rodenticide. In mammals, following oral administration, 90 percent is eliminated in the feces within 48 hours in the form of metabolites. Less than 5000 pounds of active ingredient are formulated annually with more than 70 percent (3500 pounds) used for industrial/commercial structural pest control. Exposure to the wolf could occur by the wolf feeding on dead pocket gophers and in Idaho feeding on dead mice and voles in orchards. Most of the pocket gophers and well as many of the mice and voles would die in their burrows or runways so many of them would likely not be detected by the gray wolf. No hazard ratios were given for mammals but EPA calculated the hazard ratio of less than one for a 10 gram bird. EPA concluded that adverse effects on larger mammals may be precluded because of their need to consume larger quantities of poisoned target animals. According to the information provided by EPA, the largest mammals known to have died from chlorophacinone have been mongoose and the San Joaquin kit fox which is much smaller then a wolf. Therefore, because of the restricted use of chlorophacinone and because it is highly unlikely that the wolf would be able to consume enough of the target species to cause a mortality, it is the Service's opinion that the use of chlorophacinone is not likely to jeopardize the continued existence of the gray wolf.

Incidental Take - Because it is unlikely that mortality will occur to the gray wolf, no incidental take of the gray wolf is anticipated and thus no take is authorized.

Grizzly bear - In mammals, following oral administration of chlorophacinone which is an anticoagulant, 90 percent of the pesticide is eliminated in the feces within 48 hours in the form of metabolites. Only about 1500 pounds of active ingredient is formulated annually for non-industrial/commercial structural pest control (e.g., control of pocket gophers). As with the wolf, exposure to grizzly bears may occur by a grizzly bear feeding on dead pocket gophers and, in Idaho, feeding on dead mice and voles in orchards. Many of these target species likely would die in burrows or runways thus reducing the number that the grizzly bear may dig up and consume. EPA provided no hazard ratios for mammals of any size but they concluded that adverse effects on larger mammals may not occur because of their need to consume larger quantities of poisoned target animals. Therefore, because of the limited use of chlorophacinone expected and because it is highly unlikely that the grizzly bear would consume enough of the target species to cause mortality, it is the Service's opinion that the use of chlorophacinone is not likely to jeopardize the continued existence of the grizzly bear.

Incidental Take - Because it is unlikely that mortality will occur to the grizzly bear, no incidental take of the grizzly bear is anticipated and thus no take is authorized.

Louisiana black bear - The Louisiana black bear would likely only be exposed to chlorophacinone by consuming a mouse, rat or other animal that had been poisoned by the rodenticide. Black bears occasional venture into agricultural areas where the rodenticide may be used. Although chlorophacinone is extremely toxic to mammals, based on EPA data it is very unlikely that a mammal as large a bear would consume

enough poisoned rodents to cause lethal secondary poisoning. Therefore, it is the Service's opinion that the use of chlorophacinone is not likely to jeopardize the continued existence of the Louisiana black bear.

Incidental Take - Although the chance of exposure and hazard are considered minimal, because of the high toxicity of chlorophacinone to mammals, it is still a matter of concern. Thus, the Service anticipates that an unquantifiable level of incidental take may occur as a result of this chemical's use in areas of or adjacent to bear habitat.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measure for minimizing incidental take should be adopted: prohibit the use of chlorophacinone in occupied habitat of the black bear.

Utah prairie dog - The EPA has determined that the use of chlorophacinone may affect this species because they may consume bait set out to kill other species (e.g., pocket gophers). The only registered use that could possibly overlap with Utah prairie dog habitat is control of pocket gophers. The registration requires that tamper-proof bait boxes be placed in underground runways inaccessible to wildlife. It is highly unlikely that the Utah prairie dog would be digging into these pocket gopher runways and thus obtaining the bait. It is, therefore, the Service's opinion that the use of chlorophacinone is not likely to jeopardize the continued existence of the Utah prairie dog.

Incidental Take - Because of the very low risk of exposure, no incidental take of the Utah prairie dog is anticipated and thus no take is authorized.

Eastern indigo snake - The eastern indigo snake would only be exposed to chlorophacinone by eating an animal such as a mouse or rat that had been poisoned by the rodenticide. Indigo snakes hunting for prey may occur in agricultural or non-crop areas where rodenticides are likely to be used. In Florida the rodenticide is used in non-crop areas for field mice and cotton rats. Although EPA has no toxicity data for reptiles, one study indicated that gopher snakes did not die from eating poisoned rodents but did regurgitate the poisoned prey. Other snakes however, may not regurgitate poisoned prey. The indigo snake's potential for exposure to poisoned prey is considered minimal. Therefore, it is the Service's opinion that the use of chlorophacinone is not likely to jeopardize the continued existence of the eastern indigo snake.

Incidental Take - Although the chance of exposure is considered minimal, because of the toxicity of chlorophacinone, it is still a matter of concern. Thus, the Service anticipates that an unquantifiable level of incidental take may occur as a result of this chemical's use in areas where the eastern indigo snake may occur.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measure for minimizing incidental take should be adopted: conduct laboratory studies using surrogate snake species, such as the black racer *(Coluber c. priapus)*, to obtain toxicity data on the chemical's secondary poisoning hazard to snakes. Based on the data generated by the studies, the Service will develop and revise the reasonable and prudent measures. (Because of the status and relatively broad geographic range of this species of indigo snake, the Service believes at this time that prohibiting the use of chlorophacinone within the species occupied habitat would not be reasonable and prudent).

Puerto Rican boa - The boa would only be exposed to chlorophacinone by eating an animal such as a mouse or rat that had been poisoned by the rodenticide. Boas hunting for prey may occur in agricultural or non-crop areas where rodenticides could be used. Although EPA has no toxicity data for reptiles, one study indicated that gopher snakes did not die from eating poisoned rodents but did regurgitate the poisoned prey. Other snakes however, may not regurgitate poisoned prey. The boa's potential for exposure to poisoned prey is considered minimal because the snake usually hunts for prey in trees. Therefore, it is the Service's opinion that the use of chlorophacinone is not likely to jeopardize the continued existence of the Puerto Rican boa.

Incidental Take - Although the chance of exposure is considered minimal, because of the toxicity of chlorophacinone, it is still a matter of concern. Thus, the Service anticipates that an unquantifiable level of incidental take may occur as a result of this chemical's use in areas where the Puerto Rican boa may occur.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measure for minimizing incidental take should be adopted: prohibit the use of the chemical within the known occupied habitat of the species.

Virgin Island tree boa - The boa would only be exposed to chlorophacinone by eating an animal such as a mouse or rat that had been poisoned by the rodenticide. Boas hunting for prey may occur in agricultural or non-crop areas where rodenticides could be used. Although EPA has no toxicity data for reptiles, one study indicated that gopher snakes did not die from eating poisoned rodents but did regurgitate the poisoned prey. Other snakes however, may not regurgitate poisoned prey. The boa's potential for exposure to poisoned prey is considered very minimal because the snake usually hunts for prey in trees. Therefore, it is the Service's opinion that the use of chlorophacinone is not likely to jeopardize the continued existence of the Virgin Islands tree boa.

Incidental Take - Although the chance of exposure is considered minimal, because of the toxicity of chlorophacinone, it is still a matter of concern. Thus, the Service anticipates that an unquantifiable level of incidental take may occur as a result of this chemical's use in areas where the boa may occur.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measure for minimizing incidental take should be adopted: prohibit the use of the chemical within the known occupied habitat of the species.

Diphacinone

CHEMICAL INFORMATION

TYPE: Rodenticide (indandione)

FORMULATION: Used mainly in the form of a flavored and weather resistant bait; also in the form of a tracking powder (Ditrac), but this formulation is limited to indoor use only.

REGISTERED USES: Commensal and field rodent control in and around buildings, in orchards, cropland, pasture, rangeland, ornamentals, forest, rights-of-way, along ditches and banks of waterways, in garbage dumps and sewers. Existing label restrictions for diphacinone include Endangered Species Considerations for pocket gophers and black-footed ferrets within prairie dog towns and use restrictions within one mile of active dens of the San Joaquin kit fox in certain counties of California. In addition, this chemical has certain other state registration restrictions as follows when formulated as a 0.2% tracking powder for nuisance bats in Georgia, Connecticut and Colorado. As a 0.2% powder, diphacinone can only be used in domiciles and other buildings and carries a specific warning against use in caves or natural areas. Diphacinone is also registered for control of mice and voles in orchards as a bait and in Delaware, Connecticut and in Arizona as a concentrate spray to bare ground. Furthermore, this chemical when formulated as a bait can be used to control chipmunks, jackrabbits and muskrats. For muskrats, the bait must be placed on a floating bait box designed and approved by the California Department of Food and Agriculture.

BACKGROUND:

Mode of action: An anticoagulant, diphacinone is in a class of rodenticides known as indandiones. Unlike the coumarin compounds, indandiones may cause symptoms and signs of neurologic and cardiopulmonary injury leading to death before hemorrhage occurs.

Aquatic toxicity: Diphacinone is very toxic to fish and other aquatic invertebrates and the use of ground liquid sprays poses a hazard to listed species if applied within or adjacent to their habitat where runoff or drift can occur. EPA (1991) data indicate LC_{50}s for technical grade chlorophacinone of 2.09, 2.82, 7.61, and >10 ppm for channel catfish, rainbow trout, bluegill sunfish, and pink shrimp, respectively. However, this applies only to Arizona, Connecticut and Delaware for ground sprays since Diphacinone will have no effect on listed aquatic species when used as a bait.

Terrestrial toxicity: Toxicity varies widely among the indandiones and among species, with some birds and mammals being highly sensitive and others fairly resistant. Massive single exposure or repeated low dosages may cause poisoning (Buck et al. 1982). Total dosage to death will be much lower in anticoagulants with repeated exposures over an extended period than in acute exposures, and the majority of mortalities will occur during or after the second week of exposure (Mendenhall and Pank 1980, Bennett et al.). Single dose toxicity may be 5-100 times the multiple dose toxicity, depending on species (Jones 1977). The amount of data describing toxicity of indandiones to terrestrial taxa varies, with pival being the least tested compound and diphacinone perhaps the most tested, and most toxic, compound.

EPA has determined diphacinone will have no effect on avian species due to direct ingestion of bait. However, data published by Mendenhall and Pank (1980) indicate that diphacinone may present hazards to raptors that consume poisoned rodents. They described trials whereby 3 great-horned owls and 1 saw-whet owl were fed mice (*Peromyscus maniculatus*) that had consumed a lethal diphacinone dose during a 10-day, free-choice test using an oat-groat 0.01% bait. All 4 owls showed signs consistent with anticoagulant poisoning, and 3 died from massive hemorrhaging during days 7-14.

In a second feeding study, barn owls were fed one of several anticoagulants including the indandiones diphacinone and chlorophacinone (Mendenhall and Pank 1980). Barn owls exposed to these compounds via treated rats did not die and received a higher maximum potential dose of diphacinone overall than did the other species. These findings suggest that barn owls may be less sensitive to indandiones than other raptors. However, sample sizes were small and interspecific differences in toxicity remain poorly quantified. Mendenhall and Pank (1980) noted that more severe effects may be expected under field conditions because of potential stress, changes in diet, increased activity, or high susceptibility to injuries.

For listed mammals, diphacinone poses a risk due to its use in a wide variety of locations. Large mammals [deer, antelope, bison] will not be affected if ingestion of baits occurs due to their large size. Further, listed bats will not be effected since the tracking powder is applied only inside of buildings. Because diphacinone has a 90 day half-life in soil, risks to secondary toxicity exists for predatory and scavenging mammals which feed on poisoned target animals. Also secondary poisoning may effect listed snakes where their habitat overlaps that of target species. The following table summarizes available acute oral toxicity data of diphacinone to mammals.

Species	LD_{50} (mg/kg)	Source
rat	1.5	NIOSH (1990)
rat	1.86-2.88	Sine (1992)
dog	3	NIOSH (1990)
cat	15	NIOSH (1990)
rabbit	35	NIOSH (1990)
pig	150	NIOSH (1990)
mouse	340	NIOSH (1990)
deer mouse	0.49	EPA (1991)

Diphacinone acute oral toxicity tests with captive and free-ranging coyotes yielded an LD_{50} of 0.6 mg/kg (CI = 0.3-1.2; Savarie 1979). These data indicate that coyotes are more sensitive to diphacinone than most other taxa tested.

Using EPA's approach of a safety factor of 1/10 of the LD_{50} as a "risk threshold", and assuming an oral LD_{50} of 15 mg/kg for cats, the risk threshold for diphacinone is 13.5 mg for a 9 kg ocelot, 10.5 mg for a 7 kg jaguarundi, and 21 mg for a 14 kg Florida panther.

Free choice exposure for five days in rats to be fed to owls (Mendenhall and Pank, 1980) resulted in maximum diphacinone consumption by rats of 11.69 mg. EPA did not provide field residue concentrations. However, it is clear that the risk thresholds could easily be approached with consumption of 1 or 2 poisoned prey.

Based on available toxicity data, the calculated risk thresholds will be even lower for canids than for felids. Assuming an oral LD_{50} of 3 mg/kg for dogs is applicable to a 25 kg gray wolf, the risk threshold is 7.5 mg. If one uses the lower confidence interval for a coyote (0.3 mg/kg), then 0.75 mg is the threshold for a gray wolf. Stresses associated with life in the wild may increase susceptibility of wild species to toxicants over that of laboratory species. Therefore, the lower confidence interval for the coyote data may be a more realistic estimate of toxicity to wild canids than the LD_{50} value. Consistent with use pattern and nature of chemical, diphacinone will have no direct or indirect impact on listed plants and/or plant pollinators considered in this consultation.

Wildlife incidents: Known deaths implicated by diphacinone: rabbits, raccoon, mountain lion and San Joaquin kit fox.

BIOLOGICAL OPINION

CHEMICAL REFERENCE TABLE

(The following table contains only those species for which the Service provided a jeopardy or no jeopardy call. Species not included in this list are either not affected by the chemical or have no chance for exposure. For a complete list of all species considered in this opinion, refer to the master species list on page III-1 of the species profile section.)

Species Name	J/NJ	PAGE
MAMMALS		
Alabama beach mouse	J	44
Amargosa vole	J	44
Anastasia Island beach mouse	J	45
Black-footed ferret	J	45
Carolina northern flying squirrel	J	46
Choctawhatchee beach mouse	J	44
Delmarva fox squirrel	NJ	55
Florida panther	J	47
Florida salt marsh vole	J	47
Fresno kangaroo rat	J	48
Giant kangaroo rat	J	48
Gray wolf	J	48
Grizzly bear	J	49
Hualapai Mexican vole	J	50
Jaguarundi	J	50
Key Largo cotton mouse	J	50
Key Largo woodrat	J	50
Louisiana black bear	J	51
Lower Keys rabbit	J	51
Morro Bay kangaroo rat	J	52
Ocelot	J	50
Perdido Key beach mouse	J	44
Point Arena mountain beaver	J	52
Salt marsh harvest mouse	J	52
San Joaquin kit fox	J	53
Silver rice rat	J	53
Southeastern beach mouse	J	45
Stephen's kangaroo rat	J	54
Tipton kangaroo rat	J	48
Utah prairie dog	J	54
BIRDS		
Audubon's crested caracara	J	54
REPTILES		
Eastern indigo snake	NJ	55
Puerto Rican boa	NJ	56
Virgin Islands tree boa	NJ	56

RATIONALE FOR JEOPARDY DETERMINATIONS

Alabama beach mouse, Choctawhatchee beach mouse, and Perdido Key beach mouse - Exposure of these beach mice to diphacinone could occur through consumption of poisoned baits when used within or in close proximity to their occupied habitats. All three subspecies are restricted to mature coastal barrier dune systems along the Gulf of Mexico and occur in areas that are being encroached upon by various types of human development. Therefore, there is a high possibility of diphacinone being used where these mice could come in contact with it. The Choctawhatchee beach mouse is presently known to occur only on Shell Island at St. Andrews Bay in Bay County, Florida, and on approximately 7.9 km of beach dune habitat (coastline up to 150 m inland) near Topsail Hill, from around Morrison Lake eastward to Stalworth Lake, Walton County, Florida. The Alabama beach mouse presently is surviving only on disjunct tracts of the sand dune system from Fort Morgan State Park to the Romar Beach area in Baldwin County, Alabama. The Perdido Key beach mouse occurs only on Perdido Key in Baldwin County, Alabama and Escambia County, Florida. The distance to which occupied habitat of these species extends inland from the beach varies depending upon the configuration of the sand dune system and the vegetation present. Both subspecies utilize portions of the frontal or primary dunes; interdunal areas; and dunes further inland (secondary or interior dunes). Because of the restricted distributions of these species, their limited populations and the likelihood of diphacinone being used for rodent control within or adjacent to areas which they inhabit, it is the Service's biological opinion that the registered use of diphacinone is likely to jeopardize the continued existence of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: Prohibit use of diphacinone within 100 yards of occupied habitat of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Amargosa vole - The primary exposure of diphacinone from registered uses can occur when the Amargosa vole eat bait from bait boxes used for muskrat control. It is the Service's biological opinion that use of diphacinone is likely to jeopardize the continued existence of the Amargosa vole.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Amargosa vole: prohibit the use of diphacinone within 100 yards of the occupied habitat of the Amargosa vole.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

Anastasia Island beach mouse and Southeastern beach mouse - These two beach mice are endemic to the east coast of Florida. The Anastasia Island beach mouse is presently believed to occur only on Anastasia Island, St. Johns County, Florida. The southeastern beach mouse is believed to presently occur only from Florida's Mosquito (Pounce) Inlet in Volusia County south to Hutchinson Island in St. Lucie County, Florida. Both subspecies inhabit sand dunes vegetated by sea oats and dune panic grass and the scrub adjoining these dunes, which is vegetated with oaks, sand pine, palmetto, sea grapes, and/or wax myrtle. It is likely that diphacinone could be used for pest control in areas where both these beach mice occur, since the ranges of both species have been and continue to be encroached upon by various types of human development. Exposure of the mice to diphacinone would occur through ingestion of poison baits, which would result in direct mortality of individuals of the species. Accordingly, it is the Service's biological opinion that the registered use of diphacinone is likely to jeopardize the continued existence of the Anastasia Island beach mouse or the southeastern beach mouse.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: Prohibit use of diphacinone within and in close proximity (100 yards) to the current known range of the Anastasia Island beach mouse and the southeastern beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Black-footed ferret - Diphacinone's registered uses include commensal and field rodent control (rats, mice, voles, gophers, ground squirrels) in and around buildings, orchards, cropland, pasture, rangeland, ornamentals, forest, rights-of-way, along ditches and banks of waterways, in garbage dumps, and sewers. Diphacinone is extremely toxic to mammals both directly and indirectly (secondary effects). The ferret likely would not be impacted directly. Known deaths implicated by this pesticide include rabbits, raccoon, mountain lion, and San Joaquin kit fox. Diphacinone could be used to kill rodents such as ground squirrels occurring near prairie dog towns inhabited by black-footed ferret. Mortality to the ferret would likely result if the ferret fed on the nearby ground squirrels or prairie dogs which also would likely feed on diphacinone bait. Therefore, it is the Service's opinion that the wide use of diphacinone is likely to jeopardize the continued existence of the black-footed ferret.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the black-footed ferret: prohibit the use of diphacinone within 7 kilometers (4.34 miles) from a prairie dog town. The 7 kilometers is based on the longest distance that the ferret has been observed to travel during the night. Diphacinone bait may be used within the 7 kilometers provided:

1. A black-tailed prairie dog colony or complex of less than 80 acres having no neighboring prairie dog towns may be treated within the 7 kilometers without a ferret survey. A midrange of 102 acres (61 to 294) of occupied black-tailed prairie dog habitat is believed necessary to support a single ferret, so it is highly unlikely that a ferret would be found in an isolated colony of less than 80 acres.

2. A white-tailed prairie dog colony or complex of less than 200 acres having no neighboring prairie dog towns may be treated within the 7 kilometers without a ferret survey. It is estimated to require between 196 and 475 acres of white-tailed prairie dogs to support a single ferret.

3. Urban situations (e.g., playgrounds, golf courses, etc.) may be treated without conducting ferret surveys. The appropriate Service office will be contacted by the pesticide user in advance of any treatment to determine whether a proposed action fits this situation.

4. For black-tailed prairie dog colonies or complexes over 80 acres but less than 1,000 acres, and white-tailed prairie dog colonies or complexes over 200 acres but less than 1,000 acres, the use of diphacinone may be allowed within 7 kilometers after completing a black-footed ferret survey within 30 days of proposed use of diphacinone, provided no ferrets or their sign are found. These surveys will be coordinated with the appropriate State Office of the Fish and Wildlife Service.

5. For prairie dog complexes over 1,000 acres, diphacinone shall not be used within 7 kilometers until the complex has been evaluated by appropriate State and/or Federal Agencies (those agencies working on State working groups for ferret recovery) for its potential as a recovery site and until the complex has been block cleared. One thousand acres would be minimum complex size for consideration as a black-footed ferret

reintroduction site and would likely require intensive management of habitat for a ferret population.

Surveys shall be supervised by biologists trained in ferret survey techniques and ferret biology at a Service-approved training workshop. Currently, only the University of Wyoming has such a course. Ferret surveys shall be reviewed by the Service for compliance with survey standards and Section 7 of the Endangered Species Act.

Incidental Take - With the implementation of the reasonable and prudent alternatives to preclude jeopardy of the black-footed ferret, no incidental take is anticipated and thus none is authorized.

Carolina northern flying squirrel - This species may be directly exposed to diphacinone poisoning from its registered use to control commensal and field rodents in and around agricultural buildings, forests and rights-of-way. The Carolina northern flying squirrel occurs in coniferous and northern hardwood forests, and may occasionally forage on the ground. Where land use changes, development, rights-of-way and forestry activities encroach on the species' habitat there is a potential risk of the squirrel coming in contact with diphacinone bait that is placed outside in such areas. Diphacinone bait formulated with apple, meat or peanut flavors would likely be very attractive and palatable to the squirrel. Diphacinone is toxic to rodents and would most likely kill a northern flying squirrel if it consumed the bait. Due to the restricted range and small population of the Carolina northern flying squirrel, any poisoning of individuals could threaten the survival of the species. Therefore, it is the Service's opinion that the use of diphacinone is likely to jeopardize the continued existence of the Carolina northern flying squirrel.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Carolina northern flying squirrel: prohibit the outdoor use of the chemical within the species' occupied habitat.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Florida panther - The Florida panther may be exposed to diphacinone by feeding on rodents or other animals that are dead or incapacitated from this rodenticide poison. Exposure may also occur by ingestion of meat and fish flavored baits. Panthers venture into agricultural and other areas where this rodenticide is likely used and poisoned target animals would be found. This poison has been implicated in the deaths of raccoons, fox, rabbits, and mountain lion. Even if a panther ingested a sub-lethal dose of poison, rodenticide induced internal hemorrhaging could weaken a panther to the degree that the animal would be very susceptible to fatal disease or infections. Because of the critically small panther population, the loss of even one panther could threaten the survival of the species. Therefore, it is the Service's opinion that the use of diphacinone is likely to jeopardize the continued existence of the Florida panther.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Florida panther: prohibit the use of the chemical within 20 miles of the boundary of any Federal and State lands (e.g., National Wildlife Refuge, National Park, National Preserve, State Park, State Preserve, State Wildlife Management Areas, etc.) and Indian Reservations that provide suitable panther habitat south of Charlotte, Glades and Martin counties, Florida.

Incidental Take - Because individuals of the species may disperse beyond a given home range, the use and toxicity of the pesticide is still a concern. Consequently the Service anticipates that an unquantifiable level of incidental take may occur as a result of the use of the pesticide outside of the prohibited use zone.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measure for minimizing incidental take should be adopted and implemented: within an area extending 5 miles from the edge of the prohibited use zone, the user should remove and properly dispose of any dead or incapacitated animal likely to have been poisoned during the period of rodenticide use.

Florida salt marsh vole - Exposure of the vole to diphacinone could occur through consumption of poisoned baits used to control rodents in close proximity to the vole's occupied marsh habitat. There is a possibility of the rodenticide being used around buildings or other structures, banks of waterways, or along ditches, adjacent to salt marsh habitat where the vole could come in contact with it. The vole is restricted to a single known site in the salt marsh of Waccasassa Bay, Levy County, Florida. This rodenticide is highly toxic to mammals, and has been implicated in wildlife kills. Because of the restricted distribution of the species, its limited population, and the likelihood of this rodenticide being used for rodent control adjacent to areas in which the vole occurs, it is the Service's biological opinion that the use of diphacinone is likely to jeopardize the continued existence of the Florida salt marsh vole.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: Prohibit use of diphacinone within 100 yards of the landward edge of the species' salt marsh habitat in Levy County, Florida.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Fresno kangaroo rat, giant kangaroo rat, Tipton kangaroo rat - These species are highly susceptible to diphacinone exposure because of the wide variety of registered uses of this compound, and the high likelihood of such uses in and around kangaroo rat habitats in the San Joaquin Valley, California. The primary exposure risk for kangaroo rats would occur during diphacinone use to control field rodents, such as ground squirrels, pocket gophers, and deer mice. Kangaroo rats could encounter diphacinone during use within their habitats (e.g., grasslands, saltbush scrub, fallow agricultural lands); in agricultural lands adjacent to their habitats; in bait boxes or as spillage from bait boxes; and when broadcast on the ground or inadvertently applied to their burrows. Furthermore, some diphacinone formulations, such as grain pellets, could be highly attractive to kangaroo rats if encountered. Exposure also could occur during diphacinone use to control domestic rodents around agricultural buildings and industrial structures (e.g., in the Kern County oil fields), though these risks are considered less likely than field exposure. Because of these numerous exposure factors, the high toxicity of this compound to rodents, and the fact that these species occupy significantly restricted and fragmented habitats, it is the biological opinion of the Service that diphacinone use within the ranges of the Fresno kangaroo rat, giant kangaroo rat, and Tipton kangaroo rat is likely to jeopardize the continued existence of these species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Fresno, giant, and Tipton kangaroo rat: Prohibit outdoor diphacinone use within 100 yards of the occupied habitats of these species, unless specific kangaroo rat protection programs for diphacinone use are implemented. Such programs shall integrate San Joaquin kit fox protection measures and shall be approved by the Service in writing.

Incidental take - If the reasonable and prudent alternatives described above are implemented, no incidental take of these species is anticipated and therefore none is authorized.

Gray wolf - Diphacinone's registered uses include commensal and field rodent control (rats, mice, voles, gophers, ground squirrels) in and around buildings, orchards, cropland, pasture, rangeland, ornamentals, forest, rights-of-way, along ditches and banks of waterways, in garbage dumps, and sewers. Diphacinone is extremely toxic to mammals both directly and indirectly (secondary effects). Diphacinone acute oral toxicity tests with captive and free-ranging coyotes indicate that coyotes are more sensitive to diphacinone than most other taxa tested. The susceptibility of wild species may be greater than laboratory species because of the

stress of life in the wild. EPA concluded that the size of the larger predators may preclude adverse effects because of their need to consume larger quantities of poisoned target animals. No information was given to backup those conclusions. In EPA's incident reports of fish and wildlife kills, they included rabbits, raccoon, mountain lion, and San Joaquin kit fox as being implicated as diphacinone caused deaths. EPA also suggests that the mortality of the mountain lion and raccoon were the result of illegal uses of the pesticide. Maximum application rates for ground or broadcast applications, e.g., orchards and other outdoor uses is 10 pounds of bait per acre. It would, therefore, appear that the use of diphacinone, especially when used on rangeland and forests, could result in mortality to the gray wolf as it has to other mammals. Thus, it is the Service's opinion that the use of diphacinone is likely to jeopardize the continued existence of the gray wolf.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the gray wolf: prohibit the use of diphacinone in the geographic range of the gray wolf until after the user has contacted the local Fish and Wildlife Service and that office has determined that there are no known wolves in the general vicinity of where diphacinone is going to be applied.

Incidental Take - With the implementation of the reasonable and prudent alternatives to preclude jeopardy to the gray wolf, no incidental take is anticipated and thus none is authorized.

Grizzly bear - As stated for the gray wolf, EPA concluded that adverse impacts to the larger predators would be precluded because of their need to consume larger quantities of poisoned animals. This appears to conflict with the EPA incident reports of mortality to larger animals including raccoon, mountain lion, and the San Joaquin kit fox. However, EPA suggests that the mortality of the mountain lion and raccoon were the result of illegal uses of the pesticide. Data shows that canids are quite sensitive to diphacinone but no information is available on species the size of a grizzly bear, particularly as a result of secondary poisoning. Diphacinone's registered uses include commensal and field rodent control (rats, mice, voles, gophers, ground squirrels) in and around buildings, orchards, cropland, pasture, rangeland, ornamentals, forest, rights-of-way, along ditches and banks of waterways, in garbage dumps, and sewers. Grizzly bears are opportunistic feeders and could be found feeding in a number of the above habitats. Maximum application rates for ground or broadcast applications, e.g., orchard and other outdoor uses is 10 pounds of bait per acre. While some of the target animals could die underground and not be dug up by the grizzly bear, from the little information provided to the Service by EPA, it appears that the grizzly bear could be at substantial risk particularly by ground squirrel control. Therefore, it is the Service's opinion that the use of diphacinone is likely to jeopardize the continued existence of the grizzly bear.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the grizzly bear: prohibit the application of diphacinone in the geographic range of the grizzly bear until after the user has contacted the local Fish and Wildlife Service office and that office has determined that there are no known grizzly bears in the general vicinity of where diphacinone is going to be applied.

Incidental Take - With the implementation of the reasonable and prudent alternatives to preclude jeopardy to the grizzly bear, no incidental take is anticipated and thus none is authorized.

Hualapai Mexican vole - The primary exposure of diphacinone to the Hualapai Mexican vole would be through its application to control ground squirrels in non-crop rights-of-way or recreational areas. Voles are one of a number of target organisms of diphacinone and also is highly toxic to small mammals. The likelihood that diphacinone would be used in the habitat of the vole is small but if it were used because of the very small number of known voles, the consequences would be severe. Therefore, it is the Service's biological opinion that the use of diphacinone is likely to jeopardize the continued existence of the Hualapai Mexican vole.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Hualapai Mexican vole: Prohibit the use of diphacinone within 100 yards of known Hualapai mexican vole occupied habitat.

Incidental Take - With the implementation of the reasonable and prudent alternatives to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Jaguarundi and Ocelot - The primary exposure of diphacinone to the ocelot and jaguarundi is through its use to control field rodents in orchards, cropland, pasture, rangeland and ditch banks and rights-of-way. There is little probability of the ocelot or jaguarundi directly consuming the diphacinone baits, however it is probable that secondary poisoning may occur as a result of these species consuming target rodents that have ingested diphacinone. This chemical is used in areas that are adjacent to or interspersed with known ocelot and jaguarundi habitat. Therefore, it is the Service's opinion that the use of diphacinone is likely to jeopardize the continued existence of these species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative will avoid jeopardy to the ocelot and jaguarundi: Prohibit use within three miles of occupied habitat.

Incidental Take - Despite the implementation of the reasonable and prudent alternatives described above, the Service anticipates that an unquantifiable level of incidental take of ocelot and jaguarundi may occur as a result of diphacinone use within the range of these species.

Reasonable and Prudent Measure(s) - If implemented, the following reasonable and prudent measures will minimize incidental take: Prior to use of diphacinone in potential ocelot or jaguarundi habitat, conduct survey to determine if habitat is occupied. If habitat is unoccupied, no further restrictions are applicable. If habitat is occupied, prohibit use within three miles.

Key Largo cotton mouse and Key Largo woodrat - Both the Key Largo woodrat and Key Largo cotton mouse occur in subtropical, evergreen, hardwood forests on the northern half of Key Largo, Monroe County, Florida, north of the point where U.S. Highway 1 enters Key Largo. Populations of both species may also occur in similar habitat on Lignumvitae Key, Monroe County, where the species were introduced in 1970. The Key Largo woodrat is primarily herbivorous, feeding mostly on buds, leaves, fruits, and seeds, but invertebrates occasionally are included in its diet. The diet of the Key Largo cotton mouse has not been documented, but it is believed to be very similar to that of the woodrat. The use of diphacinone baits within or adjacent to habitat of these two species is likely due the close proximity of various types of human development to the areas where these species occur. Exposure of the woodrat and cotton mouse to diphacinone would result in direct mortality of individuals of the species. The most likely means of exposure of the woodrat and the cotton mouse to diphacinone would be ingestion of the treated baits. Accordingly, it is the Service's biological opinion that the registered use of diphacinone is likely to jeopardize the continued existence of the Key Largo woodrat or Key Largo cotton mouse.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit use of diphacinone within 100 yards of occupied habitat of the Key Largo woodrat and the Key Largo cotton mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Louisiana black bear - The black bear may be exposed to diphacinone by feeding on rodents or other animals that are dead or incapacitated from this rodenticide poison. Exposure may also occur by ingestion of flavored baits. Bears venture into agricultural and other areas (e.g., along waterways, ditches, orchards, garbage dumps, and rights-of-way) where this rodenticide is likely used and where poisoned target animals

and baits would be found. This poison has been implicated in the deaths of raccoons, fox, rabbits, and mountain lion. Even if a bear ingested a sub-lethal dose of poison, rodenticide induced internal hemorrhaging could weaken a bear to the degree that the animal would be very susceptible to fatal disease or infections. Because of the bear's small population and restricted range, mortality resulting from rodenticide poisoning could threaten the survival of the species. Therefore, it is the opinion of the Service that the use of diphacinone is likely to jeopardize the continued existence of the Louisiana black bear.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Louisiana black bear: prohibit the use of the pesticide within the current known occupied habitat of the species.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Lower Keys rabbit - The Lower Keys rabbit could be exposed to diphacinone when the rodenticide is used around buildings, rights-of-way, ditches, along waterways, and garbage dumps that are adjacent to the rabbit's marsh habitat. The rabbit is likely to forage in some treated areas. Continued rapid development in the lower Keys greatly increases the potential that the rabbit would come in contact with rodenticide treated areas. Broadcast applications of flavored baits would pose a serious threat to the species. Diphacinone has been implicated in the poisoning deaths of rabbits, raccoons, fox and mountain lions. This rodenticide would be lethal to Lower Keys rabbits if it were ingested. Because of the extremely restricted range of the species and its small population, any rodenticide induced poisonings could threaten the survival of the species. Therefore, it is the opinion of the Service that the use of diphacinone is likely to jeopardize the continued existence of the Lower Keys rabbit.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Lower Keys rabbit: prohibit the outdoors use of the chemical within 100 yards of the current known occupied habitat of the species.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Morro Bay kangaroo rat - The primary exposure of diphacinone from registered uses can occur when the Morro Bay kangaroo rat ingests treated bait. The extremely limited range of this species, the presence of target rodents, and the interspersion of this species habitat with urban, agricultural, and commercial buildings place the Morro Bay kangaroo rat at risk. It is the biological opinion of the Service that use of diphacinone is likely to jeopardize the continued existence of the Morro Bay kangaroo rat.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Morro Bay kangaroo rat: prohibit the use of diphacinone within 100 yards of the occupied habitat of the Morro Bay kangaroo rat.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

Point Arena mountain beaver, salt marsh harvest mouse - The primary risk of exposure of these species to diphacinone would occur during registered uses of this compound to control rodent pests within or adjacent to occupied habitats. Mountain beaver exposure to this compound might occur during control of most target species for which diphacinone is registered--both domestic and non-domestic--since this species occupies a variety of habitats within their coastal range in Mendocino County, California, including natural lands, disturbed sites, and some areas adjacent to residences. The harvest mouse is limited to remaining salt marshes in the San Francisco Bay area, where adjacent man-made structures may exist; therefore, exposure of this species to diphacinone primarily would occur during control of domestic rodents. Because of these

exposure factors, and the fact that the Point Arena mountain beaver and salt marsh harvest mouse occupy highly restricted and fragmented habitats, it is the biological opinion of the Service that diphacinone use is likely to jeopardize the continued existence of these species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the salt marsh harvest mouse and Point Arena mountain beaver: prohibit outdoor diphacinone use within 100 yards of the occupied habitat of these species, unless specific salt marsh harvest mouse and Point Arena mountain beaver protection programs for diphacinone use, approved by the Service in writing, are implemented.

Incidental Take - If the reasonable and prudent alternatives described above are implemented, no incidental take of these species is anticipated and therefore none is authorized.

San Joaquin kit fox - The San Joaquin kit fox likely would be subject to diphacinone exposure during numerous registered uses of this compound to control a variety of rodent pests within and adjacent to occupied habitats in the San Joaquin Valley, California. The primary exposure risk for kit foxes would occur during control of field rodents, especially California ground squirrels; though control of domestic rodents around industrial, residential, and agricultural sites also poses an exposure risk. The most likely source of exposure is expected to be secondary poisoning should kit foxes feed on rodents killed or incapacitated by diphacinone exposure. However, kit foxes also may consume diphacinone baits directly (especially flavored pellets), and intensive rodent control programs utilizing diphacinone (as well as other compounds) may adversely affect kit foxes through depletion of prey species. Adverse effects of diphacinone use on the San Joaquin kit fox could be highly deleterious to this species for the following reasons: (1) diphacinone is extremely toxic to all mammals tested; (2) it is used in numerous areas occupied or frequented by kit foxes, including rangelands, agricultural areas, and the banks of aqueducts, canals, and levees; (3) the opportunistic feeding habits of kit foxes increase the likelihood of both primary and secondary poisoning; (4) serious localized effects of diphacinone use could occur in areas where the kit fox range is geographically restricted; (5) current diphacinone use restrictions are difficult to implement and enforce; and (6) at least one kit fox death resulting from diphacinone poisoning is known. For these reasons, it is the Service's biological opinion that diphacinone use within the range of the San Joaquin kit fox is likely to jeopardize the continued existence of this species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the San Joaquin kit fox: Prohibit diphacinone use within the kit fox range as determined by the U.S. Fish and Wildlife Service. Exceptions to this prohibition are as follows: (1) Agricultural areas that are one mile or more from any kit fox habitat. Such areas to be determined and mapped by the California Environmental Protection Agency in consultation with the Service, or to be determined by the Service; OR (2) Areas for which kit fox surveys have been conducted within a one mile radius of proposed treatment sites and have yielded negative results, provided such surveys are conducted by qualified individuals utilizing methods acceptable to the Service, and that such results are submitted for Service review and approval.

Incidental Take - Despite the reasonable and prudent alternatives described above, the Service anticipates that an unquantifiable level of incidental take of the San Joaquin kit fox may occur as a result of diphacinone use within the range of this species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Silver rice rat - The silver rice rat could be exposed to diphacinone when the rodenticide is used (for control of black and Norway rats, and house mice) around buildings, rights-of-way, ditches, along waterways, and garbage dumps that are adjacent to the rat's wetland habitat. The rat is likely to forage in some treated

areas. Continued rapid development in the lower Keys greatly increases the potential that the rat would come in contact with rodenticide treated areas. Broadcast applications of flavored baits would pose a serious threat to the species. Diphacinone has been implicated in the poisoning deaths of rabbits, raccoons, fox and mountain lions. This rodenticide would be lethal to silver rice rats if it were ingested. Because of the extremely restricted range of the species and its small population, any rodenticide induced poisonings could threaten the survival of the species. Therefore, it is the opinion of the Service that the use of diphacinone is likely to jeopardize the continued existence of the silver rice rat.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the silver rice rat: prohibit the outdoors use of the chemical within 100 yards of the current known occupied habitat of the species.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Stephen's kangaroo rat - The primary exposure of the Stephen's kangaroo rat to diphacinone is the ingestion of the many bait formulations. It is the biological opinion of the Service that use of diphacinone is likely to jeopardize the continued existence of the Stephen's kangaroo rat.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Stephen's kangaroo rat: prohibit the use of diphacinone within 100 yards of the occupied habitat of this species.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

Utah prairie dog - Diphacinone is registered for use to control commensal and field rodents (rats, mice, voles, gophers, ground squirrels) in and around buildings, orchards, cropland, pasture, rangeland, ornamentals, forest, rights-of-way, along ditches and banks of waterways, in garbage dumps, and sewers. Diphacinone is extremely toxic to mammals and its use to control any of the above species in croplands, pastures, or rangeland in and adjacent to Utah prairie dog colonies would result in the loss of these threatened species. It is, therefore, the Service's opinion that the wide use of diphacinone is likely to jeopardize the continued existence of the Utah prairie dog.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Utah prairie dog: prohibit the application of bait of diphacinone within 100 yards of occupied habitat of the Utah prairie dog.

Incidental Take - With the implementation of the reasonable and prudent alternatives to preclude jeopardy to the Utah prairie dog, no incidental take is anticipated and thus none is authorized.

Audubon's crested caracara - Audubon's crested caracara would be exposed to diphacinone by secondary poisoning from consuming contaminated rodents. Caracaras feed both on carrion and live prey. Studies document secondary poisoning of raptors that were fed diphacinone contaminated rodents. Diphacinone is registered for use in pastures and rangeland. Caracaras occur in open prairies and frequently use improved pastures. Since it takes several days for death to occur from diphacinone ingestion, it is conceivable that poisoned rodents may travel away from the baited area to die. Because of the caracara's small population size, any rodenticide induced mortality could threaten the survival of the species. Therefore, it is the Service's opinion that the use of diphacinone is likely to jeopardize the continued existence of the Audubon's crested caracara.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Audubon's crested caracara: prohibit the use of the pesticide within the occupied habitat of the species.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

RATIONALE FOR NO JEOPARDY DETERMINATIONS

Delmarva Fox Squirrel - Diphacinone is extremely toxic to mammals and the registered uses for outdoor rodent control could result in exposure and incidental consumption by Delmarva fox squirrels, possibly causing death.

Incidental Take - The Service estimates that no more than two squirrels per year may succumb to diphacinone poisoning.

Reasonable and Prudent Measure(s) - To minimize incidental take, the Service recommends that any diphacinone used within the range of the Delmarva fox squirrel should be placed in bait boxes small enough to exclude fox squirrels.

Eastern indigo snake - The eastern indigo snake would only be exposed to diphacinone by eating an animal such as a mouse or rat that had been poisoned by the rodenticide. Indigo snakes hunting for prey may occur in agricultural or non-crop areas where rodenticides are likely to be used. Although EPA has no toxicity data for reptiles, avian toxicity data may be applicable to reptiles. Compared to mammals, birds are not very sensitive to anticoagulants, and the reptile blood clotting process is similar to that of birds. Therefore, exposure to the anticoagulant by ingestion of a poisoned rodent may not pose a significant hazard to snakes. The indigo snake's potential for exposure to poisoned prey is expected to be minimal. Therefore, it is the Service's opinion that the use of diphacinone is not likely to jeopardize the continued existence of the eastern indigo snake.

Incidental Take - Although the chance of exposure is considered minimal, the undocumented toxicity of diphacinone to reptiles is still a matter of concern. Thus, the Service anticipates that an unquantifiable level of incidental take may occur as a result of this chemical's use in areas where the eastern indigo snake may occur.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measure for minimizing incidental take should be adopted: conduct laboratory studies using surrogate snake species, such as the black racer *(Coluber c. priapus)*, to obtain toxicity data on the chemical's secondary poisoning hazard to snakes. Based on the data generated by the studies, the Service will develop and revise the reasonable and prudent measures. (Because of the status and relatively broad geographic range of this species of indigo snake, the Service believes at this time that prohibiting the use of diphacinone within the species' occupied habitat would not be reasonable and prudent).

Puerto Rican boa - The boa would only be exposed to diphacinone by eating an animal such as a mouse or rat that had been poisoned by the rodenticide. Boas hunting for prey may occur in agricultural or non-crop areas where rodenticides are likely to be used. Although EPA has no toxicity data for reptiles, avian toxicity data may be applicable to reptiles. Compared to mammals, birds are not very sensitive to anticoagulants, and the reptile blood clotting process is similar to that of birds. Therefore, exposure to the anticoagulant by ingestion of a poisoned rodent may not pose a significant hazard to snakes. The snake's potential for exposure to poisoned prey is expected to be minimal. Therefore, it is the Service's opinion that the use of diphacinone is not likely to jeopardize the continued existence of the Puerto Rican boa.

Incidental Take - Although the chance of exposure is considered minimal, the undocumented toxicity of diphacinone to reptiles is still a matter of concern. Thus, the Service anticipates that an unquantifiable level of incidental take may occur as a result of this chemical's use in areas where the Puerto Rican boa may occur.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measure for minimizing incidental take should be adopted: prohibit the use of the chemical in the known occupied habitat of the species.

Virgin Islands tree boa - The boa would only be exposed to diphacinone by eating an animal such as a mouse or rat that had been poisoned by the rodenticide. Boas hunting for prey may occur in agricultural or non-crop areas where rodenticides are likely to be used. Although EPA has no toxicity data for reptiles, avian toxicity data may be applicable to reptiles. Compared to mammals, birds are not very sensitive to anticoagulants, and the reptile blood clotting process is similar to that of birds. Therefore, exposure to the anticoagulant by ingestion of a poisoned rodent may not pose a significant hazard to snakes. The snake's potential for exposure to poisoned prey is expected to be minimal. Therefore, it is the Service's opinion that the use of diphacinone is not likely to jeopardize the continued existence of the Virgin Island tree boa.

Incidental Take - Although the chance of exposure is considered minimal, the undocumented toxicity of diphacinone to reptiles is still a matter of concern. Thus, the Service anticipates that an unquantifiable level of incidental take may occur as a result of this chemical's use in areas where the Virgin Island tree boa may occur.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measure for minimizing incidental take should be adopted: prohibit the use of the chemical within the known occupied habitat of the species.

Methyl bromide

CHEMICAL INFORMATION

TYPE: Rodenticide, fungicide, herbicide, insecticide, acaricide, nematicide.

FORMULATION: Gas or liquid fumigant

REGISTERED USES: Used as a soil fumigant on a variety of field, fruit and vegetable crops. Also used for manure, mulch and compost fumigation, stored commodities (both raw agricultural commodities and processed foods and feeds), greenhouses, homes, grain elevators, milk, ships, transportation vehicles.

BACKGROUND:

Mode of action: Inhalation or exposure to vapors.

Toxicity levels: Moderately to highly toxic based on toxicity to laboratory rats. No data are available on toxicity to nontarget organisms.

Wildlife incidents: None reported.

BIOLOGICAL OPINION

Methyl bromide as currently registered, is not anticipated to impact any federally listed threatened or endangered species. Therefore, it is the Service's opinion that if methyl bromide is applied according to label directions, for the above registered uses, there will be no effect on listed species.

Pival

CHEMICAL INFORMATION

TYPE: Rodenticide (indandione)

FORMULATION: Powder mixed with bait material (e.g., grain). Also as a ready-to-eat bait in granular, pellet, tablet and paraffinized block forms.

REGISTERED USES: Control of Norway rats, roof rats and house mice in and around buildings, and for California ground squirrels, thirteen-lined ground squirrels, meadow and pine mice/voles in orchards and groves, non-crop rights-of-way, and other non-crop areas such as lawns, ornamentals, golf courses, parks, and nurseries.

BACKGROUND:

Mode of action: Pival is an anticoagulant rodenticide in a class of chemicals called indandiones. Indandiones depress clotting capabilities of the blood and concurrently increase permeability of capillaries throughout the body, predisposing the animal to widespread internal hemorrhage. This generally occurs in the rodent after several days of bait ingestion. Unlike the anticoagulant coumarin compounds, indandiones may cause symptoms and signs of neurologic and cardiopulmonary injury in laboratory rats leading to death before hemorrhage occurs. These actions account for the greater toxicity of indandiones in rodents.

Aquatic toxicity: There have been only two aquatic bioassays performed with pival. This was with bluegills and rainbow trout and resulted in LC50s of 1.6 and 21.0 ppm, respectively. No bioassays have been conducted using freshwater invertebrates, marine/estuarine organisms, or aquatic field studies. The hazard to aquatic organisms needs to be considered, however, since pival is registered for use where the bait can be broadcast in open areas, even though in a worst case scenario of application in an orchard, concentrations should be far below any amount that might cause a problem. EPA has determined that this compound will have no effect on aquatic listed species.

Terrestrial toxicity: Toxicity varies widely among the indandiones and among species, with some birds and mammals being highly sensitive and others fairly resistant. Massive single exposure or repeated low dosages may cause poisoning (Buck et al. 1982). Total dosage to death will be much lower in anticoagulants with repeated exposures over an extended period than in acute exposures, and the majority of mortalities will occur during or after the second week of exposure (Mendenhall and Pank 1980, Bennett et al.). Single dose toxicity may be 5-100 times the multiple dose toxicity, depending on species (Jones 1977). The amount of data describing toxicity of indandiones to terrestrial taxa varies, with pival being the least tested compound and diphacinone perhaps the most tested, and most toxic, compound.

Most of the products containing pival may only be used in and around buildings for control of rats and mice, and it must also be applied in tamper-resistant bait boxes and in locations inaccessible to wildlife. However, it is also registered for broadcast applications in open areas, thus it could likely cause harm to any listed mammal which would consume the bait. While adherence to label instructions would not normally allow access by wildlife to pival, consideration should be given to the possibility of direct oral toxicity, especially where human development has encroached on habitat of listed mice and rats. Larger mammals (e.g., deer) might feasibly ingest small quantities, but because of their large size, there would be no effect. The secondary toxicity is considered very low because the levels of pival in the target animals are too low to be toxic to a predator or scavenger under all but the most extreme circumstances.

Thus, it is concluded that there will be no effect on listed species from secondary exposure. Because birds are considerably less susceptible than mammals to anticoagulants, EPA has determined there is no effect on

avian species and consequently no avian secondary effects. Potential exposure/impact of pival on plants/pollinators would be non-existent since it is an anticoagulant.

Wildlife incidents: None reported.

BIOLOGICAL OPINION

CHEMICAL REFERENCE TABLE

(The following table contains only those species for which the Service provided a jeopardy or no jeopardy call. Species not included in this list are either not affected by the chemical or have no chance for exposure. For a complete list of all species considered in this opinion, refer to the master species list on page III-1 of the species profile section.)

Species Name	J/NJ	PAGE
MAMMALS		
Alabama beach mouse	J	60
Amargosa vole	J	60
Anastasia Island beach mouse	J	61
Carolina northern flying squirrel	J	61
Choctawhatchee beach mouse	J	60
Florida panther	J	61
Florida salt marsh vole	J	62
Fresno kangaroo rat	J	63
Giant kangaroo rat	NJ	69
Hualapai Mexican vole	J	63
Jaguarundi	J	64
Key Largo cotton mouse	J	64
Key Largo woodrat	J	64
Louisiana black bear	J	65
Lower Keys rabbit	J	65
Morro Bay kangaroo rat	J	65
Ocelot	J	64
Perdido Key beach mouse	J	60
Point Arena mountain beaver	J	66
Salt marsh harvest mouse	J	66
San Joaquin kit fox	J	66
Silver rice rat	J	67
Southeastern beach mouse	J	61
Stephen's kangaroo rat	J	68
Tipton kangaroo rat	J	63
Utah prairie dog	NJ	69
BIRDS		
Audubon's crested caracara	J	68
REPTILES		
Eastern indigo snake	NJ	70

RATIONALE FOR JEOPARDY DETERMINATIONS

Alabama beach mouse, Choctawhatchee beach mouse, and Perdido Key beach mouse - Exposure of these beach mice to pival could occur through consumption of poisoned baits when used to control rodents within or in close proximity to their occupied habitats. Since all three subspecies occur in areas that are being encroached upon by various types of human development, there is a high possibility of pival being used where these mice could come in contact with it. All three of these beach mice are restricted to mature coastal barrier dune systems along the Gulf of Mexico. The Choctawhatchee beach mouse is presently known to occur only on Shell Island at St. Andrews Bay in Bay County, Florida, and on approximately 5 miles of beach dune habitat (coastline up to 500 feet inland) near Topsail Hill, from around Morrison Lake eastward to Stalworth Lake, Walton County, Florida. The Alabama beach mouse presently is surviving only

on disjunct tracts of the sand dune system from Fort Morgan State Park to the Romar Beach area in Baldwin County, Alabama. The Perdido Key beach mouse occurs only on Perdido Key in Baldwin County, Alabama and Escambia County, Florida. The distance to which occupied habitat of these species extends inland from the beach varies depending upon the configuration of the sand dune system and the vegetation present. Both subspecies utilize portions of the frontal or primary dunes; interdunal areas; and dunes further inland (secondary or interior dunes). Because of the restricted distributions of these species and the likelihood of pival being used for rodent control within or adjacent to areas which they inhabit, it is the Service's biological opinion that the registered use of pival is likely to jeopardize the continued existence of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Reasonable and Prudent Alternative(s) - If implemented the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit use of pival within 100 yards of occupied habitat of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Amargosa vole - The primary exposure of pival from registered uses can occur when the Amargosa vole eats bait from bait boxes used for muskrat control. Therefore, it is the biological opinion of the Service that the use of pival is likely to jeopardize the continued existence of the Amargosa vole.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Amargosa vole: prohibit the use of pival within 100 yards of the occupied habitat of the Armagosa vole.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

Anastasia Island beach mouse and Southeastern beach mouse - These two beach mice are endemic to the east coast of Florida. The Anastasia Island beach mouse is presently believed to occur only on Anastasia Island, St. Johns County, Florida. The southeastern beach mouse is believed to presently occur only from Florida's Mosquito (Pounce) Inlet in Volusia County south to Hutchinson Island in St. Lucie County, Florida. Both subspecies inhabit sand dunes vegetated by sea oats and dune panic grass and the scrub adjoining these dunes, which is vegetated with oaks, sand pine, palmetto, sea grapes, and/or wax myrtle. Since the ranges of both species have been and continue to be encroached upon by various types of human development, it is likely that pival could be used for pest control in areas where both these beach mice occur. Exposure of the mice to pival would occur through ingestion of poison baits, which would result in direct mortality of individuals of the species. Accordingly, it is the Service's biological opinion that the registered use of pival is likely to jeopardize the continued existence of the Anastasia Island beach mouse and the southeastern beach mouse.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit use of pival within 100 yards of occupied habitat of the Anastasia Island beach mouse and the southeastern beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Carolina northern flying squirrel - This species may be directly exposed to pival poisoning from its registered use to control rats and mice around buildings. The Carolina northern flying squirrel occurs in coniferous and northern hardwood forests, and may occasionally forage on the ground. Where land use changes and development encroach on the species' habitat there is a potential risk of the squirrel coming in

contact with pival bait that is placed outside of buildings (e.g., storage sheds and barns). Pival is toxic to rodents and would most likely kill a northern flying squirrel if it consumed the bait. Due to the restricted range and small population of the Carolina northern flying squirrel, any poisoning of individuals could threaten the survival of the species. Therefore, it is the Service's opinion that the use of pival is likely to jeopardize the continued existence of the Carolina northern flying squirrel.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Carolina northern flying squirrel: prohibit the outdoor use of the chemical within the species' occupied habitat.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Florida panther - The Florida panther may be exposed to pival by feeding on rodents or other animals that are dead or incapacitated from this rodenticide poison. Exposure may also occur by ingestion of meat and fish flavored baits. Panthers venture into agricultural and other areas where this rodenticide is likely used and poisoned target animals would be found. This poison has been implicated in the deaths of raccoons, fox, rabbits,and mountain lion. EPA has not provided adequate data relating to felids to evaluate the secondary poisoning hazard of pival. Sensitivities to indandiones often vary by orders of magnitude among taxa. Some indandiones are known to present a secondary poisoning to felids. Given the similar mode of action of pival, such a hazard must be considered a possibility. Even if a panther ingested a sublethal dose of poison, rodenticide induced internal hemorrhaging could weaken a panther to the degree that the animal would be very susceptible to fatal disease or infections. Because of the critically small panther population, the loss of even one panther could threaten the survival of the species. Therefore, it is the Service's opinion that the use of pival is likely to jeopardize the continued existence of the Florida panther.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Florida panther: prohibit the use of the chemical within 20 miles of the boundary of any Federal and State lands (e.g. National Wildlife Refuge, National Park, National Preserve, State Park, State Preserve, State Wildlife Management Areas, etc.) and Indian Reservations that provide suitable panther habitat south of Charlotte, Glades and Martin counties, Florida.

Incidental Take - Because individuals of the species may disperse beyond a given home range, the use and toxicity of the pesticide is still a concern. Consequently the Service anticipates that an unquantifiable level of incidental take may occur as a result of the use of the pesticide outside of the prohibited use zone.

Reasonable and Prudent Measures(s) - The following reasonable and prudent measure for minimizing incidental take should be adopted and implemented: within an area extending 5 miles from the edge of the prohibited use zone, the user should remove and properly dispose of any dead or incapacitated animal likely to have been poisoned during the period of rodenticide use.

Florida salt marsh vole - Exposure of the vole to pival could occur through consumption of poisoned baits used to control rodents in close proximity to the vole's occupied marsh habitat. There is a possibility of the rodenticide being used around buildings, rights-of-way, and other open areas, adjacent to salt marsh habitat where the vole could come in contact with it. The vole is restricted to a single known site in the salt marsh of Waccasassa Bay, Levy County, Florida. This rodenticide is highly toxic to mammals, and would be lethal to voles if consumed. Because of the restricted distribution of the species, its limited population, and the likelihood of this rodenticide being used for rodent control in areas in which the vole may forage, it is the Service's biological opinion that the use of pival is likely to jeopardize the continued existence of the Florida salt marsh vole.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the species: prohibit use of pival within 100 yards of the landward edge of the species' salt marsh habitat in Levy County, Florida.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Fresno kangaroo rat, Tipton kangaroo rat - Because pival use is relatively restricted to non-habitat areas (registered for control of domestic rodents in and around buildings, and ground squirrel control in orchards, non-crop rights-of-way, and other developed areas such as parks and golf courses) the likelihood of exposure of these kangaroo rats to this compound appears to be somewhat limited. Nevertheless, Fresno and Tipton kangaroo rats may be vulnerable to periodic pival exposure because: (1) both species occupy habitats in which man-made structures (residences and agricultural buildings) exist nearby; and (2) both occasionally occupy right-of-way areas (e.g., aqueduct, canal, and levee embankments) where ground squirrel control is considered necessary. Furthermore, both species occupy highly restricted and/or fragmented habitats, and are highly susceptible to the toxic effects of this compound. Of registered formulations and applications, those most likely to adversely affect these kangaroo rats would be grain baits, broadcast applications, and applications to burrows. For these reasons, it is the Service's biological opinion that pival use within the range of the Fresno kangaroo rat and Tipton kangaroo rat is likely to jeopardize the continued existence of these species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Fresno kangaroo rat and Tipton kangaroo rat: (1) Prohibit all outdoor uses of pival grain baits within 100 yards of the occupied habitats of these species; (2) prohibit broadcast pival applications outdoors and pival applications to burrows within the ranges of these species; and (3) prohibit outdoor use of pival solid baits (granules, pellets, tablets, blocks) within the ranges of these species, unless a specific kangaroo rat protection program for solid pival baits, approved by the Service in writing, is implemented.

Incidental Take - Despite the reasonable and prudent alternatives described above, the Service anticipates that an unquantifiable level of incidental take of the Fresno and Tipton kangaroo rat may occur as a result of pival use within the ranges of these species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Hualapai Mexican vole - The primary exposure of pival to the Hualapai Mexican vole would be through its application to control ground squirrels in non-crop rights-of-way or recreational areas. Voles are one of a number of target organisms of pival and also is highly toxic to small mammals. The likelihood that pival would be used in the habitat of the vole is small but if it were used because of the very small number of known voles, the consequences would be severe. Therefore, it is the Service's biological opinion that the use of pival is likely to jeopardize the continued existence of the Hualapai Mexican vole.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Hualapai Mexican vole: prohibit the use of pival within 100 yards of known Hualapai Mexican vole occupied habitat.

Incidental Take - With the implementation of the reasonable and prudent alternatives to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Jaguarundi and Ocelot - The primary exposure of pival to the ocelot and jaguarundi is through its use to control field rodents in orchards, groves and non-crop rights-of-way. This chemical is used in areas that are

adjacent to or interspersed with known ocelot and jaguarundi habitat. There is little probability of these felids directly consuming the pival baits, however it is probable that secondary poisoning may occur as a result of these species consuming target rodents that have ingested pival. EPA has not provided adequate data relating to felids to evaluate the secondary poisoning hazard of pival. Sensitivities to indandiones often vary by orders of magnitude among taxa. Some indandiones are known to present a secondary poisoning to felids. Given the similar mode of action such a hazard must be considered a possibility for pival. Therefore, it is the Service's biological opinion that the use of pival is likely to jeopardize the continued existence of the ocelot and jaguarundi.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative will avoid jeopardy to the ocelot and jaguarundi: prohibit use within three miles of occupied habitat.

Incidental Take - Despite the implementation of the reasonable and prudent alternatives described above, the Service anticipates that an unquantifiable level of incidental take of ocelot and jaguarundi may occur as a result of pival use within the range of these species.

Reasonable and Prudent Measure(s) - If implemented, the following reasonable and prudent measures will minimize incidental take: Prior to use of pival in potential ocelot or jaguarundi habitat, conduct survey to determine if habitat is occupied. If habitat is unoccupied, no further restrictions are applicable. If habitat is occupied, prohibit use within three miles.

Key Largo woodrat and Key Largo cotton mouse - Both the Key Largo woodrat and Key Largo cotton mouse occur in subtropical, evergreen, hardwood forests on the northern half of Key Largo, Monroe County, Florida, north of the point where U.S. Highway 1 enters Key Largo. Populations of both species may also occur in similar habitat on Lignumvitae Key, Monroe County, where the species were introduced in 1970. The Key Largo woodrat is primarily herbivorous, feeding mostly on buds, leaves, fruits, and seeds, but invertebrates occasionally are included in its diet. The diet of the Key Largo cotton mouse has not been documented, but it is believed to be very similar to that of the woodrat. The use of pival broadcast baits within or adjacent to habitat of these two species is likely due to the close proximity of various types of human development to the areas where these species occur. Exposure of the woodrat and cotton mouse to pival would result in direct mortality of individuals of the species. The most likely means of exposure of the woodrat and the cotton mouse to pival would be ingestion of broadcast baits. Accordingly, it is the Service's biological opinion that the registered use of pival is likely to jeopardize the continued existence of the Key Largo woodrat or Key Largo cotton mouse.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit use of the chemical within 100 yards of occupied habitat of the Key Largo woodrat and the Key Largo cotton mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Louisiana black bear - The Louisiana black bear may be exposed to pival by feeding on rodents or other animals that are dead or incapacitated from this rodenticide poison. Exposure may also occur by ingestion of meat and fish flavored baits. Bears venture into agricultural and other areas where this rodenticide is likely used and poisoned target animals would be found. This poison has been implicated in the deaths of raccoons, fox, rabbits,and mountain lion. EPA has not provided adequate data relating to large mammals to evaluate the secondary poisoning hazard of pival. Sensitivities to indandiones often vary by orders of magnitude among taxa. Some indandiones are known to present a secondary poisoning to felids. Given the similar mode of action of pival, such a hazard must be considered a possibility. Even if a bear ingested a sublethal dose of poison, rodenticide induced internal hemorrhaging could weaken a bear to the degree that the animal would be very susceptible to fatal disease or infections. Because of the bear's small population

and restricted range, mortality resulting from rodenticide poisoning could threaten the survival of the species. Therefore, it is the Service's opinion that the use of pival is likely to jeopardize the continued existence of the Louisiana black bear.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Louisiana black bear: prohibit the use of the pesticide within the current known occupied habitat of the species.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Lower Keys rabbit - The Lower Keys rabbit could be exposed to pival when the rodenticide is used around buildings, rights-of-way, and other open areas that are adjacent to the rabbit's marsh habitat. The rabbit is likely to forage in some treated areas. Continued rapid development in the lower Keys greatly increases the potential that the rabbit would come in contact with rodenticide treated areas. Broadcast applications of flavored baits would pose a serious threat to the species. This rodenticide would be lethal to Lower Keys rabbits if it were ingested. Because of the extremely restricted range of the species and its small population, any rodenticide induced poisonings could threaten the survival of the species. Therefore, it is the opinion of the Service that the use of pival is likely to jeopardize the continued existence of the Lower Keys rabbit.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Lower Keys rabbit: prohibit the outdoors use of the chemical within 100 yards of the current known occupied habitat of the species.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Morro Bay kangaroo rat - The primary exposure of pival from registered uses can occur when the Morro Bay kangaroo rat ingests treated bait. The extremely limited range of this species, the presence of target rodents, and the interspersion of this species habitat with urban, agricultural, and commercial buildings place the Morro Bay kangaroo rat at risk. It is the biological opinion of the Service that use of pival is likely to jeopardize the continued existence of the Morro Bay kangaroo rat.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Morro Bay kangaroo rat: prohibit the use of pival within 100 yards of the occupied habitat of the Morro Bay kangaroo rat.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

Point Arena mountain beaver, salt marsh harvest mouse - These species may be subject to pival exposure because use patterns of this chemical (registered for domestic rodent control in and around buildings, and for ground squirrel control in orchards, non-crop rights-of-way, and other developed areas) may include some harvest mice or mountain beaver habitats or areas adjacent to such habitats. Both these species occupy areas in which man-made structures or sites exist nearby (commercial and industrial buildings in the vicinity of San Francisco Bay salt marshes, municipal and communication structures in the Point Arena vicinity, golf courses and similar sites in both areas). Adverse effects of pival use on the harvest mouse and mountain beaver could be significant because: (1) both species may be attracted to grain or pelletized pival baits if applied in the vicinity of occupied habitats; (2) both are highly susceptible to the toxic effects of this compound; and (3) the habitats of these species are highly restricted and fragmented. It is therefore the Service's biological opinion that pival use within the ranges of the salt marsh harvest mouse and Point Arena mountain beaver is likely to jeopardize the continued existence of these species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the salt marsh harvest mouse: prohibit outdoor pival use within 100 yards of the occupied habitat of this species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Point Arena mountain beaver: (1) Prohibit broadcast pival applications outdoors and pival applications to burrows within the occupied habitat of this species; and (2) prohibit outdoor pival use (all baits) within the occupied habitat of this species, unless a specific mountain beaver protection program for pival use, approved by the Service in writing, is implemented.

Incidental Take - Despite the reasonable and prudent alternatives described above, the Service anticipates that an unquantfiable level of incidental take of the salt marsh harvest mouse and Point Arena mountain beaver may occur as a result of pival use within the ranges of these species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

San Joaquin kit fox - This species may be subject to pival exposure because use patterns of this chemical (registered for domestic rodent control in and around buildings, and for ground squirrel control in orchards, non-crop rights-of-way, and other developed areas) include numerous areas that may be frequented by kit foxes. Such areas within the kit fox range include several municipalities (e.g., Bakersfield, California), oil fields, aqueduct and canal embankments, golf courses, and orchards. There are two potential sources of kit fox exposure to pival: (1) direct consumption of pival baits (possible especially for pelletized and other solid bait formulations, especially when broadcast or applied at burrows); and (2) secondary poisoning by consuming small mammals killed or incapacitated by pival exposure. EPA considers the possibility of secondary poisoning of kit foxes to be low. However, the Service questions whether the data on which EPA makes this assumption is applicable to canid species. Adverse effects of pival use on the San Joaquin kit fox therefore could be significant because (1) of the wide variety of pival use patterns and formulations; (2) the opportunistic feeding habitats of kit foxes, which increases the likelihood of exposure; (3) the fact that serious localized effects of pival use could occur in areas where the kit fox range is geographically restricted; and (4) the possibility of secondary effects. For these reasons, the Service concludes that pival use within the San Joaquin kit fox range is likely to jeopardize the continued existence of this species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the San Joaquin kit fox: prohibit pival use within the kit fox range as determined by the Service. Exceptions to this prohibition are as follows: (1) Agricultural areas that are one mile or more from any kit fox habitat, such areas to be determined and mapped by the California Environmental Protection Agency in consultation with the Service, or to be determined by the Service. For purposes of this alternative, kit fox habitat is defined as all native lands and rangelands within the kit fox range whether disturbed or undisturbed, agricultural lands known or likely to be occupied by kit foxes (e.g., orchards, fallow lands), and all urban and municipal areas within Kern and Tulare Counties; OR (2) areas for which kit fox surveys have been conducted within a one mile radius of proposed treatment sites and have yielded negative results, provided such surveys are conducted by qualified individuals utilizing methods acceptable to the Service, and that such results are submitted to the Service for review and approval; OR (3) laboratory data acceptable to the Service demonstrates negligible risks to canid species resulting from secondary pival exposure. If the latter is completed, a specific kit fox protection program for pival use within the kit fox range may be implemented, provided that the Service approves of any such program in writing.

Incidental Take - Despite the reasonable and prudent alternatives described above, the Service anticipates that an unquantifiable level of incidental take of the San Joaquin kit fox may occur as a result of pival use within the range of this species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Silver rice rat - The silver rice rat could be exposed to pival when the rodenticide is used (for control of black and Norway rats, and house mice) around buildings, rights-of-way, ditches, and other open areas that are adjacent to the rat's wetland habitat. The rat is likely to forage in some treated areas. Continued rapid development in the lower Keys greatly increases the potential that the rat would come in contact with rodenticide treated areas. Broadcast applications of flavored baits would pose a serious threat to the species. This rodenticide would be lethal to silver rice rats if it were ingested. Because of the extremely restricted range of the species and its small population, any rodenticide induced poisonings could threaten the survival of the species. Therefore, it is the opinion of the Service that the use of pival is likely to jeopardize the continued existence of the silver rice rat.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the silver rice rat: prohibit the outdoors use of the chemical within 100 yards of the current known occupied habitat of the species.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Stephen's kangaroo rat - The primary exposure of the Stephen's kangaroo rat to pival is the ingestion of the many bait formulations placed in proximity to the occupied habitat of this species including around buildings, groves, golf courses, and non-crop rights-of-way. It is the biological opinion of the Service that use of pival is likely to jeopardize the continued existence of the Stephen's kangaroo rat.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Stephen's kangaroo rat: (1) Prohibit all outdoor uses of pival grain baits within the 100 yards of the occupied habitat of this species; (2) prohibit broadcast pival applications outdoors and pival applications to burrows within the occupied habitat of this species; and (3) prohibit outdoor use of pival solid baits (granules, pellets, tablets, blocks) within the occupied habitat of this species, unless a specific kangaroo rat protection program for solid pival baits, approved by the Service in writing, is implemented.

Incidental Take - Despite the reasonable and prudent alternatives described above, the Service anticipates that an unquantfiable level of incidental take of the Stephen's kangaroo rat may occur as a result of pival use within the ranges of this species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Audubon's crested caracara - Audubon's crested caracara may be exposed to pival by secondary poisoning from consuming contaminated rodents. EPA did not provide adequate data relating to secondary poisoning of birds from pival. Some indandiones are known to present a secondary poisoning hazard to birds. Given the similar mode of action of pival, such a hazard must be considered a possibility. Caracaras feed both on carrion and live prey. Pival is registered for use in pastures and rangeland. Caracaras occur in open prairies and frequently use improved pastures. Since it takes several days for death to occur from pival ingestion, it is conceivable that poisoned rodents may travel away from the baited area to die. Because of the caracara's

small population size, any rodenticide induced mortality could threaten the survival of the species. Therefore, it is the Service's opinion that the use of pival is likely to jeopardize the continued existence of the Audubon's crested caracara.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Audubon's crested caracara: prohibit the use of the pesticide within the current occupied range of the species.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

RATIONALE FOR NO JEOPARDY DETERMINATIONS

Giant kangaroo rat - Giant kangaroo rats may be subject to periodic pival exposure in some habitats that are adjacent to human activities and structures where this compound may be used. Primarily, such areas would include oil fields where industrial structures may be present and rights-of-way in the southwest and west central portions of the San Joaquin Valley and Carrizo Plain, California. Of registered formulations and applications, those most likely to adversely effect giant kangaroo rats would be grain baits, broadcast applications, or applications directly to burrows. However, much of the giant kangaroo rat range is well removed from areas where pival use is anticipated. Therefore, the Service concludes that pival use within the giant kangaroo rat range is not likely to jeopardize the continued existence of this species.

Incidental Take - Although possible exposure of the giant kangaroo rat to pival probably is minimal, the Service anticipates that an unquantifiable level of incidental take may occur as a result of pival use within the range of these species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the giant kangaroo rat will be minimized: (1) Prohibit all outdoor uses of pival grain baits within 100 yards of the occupied habitat of this species; (2) prohibit broadcast pival applications outdoors and pival applications to burrows within the occupied habitat of this species; and (3) prohibit outdoor use of pival solid baits (granules, pellets, tablets, blocks) within the occupied habitat of this species, unless a specific giant kangaroo rat protection program for pival use, approved by the Service in writing, is implemented.

Utah prairie dog - The primary exposure of pival to this species may be from its registered uses to control voles in noncrop rights-of-way and other noncrop areas. EPA determined that pival may affect the Utah prairie dog which may consume pival bait. However, registered uses of this pesticide would impact only a very small portion, if any, of the population where there may be prairie dog colonies occurring near rights-of-way where vole control may take place. Therefore, it is the Service's opinion that the use of pival is not likely to jeopardize the continued existence of the Utah prairie dog.

Incidental Take - Because pival is toxic to small mammals feeding on pival bait, the Service anticipates that an unquantifiable level of incidental take may occur as a result of the use of pival to control voles in rights-of-way.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measures for minimizing incidental take and implementing terms and conditions should be adopted: prohibit the application of pival within 100 yards of occupied Utah prairie dog habitat.

Eastern indigo snake - The eastern indigo snake would only be exposed to pival by eating an animal such as a mouse or rat that had been poisoned by the rodenticide. Indigo snakes occasionally occur in agricultural areas where rodenticides are likely to be used. Although EPA has no toxicity data for reptiles, the data on birds is considered applicable to reptiles. EPA did not provide adequate data relating to secondary poisoning

of birds from pival. Some indandiones are known to present a secondary poisoning hazard to birds. Sensitivities to indandiones often vary by orders of magnitude among taxa. Some indandiones are known to present a secondary poisoning to birds. Given the similar mode of action of pival, such a hazard must be considered a possibility however minimal. Therefore, it is the Service's opinion that the use of pival is not likely to jeopardize the continued existence of the eastern indigo snake.

Incidental Take - Although the chance of exposure is considered minimal, because of the high toxicity of pival, it is still a matter of concern. Thus, the Service anticipates that an unquantifiable level of incidental take may occur as a result of this chemical's use in areas where the eastern indigo snake may occur.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measure for minimizing incidental take should be adopted: conduct laboratory studies using surrogate snake species to obtain toxicity data on the chemical's secondary poisoning hazard to snakes. Based on the data generated by the studies, the Service will develop and revise the reasonable and prudent measures. (Because of the status and relatively broad geopraphic range of this species of indigo snake, the Service believes at this time that prohibiting the use of pival within the species' occupied habitat would not be reasonable and prudent).

Potassium nitrate and Sodium nitrate

CHEMICAL INFORMATION

TYPE: Rodenticide

FORMULATION: Poisonous gas cartridges. Nitrates in cartridges range from 44% to 54% ai.

REGISTERED USES: Lawns, gardens, golf courses, cemeteries, open fields, rights-of-way and rangeland. For use only in burrows to control pocket gophers, moles, woodchucks, rats, prairie dogs, skunks and ground wasps.

BACKGROUND:

Mode of action: Suffocation

Aquatic toxicity: EPA did not provide any aquatic toxicological data on fish and invertebrates, but states, because of the method of application and extreme volatility, the use of these two chemicals will not affect aquatic organisms.

Terrestrial toxicity: The gas given off by these products are extremely toxic to any animal sealed in a burrow. Effectiveness may vary depending on burrow size, openings and soil texture and moisture. These two chemicals produce no toxic residues after the cartridge has burned. Since these two products produce a deadly gas, any listed species trapped in burrows will be killed Consistent with use pattern and volatility of gas, no direct or indirect impacts should occur for listed plants and/or plant pollinators considered in this consultation.

Wildlife incidents: None reported.

BIOLOGICAL OPINION

CHEMICAL REFERENCE TABLE

(The following table contains only those species for which the Service provided a jeopardy or no jeopardy call. Species not included in this list are either not affected by the chemical or have no chance for exposure. For a complete list of all species considered in this opinion, refer to the master species list on page III-1 of the species profile section.)

Species Name	J/NJ	PAGE
MAMMALS		
Black-footed ferret	J	72
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Hualapai Mexican vole	J	74
Giant kangaroo rat	J	73
Morro Bay kangaroo rat	J	74
Point Arena mountain beaver	J	75
San Joaquin kit fox	J	75
Stephen's kangaroo rat	J	76
Tipton kangaroo rat	J	73
Utah prairie dog	NJ	78
REPTILES		
Blunt-nosed leopard lizard	J	76
Coachella Valley fringe-toed lizard	NJ	79
Desert tortoise	NJ	79
Eastern indigo snake	J	77
Gopher tortoise	J	78
Island night lizard	NJ	79
San Francisco garter snake	J	76

RATIONALE FOR JEOPARDY DETERMINATIONS

Black-footed ferret - These two pesticides are registered for uses on lawns, gardens, golf courses, cemeteries, open fields, rights-of-way, and rangeland to control pocket gophers, moles, woodchucks, rats, prairie dogs, skunks, and ground wasps. These pesticides are placed inside burrows and sealed giving off poisonous gas which kills all the inhabitants in the burrows. The likelihood of ferrets being found in the wild, while considered low, is still possible. The further loss or fragmentation of prairie dog habitat which has already been reduced by as much as 98 percent (from over 100 million acres to around 2 million acres) as well as the loss of a single ferret in the wild could result in the extinction of the species. Therefore, it is the Service's opinion that the use of sodium nitrate and potassium nitrate is likely to jeopardize the continued existence of the black-footed ferret.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the black-footed ferret:

1. A black-tailed prairie dog colony or complex of less than 80 acres having no neighboring prairie dog towns may be treated without a ferret survey. A midrange of 102 acres (61 to 294 acres) of occupied black-footed prairie dog habitat is believed necessary to support a single ferret, so it is highly unlikely that a ferret would be found in an isolated colony of less than 80 acres. A neighboring prairie dog town is defined as a colony less than 7 kilometers

(4.34 miles) from the town to be treated, based on the longest distance that the ferret has been observed to travel during the night.

2. A white-tailed prairie dog colony or complex of less than 200 acres having no neighboring prairie dog towns may be treated without a survey. It is estimated to require between 196 and 475 acres of white-tailed prairie dogs to support a single ferret.

3. Urban situations (e.g., playgrounds, golf courses, etc.) may be treated without conducting ferret surveys. The appropriate Service office will be contacted by the pesticide user in advance of any treatment to determine whether a proposed action fits this situation.

4. For black-tailed prairie dog colonies or complexes over 80 acres but less than 1,000 acres, and white-tailed prairie dog colonies or complexes over 200 acres but less than 1,000 acres, prairie dog control may be allowed after completing a black-footed survey within 30 days of proposed treatments on colonies proposed for treatment, provided no ferrets or their sign are found. Prior to treatment, if all colonies in this complex are surveyed with no sign of ferrets, no future survey for ferrets would be recommended. These surveys will be coordinated with the appropriate Office of the Service.

5. For prairie dog complexes over 1,000 acres, no control shall be allowed until the complex has been evaluated by appropriate State and/or Federal Agencies (those agencies working on State working groups for ferret recovery) for its potential as a recovery site and until the complex has been block cleared. One thousand acres would be a minimum complex for consideration as a black-footed ferret reintroduction site and would likely require intensive management of habitat for a ferret population.

6. The EPA shall maintain records which shall be provided to the Service on an annual basis. These records can include the amount of acres of prairie dog towns or complexes controlled (e.g., Federal lands, private lands on a volunteer basis), or the amount of the chemical sold including application rates. The latter could be obtained from either the manufacturer or the vender.

Surveys shall be supervised by biologists trained in ferret survey techniques and ferret biology at a Service-approved training workshop. Currently, only the University of Wyoming has such a course. Ferret surveys shall be reviewed by the Service for compliance with survey standards and Section 7 of the Endangered Species Act.

Incidental Take - With the implementation of the reasonable and prudent alternatives to preclude jeopardy of the black-footed ferret, no incidental take is anticipated and thus none is authorized.

Fresno kangaroo rat, giant kangaroo rat, Tipton kangaroo rat - The primary risk of potassium and sodium nitrate exposure for these species would result from registered uses of these compounds as burrow fumigants in the southern San Joaquin Valley, California. The most likely source of exposure would be inadvertent application to kangaroo rat burrows during control of field rodents in occupied habitats. This risk may be minimized by the fact that kangaroo rat burrows differ somewhat in appearance from burrows of target species. Nevertheless, adverse effects of potassium and sodium nitrate use on Fresno, giant, and Tipton kangaroo rats could be significant because of: (1) their high toxicity (100 percent mortality in treated burrows is expected); (2) the frequency of ground squirrel control programs in areas occupied by these species; and (3) the fact that each of these kangaroo rats occupy habitats that are significantly restricted and/or fragmented. For these reasons, it is the Service's biological opinion that use of potassium and sodium nitrate is likely to jeopardize the continued existence of these species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Fresno kangaroo rat, giant kangaroo rat, and Tipton kangaroo rat: to avoid application to kangaroo rat burrows, potassium and sodium nitrate shall be used within the occupied habitats of these species only by qualified individuals. Such persons shall be limited to wildlife biologists, certified applicators, or agents of county agricultural commissioner offices, university extension offices, or representatives of California State or Federal agencies, who are trained to distinguish dens and burrows of target species from those of non-target species.

Incidental take - Despite the reasonable and prudent alternatives described above, the Service anticipates that an unquantifiable level of incidental take may occur as a result of potassium and sodium nitrate use within the ranges of these species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Hualapai Mexican vole - The primary exposure of sodium nitrate and potassium nitrate to the Hualapai Mexican vole would be through its application to control ground squirrels in non-crop rights-of-way or recreational areas. Voles are one of a number of target organisms of sodium nitrate and potassium nitrate and also is highly toxic to small mammals. The likelihood that sodium nitrate and potassium nitrate would be used in the habitat of the vole is small but if it were used because of the very small number of known voles, the consequences would be severe. Therefore, it is the Service's biological opinion that the use of sodium nitrate and potassium nitrate is likely to jeopardize the continued existence of the Hualapai Mexican vole.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Hualapai Mexican vole: prohibit the use of sodium nitrate and potassium nitrate in occupied habitat of the Hualapai Mexican vole.

Incidental Take - With the implementation of the reasonable and prudent alternatives to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Morro Bay kangaroo rat - The primary exposure of potassium nitrate and sodium nitrate from registered uses can occur either when Morro Bay kangaroo rat burrows are targeted or the burrows of targeted animals contain the species. The extremely limited range of this species and the present of target control species places the Morro Bay kangaroo rat at risk. It is the biological opinion of the Service that use of sodium or potassium nitrate is likely to jeopardize the continued existence of the Morro Bay kangaroo rat.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit the use of potassium nitrate and sodium nitrate within the occupied habitat of the Morro Bay kangaroo rat.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

Point Arena mountain beaver - This species is vulnerable to potassium and sodium nitrate exposure during registered uses of these burrow fumigants in Mendocino County, California. The primary source of exposure would result from inadvertent application to mountain beaver burrows during control of field rodents in occupied habitats. Adverse effects of potassium and sodium nitrate use on the Point Arena mountain beaver could be significant because of: (1) the high toxicity of these fumigants; (2) the frequency of rodent control programs within the range of this species; and (3) the fact that the mountain beaver occupies highly restricted and fragmented habitats. For these reasons, it is the Service's biological opinion that use of

potassium and sodium nitrate within the range of the Point Arena mountain beaver is likely to jeopardize the continued existence of this species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Point Arena mountain beaver: To avoid application to mountain beaver burrows, potassium and sodium nitrate shall be used within the mountain beaver's occupied habitat only by qualified individuals. Such persons shall be limited to wildlife biologists, certified applicators, or agents of county agricultural commissioner offices, university extension offices, or representatives of California State or Federal agencies, who are trained to distinguish dens and burrows of target species from those of non-target species.

Incidental take - Because of the possibility of inadvertent application of these compounds to mountain beaver burrows despite the reasonable and prudent alternatives described above, the Service anticipates that an unquantifiable level of incidental take may occur as a result of potassium and sodium nitrate use within the range of this species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

San Joaquin kit fox - The primary source of kit fox exposure to potassium and sodium nitrate would result from erroneous application of these fumigants to kit fox dens during control of rodents, primarily ground squirrels, in the San Joaquin Valley, California. The possibility of such error is especially high for kit foxes because kit fox dens and ground squirrel burrows often have similar dimensions at the ground surface. Though the kit fox is relatively wide-ranging, potassium and sodium nitrate uses could have significant adverse effects on this species because of: (1) the extremely high toxicity of these fumigants (100 percent mortality in treated burrows is expected); (2) the frequency of ground squirrel control programs within the kit fox range; and (3) the fact that serious localized effects of potassium and sodium nitrate use could occur in areas where the kit fox range is geographically restricted (e.g., the north end of the range where kit foxes are confined to a narrow strip of rangelands, and the Santa Nella area where the range forms a "bottleneck"). For these reasons, it is the Service's biological opinion that potassium and sodium nitrate use within the San Joaquin kit fox range is likely to jeopardize the continued existence of this species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the San Joaquin kit fox: To avoid application to kit fox dens, potassium and sodium nitrate shall be used within the San Joaquin kit fox's range only by qualified individuals. Such persons shall be limited to wildlife biologists, certified applicators, or agents of county agricultural commissioner offices, university extension offices, or representatives of California State or Federal agencies, who are trained to distinguish dens and burrows of target species from those of non-target species.

Incidental Take - Because of the possibility of inadvertent application of these compounds to kit fox dens despite the reasonable and prudent alternatives described above, the Service anticipates that an unquantifiable level of incidental take of San Joaquin kit foxes may occur as a result of potassium and sodium nitrate use within the range of this species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Stephen's kangaroo rat - The primary exposure of potassium nitrate and sodium nitrate from registered uses can occur either when Stephen's kangaroo rat burrows are targeted or the burrows of targeted animals

contain the species. It is the biological opinion of the Service that use of sodium or potassium nitrate is likely to jeopardize the continued existence of the Stephen's kangaroo rat.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Stephen's kangaroo rat: prohibit the use of potassium and sodium nitrate in the occupied habitat of the Stephen's kangaroo rat or potassium and sodium nitrate shall be used within this species's occupied habitat only by qualified individuals. Such persons shall be limited to wildlife biologists, certified applicators, or agents of county agricultural commissioner offices, university extension offices, or representatives of California State or Federal agencies, who are trained to distinguish dens and burrows of target species from those of non-target species.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

Blunt-nosed leopard lizard, San Francisco garter snake - The blunt-nosed leopard lizard and San Francisco garter snake utilize burrows for all or part of their life cycle, and therefore are subject to potassium and sodium nitrate exposure during registered uses of these compounds as burrow fumigants within occupied habitats (San Joaquin Valley and San Francisco Bay area, California, respectively). However, because leopard lizards and garter snakes do not construct their own burrows but utilize existing burrows of other species (usually mammals), avoidance of exposure to potassium and sodium nitrate through burrow identification is difficult. The leopard lizard is subject to such exposure year round, since it utilizes burrows during its activity and hibernation phases. The garter snake utilizes burrows only during its hibernation phase (approximately November through March) and is subject to exposure only during this period. Because of the high toxicity of these burrow fumigants, the likelihood of exposure, and the fact that these species occupy highly restricted and/or fragmented habitats, it is the biological opinion of the Service that potassium and sodium nitrate use is likely to jeopardize the continued existence of the blunt-nosed leopard lizard and San Francisco garter snake.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the blunt-nosed leopard lizard: (1) To avoid application to leopard lizard burrows, potassium and sodium nitrate shall be used within the blunt-nosed leopard lizard range only by qualified individuals; such persons shall be limited to wildlife biologists, certified applicators, or agents of county agricultural commissioner offices, university extension offices, or representatives of California State or Federal agencies, who are trained to distinguish dens and burrows of target species from those of non-target species. (2) From April 15 to September 30, potassium and sodium nitrate use within the blunt-nosed leopard lizard range shall be limited to daylight hours when air temperatures are between 77 and 95 degrees Fahrenheit (20 to 30 degrees Centigrade). (3) Potassium and sodium nitrate use shall be prohibited within occupied leopard lizard habitat during the leopard lizard inactivity period, October 1 to April 15, unless a specific blunt-nosed leopard lizard protection program for this period, approved in writing by the Service, is implemented.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the San Francisco garter snake: (1) To avoid application to garter snake burrows, potassium and sodium nitrate shall be used within the San Francisco garter snake range only by qualified individuals; such persons shall be limited to wildlife biologists, certified applicators, or agents of county agricultural commissioner offices, university extension offices, or representatives of California State or Federal agencies, who are trained to distinguish dens and burrows of target species from those of non-target species. (2) Potassium and sodium nitrate use within occupied San Francisco garter snake habitat shall be prohibited during the garter snake

inactivity period, November 1 to March 30, unless a specific San Francisco garter snake protection program for this period, approved in writing by the Service, is implemented.

Incidental Take - Because of the possibility of inadvertent application of these compounds to burrows inhabited by leopard lizards and garter snakes despite the reasonable and prudent alternatives described above, the Service anticipates that an unquantifiable level of incidental take may occur as a result of sodium and potassium nitrate use within the ranges of these species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Eastern indigo snake - The eastern indigo snake would most likely be exposed to sodium nitrate and potassium nitrate when these rodenticide chemicals are used to fumigate rodent burrows. Indigo snakes use burrows for shelter particularly during the winter season. The snake typically uses gopher tortoise burrows when they are available, but the snake is opportunistic when seeking shelter and would use rodent burrows if necessary. The chemical gas produced by these nitrate rodenticides would be lethal to any animal inhaling the gas inside a burrow. Because the eastern indigo snake population is relatively small and declining, and the fact that these snakes frequent agricultural areas where the nitrate fumigants would likely be used, it is the Service's opinion that the use of sodium nitrate and potassium nitrate fumigants is likely to jeopardize the continued existence of the species.

Reasonable and Prudent Alternative(s) - The following reasonable and prudent measure for minimizing incidental take should be adopted: prohibit the use of these fumigants in animal burrows within habitat types and locales known to support indigo snakes.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Gopher tortoise - The gopher tortoise would most likely be exposed to sodium nitrate and potassium nitrate when these rodenticide chemicals are used to fumigate rodent burrows. Gopher tortoises use burrows for shelter. Tortoise burrows may be found in agricultural areas where land owners may use fumigants. The chemical gas produced by these nitrate rodenticides would be lethal to any animal inhaling the gas inside a burrow. Because tortoise population is relatively small and declining, and the fact that these reptiles occur in agricultural areas where the nitrate fumigants would likely be used, it is the Service's opinion that the use of sodium nitrate and potassium nitrate fumigants is likely to jeopardize the continued existence of the gopher tortoise.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would jeopardy to the gopher tortoise: prohibit the use of the chemical in or adjacent to known gopher tortoise occupied habitat west of the Mobile and Tombigbee Rivers in Alabama.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

RATIONALE FOR NO JEOPARDY DETERMINATIONS

Utah prairie dog - Both potassium nitrate and sodium nitrate are registered for uses on lawns, gardens, golf courses, cemeteries, open fields, rights-of-way, and rangeland to control pocket gophers, moles, woodchucks, rats, prairie dogs, skunks, and ground wasps. The EPA label for the use of dexol gopher gasser requires that this product not be used in the range of the Utah prairie dog. However, it is not known whether this endangered species label is required for other uses on products of these two pesticides. Because there is

restricted use on at least some of the pesticide uses (e.g., dexol gopher gasser), it is the Service's opinion that the use of potassium nitrate and sodium nitrate is not likely to jeopardize the continued existence of the Utah prairie dog.

Incidental Take - Because information provided by EPA restricts the use of these two pesticides only on dexol gopher gasser, the Service anticipates that an unquantifiable level of incidental take may occur as a result of the potassium nitrate and sodium nitrate for prairie dog control.

Reasonable and Prudent Measure(s) - To minimize incidental take, the following measures should be adopted: prohibit the use of potassium nitrate and sodium nitrate within occupied Utah prairie dog habitat.

Desert tortoise - There is potential exposure of potassium nitrate and sodium nitrate from registered application for rodents since tortoise burrows, though they are much larger in size, may be accidentally treated. It is the Service's biological opinion that use of potassium nitrate and sodium nitrate is not likely to jeopardize the continued existence of the desert tortoise.

Incidental Take - The service anticipates that an unquantifiable level of incidental take may occur as a result of potassium and sodium nitrate use within the occupied habitat of this species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the desert tortoise will be minimized: sodium and potassium nitrate shall be used within the desert tortoise occupied habitat only by qualified individuals. Such persons shall be limited to wildlife biologists, certified applicators, or agents of county agricultural commissioner offices, university extension offices, or representatives of California State or Federal agencies, who are trained to distinguish dens and burrows of target species from those of non-target species.

Coachella Valley fringe-toed lizard - The primary effect of potassium nitrate and sodium nitrate would be due to an interface when burrows harboring the lizards are treated. It is the biological opinion of the Service that use of sodium and potassium nitrate is not likely to jeopardize the continued existence of the Coachella Valley fringe-toed lizard.

Incidental Take - The service anticipates that an unquantifiable level of incidental take may occur as a result of potassium and sodium nitrate use within the occupied habitat of this species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the Coachella Valley fringe-toed lizard will be minimized: prohibit the use of potassium and sodium nitrate use within the occupied habitat of the Coachella fringe-toed lizard.

Island night lizard - There is potential exposure to this species by sodium and potassium nitrate from registered application for rodents due to the use of rodent burrows by the island night lizard. It is the Service's biological opinion that use of sodium and potassium nitrate is not likely to jeopardize the continued existence of the island night lizard.

Incidental Take - The service anticipates that an unquantifiable level of incidental take may occur as a result of sodium and potassium nitrate use within the occupied habitat of this species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the island night lizard will be minimized: prohibit the use of sodium and potassium nitrate within the occupied habitat of this species.

Sodium cyanide

CHEMICAL INFORMATION

TYPE: Canid predacide

FORMULATION: Capsules (888mg sodium cyanide (NaCN), 89%ai) contained in an M-44 device.

REGISTERED USES: Control of coyotes, red foxes, gray foxes and feral dogs. M-44 use is subject to 26 restrictions designed to protect the applicator, human health, livestock, and non-target wildlife. Registered for use only by the following agencies: U. S. Department of Agriculture's Animal and Plant Health Inspection Service (Hyattsville, MD), Texas Department of Agriculture, (Austin), Montana Department of Livestock (Helena), Wyoming Department of Agriculture (Cheyenne), Navajo Fish and Wildlife Separtment (Window Rock, AZ), New Mexico Department of Agriculture, (Las Cruces) and the kansas Department of Wildlife and Parks (Pratt). All other NaCN products for mammalian predator control have been canceled and uses suspended.

BACKGROUND:

Mode of action: Converts to hydrogen cyanide gas which poisons by inactivating an enzyme essential to mammalian cellular respiration leading to central nervous system depression, cardiac arrest, and gross respiratory failure (Ballantyne 1987).

Aquatic toxicity: NaCN is highly soluble in water (480 g/L at 10° C; Eisler 1991) but completely dissociates to give free cyanide which, depending on pH, forms highly toxic hydrogen cyanide (HCN). HCN does not tend to bioaccumulate in aquatic organisms. Likewise, cyanide seldom remains biologically available in soils because it is either complexed by trace metals, metabolized by microorganisms, or lost through volatilization (Eisler 1991). Cyanide is highly to very highly toxic to most aquatic organisms. In general, fish were the most sensitive aquatic organisms tested under controlled conditions (Eisler 1991).

Cyanide acts rapidly in aquatic environments, does not persist for extended periods, and is highly species selective. Organisms usually recover quickly on removal to clean water. The critical sites for cyanide toxicity in freshwater organisms are the gills, egg capsules, and other sites where gaseous exchange and osmoregulatory processes occur (Eisler 1991). The M-44 NaCN capsules may not be used within 200 feet of water and the number of capsules that may be used is limited to a maximum of 20 per square mile. Therefore, cyanide from M-44 capsules should pose negligible hazard to aquatic organisms.

Terrestrial toxicity: NaCN is highly to very highly toxic to birds and mammals. The M-44 NaCN ejector device should be considered to have 100% efficacy. The M-44 is designed to eject a burst of crystalline NaCN into the face of a predator tugging at the bait. On contact with mucus or saliva of the eyes, nose, and mouth, hydrogen cyanide is immediately formed and the gas readily absorbed through the highly permeable membranes of the nose, mouth, lungs, and stomach.

In an avian study of acute oral toxicity, three flesh-eating species (black vulture, American kestrel, and eastern screech-owl; LD_{50}s = 4.0-8.6 mg/kg) were more sensitive to NaCN than three species (Japanese quail, European starling, and domestic chicken; LD_{50}s = 9.4-21 mg/kg) that fed predominantly on plant material (Wiemeyer et al. 1986). It was also noted that the associated dose-response curve was consistently steepest for the flesh-eaters and thereby suggests further increase in hazard to species most likely to trip an M-44 cyanide ejector device.

EPA lists a number of "may affect" mammals such as the San Joaquin kit fox, jaguar, ocelot, gray wolf, and the Mariana crow. However, it is EPA's position that adherence to the 26 conditions effectively eliminates

the non-target hazards associated with the use of M-44 cyanide capsules. Conversely, it is clear from Connolly's (1988) list of non-target species that any carrion feeding animal able to activate the trigger of the M-44s cyanide ejector device is at risk. Consistent with its use pattern, no direct or indirect effects are expected with M-44 cyanide capsules with respect to listed plants and/or plant pollinators considered in this consultation.

Wildlife incidents: EPA reported no wildlife poisoning incidents associated with NaCN. However, when the M-44 user is in compliance with the 26 specific restrictions, the likelihood of the general public locating the carcass of a non-target species is small. Many of the Animal Damage Control non-target listings (Connolly 1988) would have constituted "wildlife incidents" if located first by the general public. Also, a dead California condor was exposed to NaCN from an M-44 even though a conclusive diagnosis of death was not made (Wiemeyer et al. 1986).

The U. S. Department of Agriculture's Animal Damage Control program records mortality from M-44 cyanide ejector use. During 1976-1986, M-44s were used in 14 western states, killing 103,255 animals. This total includes 4,868 non-target animals (Connolly 1988). Non-target species reported killed include grizzly bear, black bear, mountain lion, badger, kit and swift fox, bobcat, ringtail cat, feral cat, skunk, opossum, raccoon, Russian boar, feral hog, javelina, beaver, porcupine, nutria, rabbit, vulture, raven, crow, and hawk. It is reasonable to believe birds deaths are underestimated in non-target kill reports because the bird's flight response on activation of an M-44 could easily remove them from the vicinity of the device in a few seconds.

BIOLOGICAL OPINION

CHEMICAL REFERENCE TABLE

(The following table contains only those species for which the Service provided a jeopardy or no jeopardy call. Species not included in this list are either not affected by the chemical or have no chance for exposure. For a complete list of all species considered in this opinion, refer to the master species list on page III-1 of the species profile section.)

Species Name	J/NJ	PAGE
MAMMALS		
Florida panther	J	83
Gray wolf	NJ	85
Grizzly bear	NJ	85
Jaguarundi	J	83
Louisiana black bear	J	84
Ocelot	J	83
San Joaquin kit fox	J	85
BIRDS		
Alala (Hawaiian crow)	NJ	86
California condor	J	85
Mariana crow	NJ	86

RATIONALE FOR JEOPARDY DETERMINATIONS

Florida panther - The panther could be exposed to sodium cyanide when the chemical is used in an M-44 device to control canid predators such as foxes and feral dogs. EPA requires a number of restrictions on the use of the device, which would minimize the opportunity of an endangered species coming in contact with the M-44 device. According to EPA, the M-44 shall not be used in areas where endangered species may be adversely affected. However, the panther requires a large home range, and at times will venture from that range in search of prey. Young panthers will also disperse to establish new home range territory. Consequently, there is opportunity for panthers to be exposed to an M-44 device. Although these sodium cyanide devices are designed for canid control, there are documented kills of bobcats and mountain lions. Because of the critically small panther population, any poisoning event could threaten the survival of the species. Therefore, it is the Service's opinion that the use of sodium cyanide is likely to jeopardize the continued existence of the Florida panther.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Florida panther: prohibit the use of the chemical device within 20 miles of the boundary of any Federal and State lands (e.g., National Wildlife Refuge, National Park, National Preserve, State Park, State Preserve, State Wildlife Management Areas, etc.) and Indian Reservations that provide suitable panther habitat south of Charlotte, Glades and Martin Counties, Florida.

Incidental Take - Because individuals of the species may disperse beyond a given home range, the use and toxicity of the pesticide is still a concern. Consequently, the Service anticipates that an unquantifiable level of incidental take may occur as a result of the use of the pesticide outside of the prohibited use zone.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measure for minimizing incidental take should be adopted and implemented: prohibit the use of sodium cyanide (M-44s) in the geographic range of the Florida panther until after the user has contacted the local

Fish and Wildlife Service office and that office has determined that there are no known panthers in the general vicinity of where the M-44's are going to be used.

Jaguarundi and Ocelot - The ocelot and jaguarundi could be exposed to sodium cyanide when the chemical is used in an M-44 device to control canid predators such as foxes, coyote and feral dogs. EPA requires a number of restrictions on the device, which would minimize the opportunity of an endangered species coming in contact with the M-44 device. According to EPA, the M-44 shall not be used in areas where endangered species may be adversely affected. However, young ocelots and jaguarundi will disperse in an attempt to establish new territories and could be exposed to an M-44 device. Although these sodium cyanide devices are designed for canid control, there are documented kills of bobcats and mountain lions. Because of the critically small ocelot and jaguarundi populations, any poisoning event could threaten the survival of the species. Therefore, it is the Service's opinion that the use of sodium cyanide is likely to jeopardize the continued existence of the ocelot and jaguarundi.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative will avoid jeopardy to the ocelot and jaguarundi: prohibit use within three miles of occupied habitat.

Incidental Take - Despite the implementation of the reasonable and prudent alternatives described above, the Service anticipates that an unquantifiable level of incidental take of ocelot and jaguarundi may occur as a result of sodium cyanide use within the range of these species.

Reasonable and Prudent Measure(s) - If implemented, the following reasonable and prudent measures will minimize incidental take: prior to use of sodium cyanide in potential ocelot or jaguarundi habitat, conduct survey to determine if habitat is occupied. If habitat is unoccupied, no further restrictions are applicable. If habitat is occupied, prohibit use within three miles.

Louisiana black bear - The bear could be exposed to sodium cyanide when the chemical is used in an M-44 device to control canid predators such as foxes and feral dogs. EPA requires a number of restrictions on the use of the device, which would minimize the opportunity of an endangered species coming in contact with the M-44 device. According to EPA, the M-44 shall not be used in areas where endangered species may be adversely affected. However, the bear requires a large home range, and at times will venture from that range in search of additional prey. Young bears will also disperse to establish new home range territory. The registered use of the canid control chemical permits up to 20 M-44 devices per square mile. Consequently, there is opportunity for bears to be exposed to an M-44 device. Although these sodium cyanide devices are designed for canid control, there are documented kills of other mammals including skunks, bobcats and mountain lions. Because of the bear's relatively small population, any poisoning event could threaten the survival of the species. Therefore, it is the Service's opinion that the use of sodium cyanide is likely to jeopardize the continued existence of the Louisiana black bear.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Louisiana black bear: prohibit the use of the chemical device within the known occupied habitat of the Louisiana black bear.

Incidental Take - Because individuals of the species may disperse beyond a given home range, the use and toxicity of the pesticide is still a concern. Consequently, the Service anticipates that an unquantifiable level of incidental take may occur as a result of the use of the pesticide outside of the prohibited use zone.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measure for minimizing incidental take should be adopted and implemented: prohibit the use of sodium cyanide (M-44s) in the geographic range of the Louisiana black bear until after the user has contacted the

local Fish and Wildlife Service office and that office has determined that there are no known Louisiana black bears in the general vicinity of where the M-44's are going to be used.

San Joaquin kit fox - The primary risk of exposure of San Joaquin kit foxes to sodium cyanide would occur during use of this chemical in M-44 devices to control coyotes and other canids. M-44 devices (consisting of a stake with an attractant and spring loaded capsule containing the active ingredient) are targeted specifically for the control of wide-ranging canid species. They are highly attractive to such species, are highly dangerous when triggered, and are relatively non-selective. Because of these qualities, use of M-44 devices within the San Joaquin kit fox range would pose a significant exposure hazard to kit foxes and could have significant adverse impacts on the species. If permitted, use of M-44 devices likely would occur throughout the kit fox range because four potential target species (coyotes, red foxes, grey foxes, and feral dogs,) share this area. For these reasons, it is the Service's biological opinion that use of sodium cyanide in M-44 devices within the San Joaquin kit fox range is likely to jeopardize the continued existence of this species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the San Joaquin kit fox: prohibit use of sodium cyanide M-44 devices within the range of the San Joaquin kit fox.

Incidental Take - With implementation of the reasonable and prudent alternatives described above, no incidental take is anticipated and therefore none is authorized.

California Condor - The primary exposure of sodium cyanide from registered uses can occur when a California condor activates the M-44 device by its foraging activities. Limited reintroduction of California condors by the Service has begun in 1991. Therefore, it is the Service's biological opinion that use of sodium cyanide is likely to jeopardize the continued existence of this species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the California condor: the use of sodium cyanide should be prohibited in condor occupied habitat including Ventura, Kern, Santa Barbara, Los Angeles, and San Luis Obispo Counties. Alternative control of canid predators must be considered to avoid the inadvertent poisoning of California condors.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

RATIONALE FOR NO JEOPARDY DETERMINATIONS

Gray wolf and Grizzly bear - The registration of sodium cyanide capsules for use in the M-44 device for control of canid predators could result in the mortality of a gray wolf or grizzly bear. However, EPA also requires a number of restrictions, some of which should provide protection to the gray wolf and grizzly bear. According to EPA, the M-44 shall not be used in areas where
threatened or endangered species may be adversely affected. Based on that restriction, it is the Service's opinion that the registered use of sodium cyanide is not likely to jeopardize the continued existence of the gray wolf or the grizzly bear.

Incidental Take - While applicators are restricted from using the M-44 in areas where a gray wolf or grizzly bear may be adversely affected, these two species have a very wide range and thus could be inadvertently taken in areas not mapped and/or prior to the applicator's knowledge that the species may be in the control area. The Service, therefore, anticipates that an unquantifiable level of incidental take may occur as a result of the use of sodium cyanide.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measures should be adopted: prohibit the application of sodium cyanide (M-44s) in the geographic range of the gray

wolf and grizzly bear until after the user has contacted the local Fish and Wildlife Service office and that office has determined that there are no known wolves or grizzly bears in the general vicinity of where the M44's are going to be applied.

Alala (Hawaiian crow) and Mariana crow- Both of these corvids are, in part, carrion feeders. M-44 sodium cyanide devices may pose a potential threat due to the possibility that the crows may be attracted to baits associated with capsule deployment. There are few incidents of feral dog predation on livestock in these geographic areas and canid control is typically effected through shooting or trapping. M-44 devices are not expected to be employed in Hawaii or Guam. The alala is currently restricted to the coastal slope of Mona Loa on the island of Hawaii and only 12 birds were estimated to occur in the wild in 1990. The Mariana Crow is currently restricted to forest areas from Ritidian Point to Anao along the northern cliffline, in Northwest Field, and in the Convention Weapons Storage Areas of Guam and on the island of Rota. Consequently, it is the Service's biological opinion that use of sodium cyanide as described above within or adjacent to habitat occupied by the alala and Mariana crow is not likely to jeopardize the continued existence of these species.

Incidental take- The Service anticipates that an unquantifiable level of incidental take of the alala and Mariana common crow may occur as a result of sodium cyanide use within the occupied habitat of these species.

Reasonable and Prudent Measure(s)- The following reasonable and measure for minimizing incidental take must be adopted: prohibit the use of sodium cyanide within occupied habitat on Guam, Rota and the island of Hawaii.

Sodium fluroacetate (1080)

CHEMICAL INFORMATION

TYPE: Predator control - coyotes

FORMULATION: Livestock protection collar, 30 ml (300 mg Compound 1080 = 1% AI) or 60 ml (600 mg Compound 1080 = 1% AI) rubber bladder toxicant reservoir, for use on sheep and goats only.

REGISTERED USES: Livestock depredation collar for sheep and goats to control depredating coyotes. Registered for use only by the states of South Dakota, Montana, Wyoming, New Mexico, and Texas. All other uses of sodium fluoroacetate have been canceled.

BACKGROUND:

Mode of action: Inhibitor of citric acid cycle leading to general inhibition of oxidative energy metabolism at the cellular level with the central nervous system and heart most critically affected (Peters 1952). Three molecules of fluroacetate combine in the liver to form a molecule of flurocitrate, which poisons enzymes critical to cellular respiration. The heart and the brain are most affected.

Aquatic toxicity: Because use of sodium fluoroacetate is limited to toxic collars on livestock in fenced pastures, and restricted to use by trained applicators, the potential for exposure of Compound 1080 in amounts that would cause harm in aquatic environments is virtually nonexistent. However, if a lake or large river is used as a containment barrier, exposure of aquatic species must be considered in event of a collar puncture in or immediately adjacent to water.

Terrestrial toxicity: Sodium fluoroacetate is very highly toxic to birds and mammals. The median LD_{50} for 13 species of birds representing five taxonomic orders is 5.5 mg Compound 1080/kg body mass, with carrion feeding black-billed magpie (1.6 mg/kg) and turkey vulture (20 mg/kg) representing the extremes (Atzert 1971, Hudson et al. 1984). Japanese quail and turkey vulture are the only birds to give LD_{50}s above 10 mg/kg. The golden eagle LD_{50} is 3.5 mg/kg. In tests of 11 carnivorous and four herbivorous mammals, the median LD_{50} is 0.5 mg Compound 1080/kg body mass, with the domestic dog (0.07 mg/kg) and opossum (60 mg/kg) providing the extremes (Atzert 1971, Hudson et al. 1984). Domestic sheep and cows and mule deer all have LD_{50}s <1 mg/kg. In a test of Compound 1080's secondary hazard, European ferrets were fed mice that had been dosed with the equivalent of 1, 2, 4, or 8 mg/kg of ferret body weight. The ferrets were given one mouse at 1-2 h after dosing and all the ferrets died (Hudson et al. 1984). Other studies also suggest the potential for poisoning from secondary exposure to Compound 1080 (e.g., Rudd and Genelly 1956, Eastland and Beasom 1986, Hegdal et al. 1986). Another variable affecting toxicity is ambient temperature. Turkey vultures are about 2.5 times as sensitive to acute Compound 1080 exposure at 8-9°C then when dosed at 23-28°C (Fry et al. 1986).

The EPA concludes that direct ingestion of Compound 1080 likely would kill most predators, and ingestion of dead sheep, goats, or coyotes with Compound 1080 in or on their flesh, conceivably could kill the predators as well. Thus, concerning this pesticidal use, the possibility of direct exposure is the primary issue in making a "may affect" determination. There is a direct exposure risk to grizzly bears and gray wolves depredating on Compound 1080 collared livestock. There is less risk to listed species that scavenge because of their feeding habitats and the fact that the use of the toxic collar is restricted to trained applicators. However, when a water barrier is used to contain collared animals, carrion-feeding and predatory mammals and birds associated with water will be at risk to exposure. There is a slight risk of poisoning associated with exposure to carcasses of animals killed with Compound 1080. Consistent with its restricted use pattern, no direct or indirect effects are expected with Compound 1080 with respect to listed plants or plant pollinators.

Wildlife incidents: The livestock protection collar may only be used on a restricted number of sheep and goats in accordance with specified acreage within approved enclosures that may include natural barriers such as escarpments, lakes, and large rivers (Connolly 1989). All collared livestock must be accounted for weekly. Once a toxicant reservoir is punctured or the collar otherwise damaged, the collar and all Compound 1080 wastes must be retrieved and properly disposed (toxic solution contains yellow dye as a safety marker). Prompt disposal of collared livestock carcasses and predators suspected of Compound 1080 poisoning is essential because residual toxicant on livestock and poisoning by secondary exposure from scavenging dead predators has been reported (Rudd and Genelly 1956, Eastland and Beasom 1986, Connolly 1989). Because of the highly controlled use of the livestock protection collar and the manageable circumstances of its use, significant environmental pressure of sodium fluoroacetate is highly unlikely from its single registered use provided barriers prevent contamination of natural waters.

BIOLOGICAL OPINION

CHEMICAL REFERENCE TABLE

(The following table contains only those species for which the Service provided a jeopardy or no jeopardy call. Species not included in this list are either not affected by the chemical or have no chance for exposure. For a complete list of all species considered in this opinion, refer to the master species list on page III-1 of the species profile section.)

Species Name	J/NJ	PAGE
MAMMALS		
Gray wolf	J	88
Grizzly bear	J	89

RATIONALE FOR JEOPARDY DETERMINATIONS

Gray wolf - The only registered use for compound 1080 is in toxic livestock collars for sheep and goats that are used to control depredating coyotes. It is a restricted use pesticide registered for use only by the Animal and Plant Health Inspection Service (APHIS) and the States of SD, MT, WY, NM, and TX. While wolves usually do not make throat attacks, there is still a possibility that they may bite into a collar while killing or feeding on a collared animal. As little as 0.1 ml of collar contents could be fatal to a 25-pound dog, and the amount of compound 1080 (30 ml or 60 ml) used to kill coyotes could have a lethal or sublethal effect on the wolf. It is, therefore, the Service's opinion that the registered use of sodium fluroacetate (compound 1080) is likely to jeopardize the continued existence of the gray wolf.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the gray wolf: prior to the proposed use of the 1080 livestock protection collar in the following areas, the user should contact the nearest office of the Service to determine whether use of the collar may adversely affect the wolf. If it is determined by the Service or the user that the use of the collar may adversely impact a wolf, the collar should not be used in these following areas.

Idaho:	Northern Boise, Bonner, Boundary, Clearwater, northwest Custer, Idaho, Lemhi, Shoshone, and Valley Counties.
Montana:	Beaverhead, Carbon, Flathead, Gallatin, Glacier, Lake, Lewis and Clark, Lincoln, Madison, Missoula, Park, Pondera, Powell, Sanders, Stillwater, Sweetgrass, and Teton Counties.
Washington:	Pend Oreille County.
Wyoming:	Fremont, Hot Springs, Park, Sublette, and Teton Counties, and Yellowstone National Park.

Incidental Take - With the implementation of the reasonable and prudent alternatives to preclude jeopardy to the gray wolf, no incidental take is anticipated and thus none is authorized.

Grizzly bear - As stated for the gray wolf, the only registered use for compound 1080 is in toxic livestock collars for sheep and goats that are used to control depredating coyotes. It is registered for use only by APHIS and several States including Wyoming and Montana. Being opportunistic feeders, grizzly bears could feed upon live sheep or lambs and on carrion of dead collared sheep as well as coyotes that have been killed as a result of the 1080 livestock protection collar. Although compound 1080 is highly toxic to some warm-blooded animals, there is no information on the toxicity of compound 1080 to grizzly bears. There is a reported LD50 for other bears of 0.5 to 1.0 mg/kg. It would, therefore, appear that a large collar (60 ml) or a small collar (30 ml) could be toxic to even a large grizzly bear. It is the Service's opinion that the

registered use of sodium fluroacetate (compound 1080) is likely to jeopardize the continued existence of the grizzly bear.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the grizzly bear: prior to the proposed use of the 1080 livestock protection collar in the following areas, the user should contact the nearest office of the Service to determine whether use of the collar may adversely impact the grizzly bear. If it is determined by the Service or the user that the use of the collar may adversely impact a grizzly bear, the collar should not be used in these specific areas.

Idaho: Bonner, Boundary, and Fremont Counties.
Montana: Beaverhead, Carbon, Flathead, Gallatin, Glacier, Lake, Lewis and Clark, Lincoln, Madison, Missoula, Park, Sanders, Stillwater, Sweetgrass, and Teton Counties.
Washington: East Pend Oreille, west Okanogan, Sakagit, and Whitcom Counties.
Wyoming: Fremont, Park, and Teton Counties, and Yellowstone National Park.

Incidental Take - With the implementation of the reasonable and prudent alternatives to preclude jeopardy to the grizzly bear, no incidental take is anticipated and thus none is authorized.

Vitamin D3

CHEMICAL INFORMATION

TYPE: Rodenticide

FORMULATION: Ready-to-use bait, with station application rates ranging from 0.25-8 ounces of 0.075% AI bait concentration.

REGISTERED USES: Control of Norway rats, roof rats and house mice in and around homes, industrial, commercial, agricultural and poultry buildings and similar man-made structures.

BACKGROUND:

Mode of action: This product is the activated form of vitamin D and its toxic effects is a combination of actions on liver, kidney and possibly the myocardium. Death results from renal injury brought on by hypercalcemia.

Aquatic toxicity: EPA has not required aquatic toxicity data to support the registration of vitamin D3, and EPA provided no other aquatic toxicity with the consultation request. EPA (1991) reported that, due to the virtual insolubility of vitamin D3 (solubility < 1 ppm) and the bait application patterns, the pesticide will not be subject to run-off into aquatic systems. Therefore, EPA does not expect vitamin D3 to pose any problems for listed aquatic species.

Terrestrial toxicity: Vitamin D3 is classified as highly toxic to mammals with the lowest acute oral LD_{50} value reported by EPA of 42.0 mg/kg for the rat. Avian toxicity testing with 30% AI material yielded in the following values: mallard LD_{50} > 2,000 mg/kg, mallard LC_{50} = 4,000 ppm, and northern bobwhite LC_{50} = 2,000 ppm. Although EPA provided no data concerning potential secondary exposure, EPA does not expect vitamin D3 to pose any secondary hazard to listed species because (1) "Bell Laboratories indicated there was none when fed to beagles [personal communication with George Matschke, APHIS, Denver Wildlife Research Center]", (2) "opportunities for predatory or scavenging listed species to be exposed to mice or rats killed with vitamin D3 would be few", and (3) "using the worst case scenario of poisoned mice being consumed by a San Joaquin kit fox [see Bromadiolone], the hazard ratio would be >1." EPA does not expect problems to avian species associated with direct or secondary exposure. EPA concluded that because vitamin D3 is used in bait boxes and in locations inaccessible to wildlife, there should be no direct hazard to listed species, except where (1) listed species habitat is adjacent to urban buildings where vitamin D3 might be used, and (2) any listed species might be inclined to feed on bait attractive to commensal rodents.

Wildlife incidents: EPA reported no fish or wildlife poisoning incidents associated with D3.

BIOLOGICAL OPINION

CHEMICAL REFERENCE TABLE

(The following table contains only those species for which the Service provided a jeopardy or no jeopardy call. Species not included in this list are either not affected by the chemical or have no chance for exposure. For a complete list of all species considered in this opinion, refer to the master species list on page III-1 of the species profile section.)

Species Name	J/NJ	PAGE
MAMMALS		
Alabama beach mouse	J	92
Anastasia Island beach mouse	J	93
Carolina northern flying squirrel	J	93
Choctawhatchee beach mouse	J	92
Florida salt marsh vole	J	94
Fresno kangaroo rat	J	94
Giant kangaroo rat	NJ	95
Morro Bay kangaroo rat	J	95
Perdido Key beach mouse	J	92
Point Arena mountain beaver	NJ	95
Salt marsh harvest mouse	J	94
Southeastern beach mouse	J	93
Stephen's kangaroo rat	NJ	96
Tipton kangaroo rat	NJ	95

RATIONALE FOR JEOPARDY DETERMINATIONS

Alabama beach mouse, Choctawhatchee beach mouse, and Perdido Key beach mouse - Exposure of these beach mice to vitamin D3 could occur through consumption of poisoned baits when used to control rodents within or in close proximity to their occupied habitats. All three subspecies are restricted to mature coastal barrier dune systems along the Gulf of Mexico and occur in areas that are being encroached upon by various types of human development. Therefore, there is a high possibility of vitamin D3 being used where these mice could come in contact with it. The Choctawhatchee beach mouse is presently known to occur only on Shell Island at St. Andrews Bay in Bay County, Florida, and on approximately 7.9 km of beach dune habitat (coastline up to 150 m inland) near Topsail Hill, from around Morrison Lake eastward to Stalworth Lake, Walton County, Florida. The Alabama beach mouse presently is surviving only on disjunct tracts of the sand dune system from Fort Morgan State Park to the Romar Beach area in Baldwin County, Alabama. The Perdido Key beach mouse occurs only on Perdido Key in Baldwin County, Alabama and Escambia County, Florida. The distance to which occupied habitat of these species extends inland from the beach varies depending upon the configuration of the sand dune system and the vegetation present. Both subspecies utilize portions of the frontal or primary dunes; interdunal areas; and dunes further inland (secondary or interior dunes). Because of the restricted distributions of these species and the likelihood of vitamin D3 being used for rodent control within or adjacent to areas which they inhabit, it is the Service's biological opinion that the registered use of vitamin D3 is likely to jeopardize the continued existence of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit use of vitamin D3 within 100 yards of occupied habitat of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Anastasia Island beach mouse and Southeastern beach mouse - These two beach mice are endemic to the east coast of Florida. The Anastasia Island beach mouse is presently believed to occur only on Anastasia Island, St. Johns County, Florida. The southeastern beach mouse is believed to presently occur only from Florida's Mosquito (Ponce) Inlet in Volusia County south to Hutchinson Island in St. Lucie County, Florida. Both subspecies inhabit sand dunes vegetated by sea oats and dune panic grass and the scrub adjoining these dunes, which is vegetated with oaks, sand pine, palmetto, sea grapes, and/or wax myrtle. Since the ranges of both species have been and continue to be encroached upon by various types of human development, it is likely that vitamin D3 could be used for pest control in areas where both these beach mice occur. Exposure of the mice to vitamin D3 would occur through ingestion of poison baits, which would result in direct mortality of individuals of the species. Accordingly, it is the Service's biological opinion that the registered use of vitamin D3 is likely to jeopardize the continued existence of the Anastasia Island beach mouse or the southeastern beach mouse.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit use of vitamin D3 within 100 yards of occupied habitat of the Anastasia Island beach mouse and the southeastern beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Carolina northern flying squirrel - This species may be directly exposed to vitamin D3 poisoning from its registered use to control rats and mice around agricultural buildings and other man-made structures. The Carolina northern flying squirrel occurs in coniferous and northern hardwood forests, and may occasionally forage on the ground. Where land use changes and development encroach on the species' habitat there is a potential risk of the squirrel coming in contact with vitamin D3 bait that is placed outside of buildings (e.g., storage sheds and barns). Vitamin D3 bait is toxic to rodents and would most likely kill a northern flying squirrel if it consumed the bait. Due to the restricted range and small population of the Carolina northern flying squirrel, any poisoning of individuals could threaten the survival of the species. Therefore, it is the Service's opinion that the use of vitamin D3 is likely to jeopardize the continued existence of the Carolina northern flying squirrel.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Carolina northern flying squirrel: prohibit the outdoor use of the chemical within the species' occupied habitat.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Florida salt marsh vole - Exposure of the vole to vitamin D3 could occur through consumption of poisoned baits used to control rodents in close proximity to the vole's occupied marsh habitat. There is a possibility of the rodenticide being used around buildings or other structures adjacent to salt marsh habitat where the vole could come in contact with it. The vole is restricted to a single known area in the salt marsh of Waccasassa Bay, Levy County, Florida. This rodenticide is highly toxic to mammals. Because of the restricted distribution of the species, its limited population, and the likelihood of this rodenticide being used for rodent control adjacent to areas in which the vole occurs, it is the Service's biological opinion that the use of vitamin D3 is likely to jeopardize the continued existence of the Florida salt marsh vole.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit use of vitamin D3 within 100 yards of the landward edge of the species' salt marsh habitat in Levy County, Florida.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Fresno kangaroo rat, salt marsh harvest mouse - Despite relatively restricted vitamin D3 use patterns (registered for use as ready-to-use bait in and around human structures only), Fresno kangaroo rats, and salt marsh harvest mice are vulnerable to vitamin D3 exposure for the following reasons: (1) all occupy some habitats in which man-made structures exist nearby (residences and agricultural buildings in the San Joaquin Valley, commercial and industrial buildings in the vicinity of San Francisco Bay salt marshes, (2) all occupy highly restricted and/or fragmented habitats; and (3) all rodents are highly susceptible to the toxic effects of this compound. It is the Service's biological opinion that use of vitamin D-3 within the range of the Fresno kangaroo rat and salt marsh harvest mouse is likely to jeopardize the continued existence of these species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Fresno kangaroo rat, salt marsh harvest mouse: prohibit outdoor vitamin D-3 use within 100 yards of all habitats occupied by these species.

Incidental Take - Although possible exposure of the Fresno kangaroo rat and salt marsh harvest mouse to Vitamin D-3 probably is minimal, the Service anticipates that an unquantifiable level of incidental take may occur as a result of Vitamin D-3 use within the ranges of these species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Morro Bay kangaroo rat - The primary exposure of vitamin D3 from registered uses can occur when the Morro Bay kangaroo rat ingests treated bait. The extremely limited range of this species, the presence of target rodents, and the interspersion of this species habitat with urban, agricultural, and commercial buildings place the Morro Bay kangaroo rat at risk. It is the biological opinion of the Service that use of vitamin D3 is likely to jeopardize the continued existence of the Morro Bay kangaroo rat.

Reasonable and Prudent Alternative - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Morro Bay kangaroo rat: prohibit the use of vitamin D3 within 100 yards of the occupied habitat of the Morro Bay kangaroo rat.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

RATIONALE FOR NO JEOPARDY DETERMINATIONS

Giant kangaroo rat, Tipton kangaroo rat - Despite relatively restricted vitamin D3 use patterns (registered for use as ready-to-use baits in and around human structures only), giant kangaroo rats and Tipton kangaroo rats may be subject to periodic vitamin D3 exposure because they sometimes occupy habitats that are adjacent to human activities and structures. Tipton kangaroo rats may be found near residential, agricultural, and commercial buildings in the southern San Joaquin Valley; while giant kangaroo rats may be found in oil fields and rangelands in the southwest and west central portions of the Valley where industrial and ranch structures are present. However, both species have a more widespread range than the Fresno kangaroo rat discussed above, and large portions of their ranges are far removed from anticipated vitamin D3 uses. Therefore, the Service concludes that vitamin D3 use within the range of the giant kangaroo rat and Tipton kangaroo rat is not likely to jeopardize the continued existence of these species.

Incidental Take - Although possible exposure of the giant kangaroo rat and Tipton kangaroo rat to vitamin D-3 probably is minimal, the Service anticipates that an unquantifiable level of incidental take may occur as a result of vitamin D-3 use within the range of this species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the giant and Tipton kangaroo rat will be minimized: prohibit outdoor vitamin D-3 use within areas accessible to wildlife that are within 100 yards of all habitats known or likely to be occupied by these species. Habitats likely to be occupied include native lands, grasslands, agricultural lands fallow for two years or more, and canal and levee embankments.

Point Arena Mountain Beaver - Despite relatively restricted vitamin D3 use patterns (registered for use as ready-to-use bait in tamper-resistant bait boxes in and around human structures only), the Point Arena Mountain beaver is vulnerable to vitamin D3 exposure for the following reasons: (1) it occupies some habitats in which man-made structures exist nearby (residences, agricultural buildings, municipal, and communication structures in the Point Arena vicinity); (2) it occupies highly restricted and/or fragmented habitats; and (3) rodents are highly susceptible to the toxic effects of this compound. It is the Service's biological opinion that use of vitamin D-3 within the range of the Point Arena mountain beaver is not likely to jeopardize the continued existence of this species.

Incidental Take - Although possible exposure of the Point Arena mountain beaver to vitamin D-3 probably is minimal, the Service anticipates that an unquantifiable level of incidental take may occur as a result of vitamin D-3 use within the range of this species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the Point Arena mountain beaver will be minimized: prohibit outdoor vitamin D-3 use within 100 yards of all habitats occupied by this species.

Stephen's kangaroo rat -primary exposure of vitamin D3 from registered uses can occur when Stephen's kangaroo rat ingests treated bait. It is the biological opinion of the Service that use of vitamin D3 is not likely to jeopardize the continued existence of the Stephen's kangaroo rat.

Incidental Take - The service anticipates that an unquantifiable level of incidental take may occur as a result of vitamin D3 use within the occupied habitat of this species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the Stephen's kangaroo rat will be minimized: prohibit the use of vitamin D3 within 100 yards of all habitats occupied by this species.

Warfarin

CHEMICAL INFORMATION

TYPE: Rodenticide (coumarin anticoagulant)

FORMULATION: Water soluble, ready-to-use baits, concentrates (in corn starch for mixing with cornmeal, rolled oats, or other materials), powder, liquid concentrates, nylon pouches, coated talc, and dust (Sine 1992).

REGISTERED USES: Control of Norway rats, roof rats, and house mice control primarily in and around homes and other buildings. Warfarin's uses also include agricultural, commercial, institutional, and industrial sites as well as transportation vehicles such as aircraft, ships, and rail cars. Warfarin baits must be placed in tamperproof boxes (d-CON 1974, Haco Inc. 1992a and 1992b). Approximately 8000 pounds active ingredient of warfarin are used annually.

BACKGROUND:

Mode of action: Warfarin (including its sodium salt) is a general use anticoagulant rodenticide that acts by depressing the clotting capabilities of the blood while concurrently increasing the permeability of capillaries throughout the body. This action predisposes the exposed animal to widespread internal hemorrhage. There is a 12-72 hour delay between ingestion of a single toxic dose and the appearance of the first toxic effects. It takes several days and repeated feedings on warfarin to kill a rodent.

Aquatic Toxicity: Warfarin is essentially insoluble in water (solubility 195 ppm), except for its water soluble sodium salt formed in alkaline solutions. Laboratory LC_{50} values for rainbow trout and bluegill, are >16 and >17.5 ppm, respectively, and the *Daphnia magna* EC_{50} is 17 ppm. It is unlikely that normal use of warfarin would harm aquatic fauna, as its application methods (mainly tamper-proof bait packets in and around buildings) and its characteristic of being essentially insoluble in water should preclude exposure. Therefore, warfarin should not be subject to runoff, leaching, or drift.

Terrestrial toxicity: Laboratory LD_{50}s of warfarin for rats, mallards, and northern bobwhite are 3.0, 621, and >2000 mg/kg, respectively. Data indicate that warfarin is non-toxic to bees (Sine 1992). Direct exposure of listed species to warfarin is unlikely because the pesticide should be inaccessible to wildlife when used according to label directions. However, there is concern for exposure where human development has encroached on the habitat of listed rodents. Thus, there is a "may affect" situation if (1) habitat of a listed species is adjacent to buildings where warfarin might be used and, (2) any listed species might be inclined to feed on bait attractive to commensal rodents. The potential for significant secondary exposure to warfarin is low because the levels of warfarin in the target animals are likely to be quite low to a predator or scavenger under all but the most extreme circumstances.

Wildlife incidents: EPA reported no wildlife poisoning incidents associated with warfarin.

BIOLOGICAL OPINION

CHEMICAL REFERENCE TABLE

(The following table contains only those species for which the Service provided a jeopardy or no jeopardy call. Species not included in this list are either not affected by the chemical or have no chance for exposure. For a complete list of all species considered in this opinion, refer to the master species list on page III-1 of the species profile section.)

Species Name	J/NJ	PAGE
MAMMALS		
Alabama beach mouse	J	98
Anastasia Island beach mouse	J	99
Carolina northern flying squirrel	J	99
Choctawhatchee beach mouse	J	98
Florida salt marsh vole	J	100
Fresno kangaroo rat	J	100
Giant kangaroo rat	NJ	101
Morro Bay kangaroo rat	J	101
Perdido Key beach mouse	J	98
Point Arena mountain beaver	NJ	101
Salt marsh harvest mouse	J	100
Southeastern beach mouse	J	99
Stephen's kangaroo rat	NJ	101
Tipton kangaroo rat	NJ	101

RATIONALE FOR JEOPARDY DETERMINATIONS

Alabama beach mouse, Choctawhatchee beach mouse, and Perdido Key beach mouse - Exposure of these beach mice to warfarin could occur through consumption of poisoned baits when used to control rodents within or in close proximity to their occupied habitats. All three subspecies are restricted to mature coastal barrier dune systems along the Gulf of Mexico and occur in areas that are being encroached upon by various types of human development. Therefore, there is a high possibility of warfarin being used where these mice could come in contact with it. The Choctawhatchee beach mouse is presently known to occur only on Shell Island at St. Andrews Bay in Bay County, Florida, and on approximately 7.9 km of beach dune habitat (coastline up to 150 m inland) near Topsail Hill, from around Morrison Lake eastward to Stalworth Lake, Walton County, Florida. The Alabama beach mouse presently is surviving only on disjunct tracts of the sand dune system from Fort Morgan State Park to the Romar Beach area in Baldwin County, Alabama. The Perdido Key beach mouse occurs only on Perdido Key in Baldwin County, Alabama and Escambia County, Florida. The distance to which occupied habitat of these species extends inland from the beach varies depending upon the configuration of the sand dune system and the vegetation present. Both subspecies utilize portions of the frontal or primary dunes; interdunal areas; and dunes further inland (secondary or interior dunes). Because of the restricted distributions of these beach mice and the likelihood of warfarin being used for rodent control within or adjacent to areas which they inhabit, it is the Service's biological opinion that the registered use of warfarin is likely to jeopardize the continued existence of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Reasonable and Prudent Alternative(s) - If implemented the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit use of warfarin within 100 yards of occupied habitat of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Anastasia Island beach mouse and Southeastern beach mouse - These two beach mice are endemic to the east coast of Florida. The Anastasia Island beach mouse is presently believed to occur only on Anastasia Island, St. Johns County, Florida. The southeastern beach mouse is believed to presently occur only from Florida's Mosquito (Pounce) Inlet in Volusia County south to Hutchinson Island in St. Lucie County, Florida. Both subspecies inhabit sand dunes vegetated by sea oats and dune panic grass and the scrub adjoining these dunes, which is vegetated with oaks, sand pine, palmetto, sea grapes, and/or wax myrtle. Since the ranges of both subspecies have been and continue to be encroached upon by various types of human development, it is likely that warfarin could be used for pest control in areas where both these beach mice occur. Exposure of the mice to warfarin would occur through ingestion of poison baits, which would result in direct mortality of individuals of the species. Accordingly, it is the Service's biological opinion that the registered use of warfarin is likely to jeopardize the continued existence of the Anastasia Island beach mouse or the southeastern beach mouse.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit use of warfarin within 100 yards of occupied habitat of the Anastasia Island beach mouse and the southeastern beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Carolina northern flying squirrel - This species may be directly exposed to warfarin poisoning from its registered use to control rats and mice around and in the vicinity of buildings, including homes, commercial and agricultural sites. The Carolina northern flying squirrel occurs in coniferous and northern hardwood forests, and may occassionally forage on the ground. Where land use changes and development encroach on the species' habitat there is a potential risk of the squirrel coming in contact with warfarin bait that is placed outside of buildings (e.g., storage sheds and barns). Warfarin is toxic to rodents and would most likely kill a northern flying squirrel if it consumed the bait. Due to the restricted range and small population of the Carolina northern flying squirrel, any poisoning of individuals could threaten the survival of the species. Therefore, it is the Service's opinion that the use of warfarin is likely to jeopardize the continued existence of the Carolina northern flying squirrel.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Carolina northern flying squirrel: prohibit the outdoor use of the chemical within the species' occupied habitat.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Florida salt marsh vole - Exposure of the vole to warfarin could occur through consumption of poisoned baits used to control rodents in close proximity to the vole's occupied marsh habitat. There is a possibility of the rodenticide being used around buildings or other structures adjacent to salt marsh habitat where the vole could come in contact with it. The vole is restricted to a single known area in the salt marsh of Waccasassa Bay, Levy County, Florida. This rodenticide is highly toxic to mammals. Because of the restricted distribution of the species, its limited population, and the likelihood of this rodenticide being used for rodent control adjacent to areas in which the vole occurs, it is the Service's biological opinion that the use of warfarin is likely to jeopardize the continued existence of the Florida salt marsh vole.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: Prohibit use of warfarin within 100 yards of the landward edge of the species' salt marsh habitat in Levy County, Florida.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Fresno kangaroo rat, salt marsh harvest mouse - Despite relatively restricted warfarin use patterns (registered for use in bait boxes in and around human structures only), Fresno kangaroo rats and salt marsh harvest mice are vulnerable to warfarin exposure for the following reasons: (1) both occupy some habitats in which man-made structures exist nearby (residences and agricultural buildings in the San Joaquin Valley for the Fresno kangaroo rat, commercial and industrial buildings in the vicinity of San Francisco Bay salt marshes for the harvest mouse; (2) both occupy highly restricted and/or fragmented habitats; and (3) all rodent species are highly susceptible to the toxic effects of this compound. It is the Service's biological opinion that warfarin use within the range of the Fresno kangaroo rat and salt marsh harvest mouse is likely to jeopardize the continued existence of these species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Fresno kangaroo rat and salt marsh harvest mouse: prohibit outdoor warfarin use within 100 yards of all habitats occupied by these species.

Incidental Take - Although possible exposure of the Fresno kangaroo rat and salt marsh harvest mouse to warfarin probably is minimal, the Service anticipates that an unquantifiable level of incidental take may occur as a result of warfarin use within the ranges of these species.

Reasonable and Prudent Measure(s)- To minimize incidental take, EPA must establish a monitoring/enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Morro Bay kangaroo rat - The primary exposure of warfarin from registered uses can occur when the Morro Bay kangaroo rat ingests treated bait. The extremely limited range of this species, the presence of target rodents, and the interspersion of this species habitat with urban, agricultural, and commercial buildings place the Morro Bay kangaroo rat at risk.It is the biological opinion of the Service that use of warfarin is likely to jeopardize the continued existence of the Morro Bay kangaroo rat.

Reasonable and Prudent Alternative - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Morro Bay kangaroo rat: prohibit the use of warfarin within 100 yards of the occupied habitat of the Morro Bay kangaroo rat.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

RATIONALE FOR NO JEOPARDY DETERMINATIONS

Giant kangaroo rat, Point Arena mountain beaver, Tipton kangaroo rat - Despite relatively restricted warfarin use patterns (registered for use in bait boxes in and around human structures only), giant kangaroo rats, Point Arena mountain beaver, and Tipton kangaroo rats may be subject to periodic warfarin exposure because they sometimes occupy habitats that are adjacent to human activities and structures. Tipton kangaroo rats may be found near residential, agricultural, and commercial buildings in the southern San Joaquin Valley of California; mountain beaver near municipal and communication structures in the Point Arena vicinity; and giant kangaroo rats in oil fields and rangelands in the southwest and west central portions of the San Joaquin Valley where industrial and ranch structures are present. However, both kangaroo species have a more widespread range than the Fresno kangaroo rat discussed above and large portions of their ranges are far removed from anticipated warfarin uses. Furthermore, restriction of this compound to use in bait boxes eliminates most avenues of exposure to mountain beaver. Therefore, the Service concludes that use of warfarin within the range of the giant kangaroo rat, Point Arena mountain beaver, and Tipton kangaroo rat is not likely to jeopardize the continued existence of these species.

Incidental Take - Although possible exposure of the giant kangaroo rat, Point Arena mountain beaver, and Tipton kangaroo rat to warfarin probably is minimal, the Service anticipates that an unquantifiable level of incidental take may occur as a result of warfarin use within the range of these species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the giant kangaroo rat, Point Arena mountain beaver, and Tipton kangaroo rat will be minimized: Prohibit outdoor warfarin use within 100 yards of habitats occupied by these species.

Stephen's kangaroo rat - The primary exposure of warfarin from registered uses can occur when Stephen's kangaroo rat ingests treated bait. It is the biological opinion of the Service that use of warfarin is not likely to jeopardize the continued existence of the Stephen's kangaroo rat.

Incidental Take - The service anticipates that an unquantifiable level of incidental take may occur as a result of warfarin use within the occupied habitat of this species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the Stephen's kangaroo rat will be minimized: prohibit the use of warfarin within 100 yards of its occupied habitat.

Zinc phosphide

CHEMICAL INFORMATION

TYPE: Rodenticide

FORMULATION: Bait in the form of granules, pellets, tablets, or treated oats, wheat, or corn meal. It is also formulated as wettable powder used to coat fruit, vegetables or dry pet food for use at specific bait stations. Also, a 10% tracking powder which is registered for indoor use only. Broadcast baiting and aerial application of granular bait is used. Aerial application cannot be used over unharvested crops, nor on bare ground.

REGISTERED USES: To control rodents in orchards, rangeland, forest, vineyards, sugarcane, macadamia nuts, agricultural crops, ornamentals, lawns, golf courses, recreational areas, rights-of-way, animal burrows, and in and around all types of buildings.

BACKGROUND:

Mode of action: Its effect comes from the liberation and absorption of phosphine gas when the ingested zinc phosphide comes in contact with the acidic condition in the gut. Pulmonary edema is a common cause of death.

Aquatic toxicity: Zinc phosphide's solubility is <1 ppm, and it is relatively insoluble in alcohol or cold water. The pesticide breaks down into zinc and phosphine gas when exposed to acidic conditions. The available aquatic bioassay data indicate that even in a worst case scenario using broadcast application, zinc phosphide would not affect aquatic organisms. Therefore, EPA finds that there will be no problems to aquatic organisms associated with direct or secondary exposure to zinc phosphide.

Terrestrial toxicity: Zinc phosphide breaks down in the acidic environment of the gut and releases highly volatile phosphine gas. Thus, there should not be a great opportunity for predators or scavengers to be secondarily exposed to the pesticide. However, several days are required for a complete breakdown in the gut, and there is a secondary poisoning hazard for this period (Rudd and Genelly 1956). In some instances it may be possible for a predator or scavenger to receive lethal exposure from ingesting or inhaling phosphine gas directly from the gut of prey that had ingested zinc phosphide bait. This has been demonstrated in laboratory tests. There are no readily available accounts of predators or scavengers being poisoned in the wild by secondary exposure to zinc phosphide. However laboratory tests indicate that there is potential hazard.

In a zinc phosphide study conducted by the Fish and Wildlife Service in Michigan, Hegdal and Gatz (1977) found that most microtine rodents and some rabbits and pheasants were killed. Other notable findings include (1) although bait left in the field for 5 months lost 80-90% of its toxicity, it still would kill a deer mouse, (2) hazards to seed-eating birds appear to be minimal, although 1 jay species died from apparent direct zinc phosphide poisoning, and (3) the potential for significant secondary exposure to predators and raptors from baiting for orchard mice is highly unlikely. In a controlled experiment, treated grain exposed to rain and snow was still lethal to laboratory mice after 27 days of outdoor exposure (Hayne 1951).

Tietjen (1976) conducted laboratory and field studies required for development of zinc phosphide to control black-tailed prairie dogs (*Cynomys ludovicianus*). His conclusions including the following: (1) Residues of phosphine in vegetation from areas treated with up to 3 times a high and low application rate were nominal and of no environmental consequence at 1, 15 and 30 days posttreatment. (2) The likelihood of treatment with 4 g per prairie dog burrow causing either primary or secondary intoxication of non-target vertebrates, including black-footed ferrets (*Mustela nigripes*), is remote.

During 1964-1965, Denver Wildlife Research Center scientists conducted studies of secondary exposure using zinc phosphide-poisoned nutria (*Mycocastor coypus*) (Evans et al. 1965). Poisoning occurred only when test species ingested zinc phosphide directly from the stomach contents or hair of an intoxicated nutria.

Zinc phosphide initially was considered a possible substitute for strychnine, primarily because of its lower secondary hazard potential and toxic residues are not stored in tissues of poisoned animals. Poisoning from secondary exposure is associated with consuming stomach contents rather than the tissues of poisoned animals (Evans et al. 1970). In addition, animals that can regurgitate are further protected if they consume stomach contents containing zinc phosphide. Although cats can vomit after eating rats poisoned with zinc phosphide, they do not always do so in time to save themselves (Chitty 1954). Poultry and wild birds are all apparently very susceptible to direct poisoning from consuming treated bait (Chitty 1954). The color of zinc phosphide-treated baits may offer some protection to seed-eating birds by stimulating a feeding aversion (Rudd and Genelly 1956, Siefgried 1968, Hines and Dimmick 1970). The high degree of toxicity and lack of specificity of zinc phosphide pose some hazard to all vertebrates which may encounter it (Hines and Dimmick 1970).

Wildlife incidents: EPA reported no fish or wildlife poisoning incidents associated with zinc phosphide. Hundreds of wild geese died from consuming zinc phosphide bait 3 months after it was applied to fields to control meadow mice (Keith and O'Neill 1964). Nearly 40% of the zinc phosphide remained on the bait after 3 months of field exposure even though 1.5 inches of rain fell during the period.

BIOLOGICAL OPINION

CHEMICAL REFERENCE TABLE

(The following table contains only those species for which the Service provided a jeopardy or no jeopardy call. Species not included in this list are either not affected by the chemical or have no chance for exposure. For a complete list of all species considered in this opinion, refer to the master species list on page III-1 of the species profile section.)

Species Name	J/NJ	PAGE
MAMMALS		
Alabama beach mouse	J	105
Anastasia Island beach mouse	J	106
Black-footed ferret	J	106
Carolina northern flying squirrel	J	108
Choctawhatchee beach mouse	J	105
Florida salt marsh vole	J	108
Fresno kangaroo rat	J	109
Giant kangaroo rat	J	109
Gray wolf	NJ	116
Grizzly bear	NJ	116
Key Largo cotton mouse	J	109
Key Largo woodrat	J	109
Louisiana black bear	J	110
Lower Keys rabbit	J	110
Morro Bay kangaroo rat	J	111
Perdido Key beach mouse	J	105
Point Arena mountain beaver	J	111
Salt marsh harvest mouse	J	111
San Joaquin kit fox	NJ	117
Silver rice rat	J	112
Southeastern beach mouse	J	106
Stephen's kangaroo rat	J	112
Tipton kangaroo rat	J	109
Utah prairie dog	NJ	117
BIRDS		
Alala (Hawaiian crow)	J	113
Attwater's prairie chicken	J	113
Hawaiian coot	J	113
Hawaiian duck	J	113
Mariana crow	J	114
Mississippi sandhill crane	J	114
Nene (Hawaiian goose)	J	115
Puerto Rican plain pigeon	J	115
San Clemente sage sparrow	NJ	118
Whooping crane	NJ	118
Yellow-shouldered blackbird	J	116

RATIONALE FOR JEOPARDY DETERMINATIONS

Alabama beach mouse, Choctawhatchee beach mouse, and Perdido Key beach mouse - Exposure of these beach mice to zinc phosphide could occur through ingestion of poisoned baits when used to control rodents within or in close proximity to their occupied habitats. All three subspecies occur in areas that are being encroached upon by various types of human development. Therefore, there is a high possibility of zinc phosphide being used where these mice could come in contact with it. All three are restricted to mature coastal barrier dune systems along the Gulf of Mexico. The Choctawhatchee beach mouse is presently known to occur only on Shell Island at St. Andrews Bay in Bay County, Florida, and on approximately 7.9 km of beach dune habitat (coastline up to 150 m inland) near Topsail Hill, from around Morrison Lake eastward to Stalworth Lake, Walton County, Florida. The Alabama beach mouse presently is surviving only on disjunct tracts of the sand dune system from Fort Morgan State Park to the Romar Beach area in Baldwin County, Alabama. The Perdido Key beach mouse occurs only on Perdido Key in Baldwin County, Alabama and Escambia County, Florida. The distance to which occupied habitat of these species extends inland from the beach varies depending upon the configuration of the sand dune system and the vegetation present. Both subspecies utilize portions of the frontal or primary dunes; interdunal areas; and dunes further inland (secondary or interior dunes). Because of the restricted distributions of these species and the likelihood of zinc phosphide being used for rodent control within or adjacent to areas which they inhabit, it is the Service's biological opinion that the registered use of zinc phosphide is likely to jeopardize the continued existence of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Reasonable and Prudent Alternative(s) - If implemented the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit use of zinc phosphide within 100 yards of occupied habitat of the Choctawhatchee beach mouse, the Alabama beach mouse, and the Perdido Key beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Anastasia Island beach mouse and Southeastern beach mouse - These two beach mice are endemic to the east coast of Florida. The Anastasia Island beach mouse is presently believed to occur only on Anastasia Island, St. Johns County, Florida. The southeastern beach mouse is believed to presently occur only from Florida's Mosquito (Pounce) Inlet in Volusia County south to Hutchinson Island in St. Lucie County, Florida. Both subspecies inhabit sand dunes vegetated by sea oats and dune panic grass and the scrub adjoining these dunes, which is vegetated with oaks, sand pine, palmetto, sea grapes, and/or wax myrtle. Since the ranges of both species have been and continue to be encroached upon by various types of human development, it is likely that zinc phosphide could be used for pest control in areas where both these beach mice occur. Exposure of the mice to zinc phosphide would occur through ingestion of poison baits, which would result in direct mortality of individuals of the species. Accordingly, it is the Service's biological opinion that the registered use of zinc phosphide is likely to jeopardize the continued existence of the Anastasia Island beach mouse or the southeastern beach mouse.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit use of zinc phosphide within 100 yards of occupied habitat of the Anastasia Island beach mouse and the southeastern beach mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Black-footed ferret - Zinc phosphide is a restricted use rodenticide registered for use on a wide variety of sites including orchards, rangeland, forest, agricultural crops, ornamentals, lawns, golf courses, recreational

areas, rights-of-way, animal burrows, and in and around all types of buildings. It is used to control mice, rats, kangaroo rats, wood rats, ground squirrels, moles, pocket gophers, prairie dogs, and muskrats. EPA has determined that because zinc phosphide breaks down in the acidic environment of the gut and releases highly volatile phosphine gas, there should be little opportunity for predators or scavengers to be secondarily exposed to the pesticide. The likelihood of ferrets being found in the wild, while considered low, is still possible. The further loss or fragmentation of prairie dog habitat which has already been reduced by as much as 98 percent (from over 100 million acres to about 2 million acres) could cause the extinction of the species. Therefore, it is the Service's opinion that the use of zinc phosphide is likely to jeopardize the continued existence of the black-footed ferret.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the black-footed ferret:

1. A black-tailed prairie dog colony or complex of less than 80 acres having no neighboring prairie dog towns may be treated without a ferret survey. A midrange of 102 acres (61 to 294 acres) of occupied black-tailed prairie dog habitat is believed necessary to support a single isolated colony of less than 80 acres. A neighboring prairie dog town is defined as a colony less than 7 kilometers (4.34 miles) from the town to be treated, based on the longest distance that the ferret has been observed to travel during the night.

2. A white-tailed prairie dog colony or complex of less than 200 acres having no neighboring prairie dog towns may be treated without a survey. It is estimated to require between 196 and 475 acres of white-tailed prairie dogs to support a single ferret.

3. Urban situations (e.g., playgrounds, golf courses, etc.) and cultivated lands adjacent to prairie dog colonies may be treated without conducting surveys. The appropriate Service office will be contacted by the pesticide user in advance of any treatment to determine whether a proposed action fits this situation.

4. For black-tailed prairie dog colonies or complexes over 80 acres but less than 1,000 acres, and white-tailed prairie dog colonies or complexes over 200 acres but less than 1,000 acres, prairie dog control may be allowed after completing a black-footed ferret survey within 30 days of proposed treatments on colonies proposed for treatment, provided no ferrets or their sign are found. Prior to treatment, if all colonies in this complex are surveyed with no sign of ferrets, no future survey for ferrets would be recommended. These surveys will be coordinated with the appropriate State Office of the Fish and wildlife Service.

5. For prairie dog complexes over 1,000 acres, no control shall be allowed until the complex has been evaluated by appropriate State and/or Federal Agencies (those agencies working on State working groups for ferret recovery) for its potential as a recovery site and until the complex has been block cleared. One thousand acres would be a minimum complex size for consideration as a black-footed ferret reintroduction site and would likely require intensive management of habitat for a ferret population.

6. The EPA shall maintain records which shall be provided to the Service on an annual basis. These records can include the amount of acres of prairie dog towns or complexes controlled (e.g., Federal lands, private lands on a volunteer basis), or the amount of the chemical sold including application rates. This latter could be obtained from either the manufacturer or the vender.

Surveys shall be supervised by biologists trained in ferret survey techniques and ferret biology at a Service-approved training workshop. Currently, only the University of Wyoming

has such a course. Ferret surveys shall be reviewed by the Service for compliance with survey standards and Section 7 of the Endangered Species Act.

Incidental Take - With the implementation of the reasonable and prudent alternatives to preclude jeopardy of the black-footed ferret, no incidental take is anticipated and thus none is authorized.

Carolina northern flying squirrel - This speciesposed to zinc phosphide poisoning from its registered use to control rodents including mice, rats and ground squirrels in and around agricultural buildings, forests, rights-of-way, and recreational areas. The Carolina northern flying squirrel occurs in coniferous and northern hardwood forests, and may occassionally forage on the ground. Where land use changes and development encroach on the species' habitat there is a potential risk of the squirrel coming in contact with zinc phosphide bait that is placed outside of buildings (e.g., storage sheds and barns) or in rights-of-way and forests. Zinc phosphide bait formulated as coated pet food, fruit and vegetables would likely be very attractive and palatable to the squirrel. Zinc phosphide when ingested is toxic to rodents and would most likely kill a northern flying squirrel if it consumed the bait. Due to the restricted range and small population of the Carolina northern flying squirrel, any poisoning of individuals could threaten the survival of the species. Therefore, it is the Service's opinion that the use of zinc phosphide is likely to jeopardize the continued existence of the Carolina northern flying squirrel.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Carolina northern flying squirrel: prohibit the outdoor use of the chemical within the species' occupied habitat.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Florida salt marsh vole - Exposure of the vole to zinc phosphide could occur through consumption of poisoned baits used to control rodents in close proximity to the vole's occupied marsh habitat. There is a possibility of the rodenticide being used around buildings or other structures and open areas adjacent to salt marsh habitat where the vole could come in contact with it. The vole is restricted to a single known area in the salt marsh of Waccasassa Bay, Levy County, Florida. This rodenticide is highly toxic to mammals. Because of the restricted distribution of the species, its limited population, and the likelihood of this rodenticide being used for rodent control adjacent to areas in which the vole occurs, it is the Service's biological opinion that the use of zinc phosphide is likely to jeopardize the continued existence of the Florida salt marsh vole.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit use of zinc phosphide within 100 yards of the landward edge of the species' salt marsh habitat in Levy County, Florida.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Fresno kangaroo rat, giant kangaroo rat, Tipton kangaroo rat - These kangaroo rats are highly vulnerable to zinc phosphide exposure because of the extremely wide variety of use patterns for which this chemical is registered. Areas within the ranges of these species (southern San Joaquin Valley, California) where zinc phosphide is likely to be used include the following: oil fields; rangelands; agricultural croplands; fallow agricultural lands; rights-of-way (e.g., aqueduct, canal, and levee embankments and roads); and buildings in and around oil fields, agricultural areas, and some municipalities (e.g., Tipton kangaroo rats in the Bakersfield vicinity). Most permitted zinc phosphide formulations would be highly attractive to kangaroo rats, including pellets and tablets, corn meal baits, pet food baits, and especially grain baits (oats and wheat). Furthermore, some permitted application methods would greatly increase the likelihood of kangaroo rats encountering such baits, including broadcast baiting and applications to burrows. In conclusion, because of

(1) the numerous and potentially non-specific zinc phosphide exposure factors for these species; (2) the high toxicity of this compound to all rodents; and (3) the fact that each of these species occupies significantly restricted and/or fragmented habitats, the Service concludes that zinc phosphide use within the ranges of the Fresno kangaroo rat, giant kangaroo rat, and Tipton kangaroo rat is likely to jeopardize the continued existence of these species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Fresno, giant, and Tipton kangaroo rat: (1) Prohibit all outdoor uses of zinc phosphide grain baits within 100 yards of the occupied habitat of these species; (2) prohibit broadcast zinc phosphide applications outdoors and zinc phosphide applications to burrows within 100 yards of the occupied habitats of these species; and (3) prohibit outdoor use of zinc phosphide solid baits (granules, pellets, tablets, blocks) within 100 yards of the occupied habitats of these species, unless a specific kangaroo rat protection program for zinc phosphide use, approved by the Service in writing, is implemented.

Incidental Take - Despite the reasonable and prudent alternatives described above, the Service anticipates that an unquantfiable level of incidental take of the Fresno, giant, and Tipton kangaroo rat may occur as a result of zinc phosphide use within the ranges of these species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Key Largo woodrat and Key Largo cotton mouse - Both the Key Largo woodrat and Key Largo cotton mouse occur in subtropical, evergreen, hardwood forests on the northern half of Key Largo, Monroe County, Florida, north of the point where U.S. Highway 1 enters Key Largo. Populations of both species may also occur in similar habitat on Lignumvitae Key, Monroe County, where the species were introduced in 1970. The Key Largo woodrat is primarily herbivorous, feeding mostly on buds, leaves, fruits, and seeds, but invertebrates occasionally are included in its diet. The diet of the Key Largo cotton mouse has not been documented, but it is believed to be very similar to that of the woodrat. The use of broadcast baits within or adjacent to habitat of these two species is likely due to the close proximity of various types of human development to the areas where these species occur. Exposure of the woodrat and cotton mouse to zinc phosphide would result in direct mortality of individuals of the species. The most likely means of exposure of the woodrat and the cotton mouse to zinc phosphide would be ingestion of broadcast baits. Accordingly, it is the Service's biological opinion that the registered use of zinc phosphide is likely to jeopardize the continued existence of the Key Largo woodrat or Key Largo cotton mouse.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the species: prohibit use of the chemical within 100 yards of occupied habitat of the Key Largo woodrat and the Key Largo cotton mouse.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to these species, no incidental take is anticipated and therefore none is authorized.

Louisiana black bear - The black bear may be exposed to baits used in orchards, forests, sugarcane, vineyards, rights-of-way, other agricultural crops. Bears venture into such areas in search of food, and being opportunistic they will consume most any available food item. Because of the bear's small population and restricted range, mortality resulting from rodenticide poisoning could threaten the survival and recovery of the species. Therefore, it is the opinion of the Service that the use of zinc phosphide is likely to jeopardize the continued existence of the Louisiana black bear.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Louisiana black bear: use only tamper resistant bait boxes within the current known occupied habitat of the species.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to this species, no incidental take is anticipated and therefore none is authorized.

Lower Keys rabbit - The Lower Keys rabbit could be exposed to zinc phosphide when the rodenticide is used around buildings, rights-of-way, and other open areas that are adjacent to the rabbit's marsh habitat. The rabbit is likely to forage in some treated areas. Continued rapid development in the lower Keys greatly increases the potential that the rabbit would come in contact with rodenticide treated areas. Broadcast applications of flavored baits or poisoned food items would pose a serious threat to the species. This rodenticide would be lethal to Lower Keys rabbits if it were ingested. Because of the extremely restricted range of the species and its small population, any rodenticide induced poisonings could threaten the survival of the species. Therefore, it is the opinion of the Service that the use of zinc phosphide is likely to jeopardize the continued existence of the Lower Keys rabbit.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Lower Keys rabbit: Only tamper resistant bait boxes may be used outdoors within 100 yards of the species' occupied habitat.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Morro Bay kangaroo rat - The primary exposure of zinc phosphide from registered uses can occur when the Morro Bay kangaroo rat ingests granules, pellets, tablets, or other treated materials. The species is restricted to only a few locations in the vicinity of Morro Bay, California. It is the biological opinion of the Service that use of zinc phosphide is likely to jeopardize the continued existence of the Morro Bay kangaroo rat.

Reasonable and Prudent Alternative - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Morro Bay kangaroo rat: prohibit the use of zinc phosphide within 100 yards of the occupied habitat of the Morro Bay kangaroo rat.

Incidental Take - With implementation of the reasonable and prudent alternative described above, no incidental take is anticipated and therefore none is authorized.

Point Arena mountain beaver, salt marsh harvest mouse - These species may be subject to zinc phosphide exposure because some uses for which this chemical is registered (e.g., in and around buildings, lawns, recreational areas, golf courses, and rights-of-way) could occur within harvest mice or mountain beaver habitats or areas adjacent to such habitats. Both these species occupy areas in which man-made structures or sites exist nearby (commercial and industrial buildings in the vicinity of San Francisco Bay salt marshes, municipal and communication structures in the Point Arena vicinity, golf courses and similar sites in both areas). Furthermore, adverse effects of zinc phosphide use on the harvest mouse and mountain beaver could be significant because: (1) both species may be attracted to grain or pelletized zinc phosphide baits if applied in the vicinity of occupied habitats; (2) both are highly susceptible to the toxic effects of this compound; and (3) the habitats of these species are highly restricted and fragmented. It is the Service's biological opinion that zinc phosphide use within the ranges of the salt marsh harvest mouse and Point Arena mountain beaver is likely to jeopardize the continued existence of these species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the salt marsh harvest mouse: prohibit outdoor zinc phosphide use within 100 yards of occupied habitat of this species.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Point Arena mountain beaver: (1) Prohibit broadcast zinc phosphide applications outdoors and zinc phosphide applications to burrows within 100 yards of the occupied habitat of this species; and (2) prohibit outdoor zinc phosphide use (all baits) within 100 yards of the occupied habitat of this species, unless a specific mountain beaver protection program for zinc phosphide use, approved by the Service in writing, is implemented.

Incidental Take - Despite the reasonable and prudent alternatives described above, the Service anticipates that an unquantfiable level of incidental take of the salt marsh harvest mouse and Point Arena mountain beaver may occur as a result of zinc phosphide use within the ranges of these species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Silver rice rat - The silver rice rat could be exposed to zinc phosphide when the rodenticide is used (for control of black and Norway rats, and house mice) around buildings, rights-of-way, ditches, and other areas that are adjacent to the rat's wetland habitat. The rat is likely to forage in some treated areas. Continued rapid development in the lower Keys greatly increases the potential that the rat would come in contact with rodenticide treated areas. Broadcast applications of flavored baits or poisoned food items would pose a serious threat to the species. This rodenticide would be lethal to silver rice rats if it were ingested. Because of the extremely restricted range of the species and its small population, any rodenticide induced poisonings could threaten the survival of the species. Therefore, it is the opinion of the Service that the use of zinc phosphide is likely to jeopardize the continued existence of the silver rice rat.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the silver rice rat: prohibit the outdoors use of the chemical within 100 yards of the current known occupied habitat of the species.

Incidental Take - With the implementation of the reasonable and prudent alternative to preclude jeopardy of the species, no incidental take is anticipated and therefore none is authorized.

Stephen's kangaroo rat- The primary exposure of zinc phosphide from registered uses can occur when Stephen's kangaroo rat ingests granules, pellets, tablets, or other treated materials. It is the biological opinion of the Service that use of zinc phosphide is likely to jeopardize the continued existence of the Stephen's kangaroo rat.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Stephen's kangaroo rat: (1) Prohibit all outdoor uses of zinc phosphide grain baits within 100 yards of the occupied habitat of this species; (2) prohibit broadcast zinc phosphide applications outdoors and zinc phosphide applications to burrows within 100 yards of occupied habitat of this species; and (3) prohibit outdoor use of zinc phosphide solid baits (granules, pellets, tablets, blocks) within 100 yards of the occupied habitat of this species, unless a specific kangaroo rat protection program for solid zinc phosphide baits, approved by the Service in writing, is implemented.

Incidental Take - Despite the reasonable and prudent alternatives described above, the Service anticipates that an unquantfiable level of incidental take of the Stephen's kangaroo rat may occur as a result of zinc phosphide use within the ranges of this species.

Reasonable and Prudent Measure(s) - To minimize anticipated incidental take, EPA must establish a monitoring enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Alala (Hawaiian crow) - The alala is found in a relatively well defined, restricted native forest area on the Island of Hawaii. Less than 20 individuals remain in the wild. There is an ongoing and approved mongoose trapping program in that area, and it is anticipated that certain rodenticide control measures for mongoose will be approved for the area in the near future. As both rats and mongooses are known to eat alala eggs, chicks, and fledglings, their control is recommended in the Hawaiian Crow Recovery Plan and consequently, other rodenticide agents may be considered. The alala are curious omnivores that may eat zinc phosphide-treated baits. Because of the above-mentioned threats, it is the Service's biological opinion that use of zinc phosphide on the island of Hawaii is likely to jeopardize the continued existence of the alala.

Reasonable and prudent Alternative(s)- If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the alala: prohibit the use of zinc phosphide within alala occupied habitat, unless it is contained in tamper resistant bait boxes.

Incidental Take- With the implementation of the Reasonable and Prudent Alternative to preclude jeopardy to the species, no incidental take is anticipated and, therefore, none is authorized.

Attwater's prairie chicken - The primary exposure of zinc phosphide to the prairie chicken is through its use on agricultural crops and rangeland. The bait is in the form of granules, pellets or treated grain and therefore would be available for direct ingestion by the prairie chicken. Zinc phosphide is acutely toxic to birds and could cause mortality if only a few treated grains or granules were consumed. Therefore, it is the Service's biological opinion that the use of zinc phosphide is likely to jeopardize the continued existence of Attwater's prairie chicken.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Attwater's prairie chicken: prohibit the use of zinc phosphide within 100 yards of occupied habitat. Tamper resistant bait boxes can be used within occupied habitat.

Incidental Take - With the implementation of the reasonable and prudent alternatives to preclude jeopardy of the species no incidental take is anticipated and therefore none is authorized.

Hawaiian coot and Hawaiian duck - Both of these Hawaiian waterbirds use ponds and other water features of golf courses and other grassy areas (such as turf farms) adjacent to wetlands. These ducks and coots will regularly come "ashore" to feed on invertebrates, grass shoots, seeds, and other dryland foods. Such feeding could expose them to zinc phosphide baits applied to grassy areas. The birds could be killed or sickened as a result of such rodenticide exposure.

The Hawaiian duck population in the State of Hawaii is estimated to be several thousand, with concentrations on the island of Kauai. Perhaps less than 100 still exist on the island of Oahu. About 1,000 Hawaiian coots remain on the islands of Kauai, Oahu, and Maui. Depletion of wetland habitat and predation by rats, mongooses, feral pigs, cats, and dogs are implicated in the endangered status of both species. Although depressed below "recovered" numbers, the populations of both of these species are relatively stable, and the dramatic increase in the number of golf courses and their water features may have, in small part, aided in their recovery. However, if zinc phosphide baits are applied to these golf courses and turf farms, ducks and coots may ingest the rodenticide. Because of the above-mentioned threats, it is the Service's biological opinion that use of zinc phosphide in Hawaii is likely to jeopardize the continued existence of the Hawaiian duck and Hawaiian coot.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Hawaiian duck and Hawaiian coot: prohibit the use of zinc phosphide within 100 yards of any water or wetland on or adjacent to any golf course or turf farm on the islands of Kauai, Oahu, for the Hawaiian Duck, and the islands of Kauai, Oahu, and Maui for Hawaiian Coot, unless it is contained in tamper resistant bait boxes.

Incidental Take- With the implementation of the Reasonable and Prudent Alternative to preclude jeopardy to the species, no incidental take is anticipated and, therefore, none is authorized.

Mariana crow - Approximately 100 Mariana crows remain on Guam, confined to the forests at the far northern and, possibly, south-central portions of the island. Its endangered status is due to the brown tree snake, an introduced predator that feeds on crow eggs and chicks. Mariana crows are curious omnivores that might eat zinc phosphide-treated baits. Because of the above-mentioned threats, it is the Service's biological opinion that use of zinc phosphide in Guam is likely to jeopardize the continued existence of the Mariana crow.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Mariana crow: prohibit the use of zinc phosphide within Mariana crow occupied habitat, unless it is contained in tamper resistant bait boxes.

Incidental Take- With the implementation of the Reasonable and Prudent Alternative to preclude jeopardy to the species, no incidental take is anticipated and, therefore, none is authorized.

Mississippi sandhill crane - Zinc phosphide poses a threat to the Mississippi sandhill crane primarily when the rodenticide is used in agricultural fields, rangeland, orchards, and rights-of-way. This species presently exists in only very low numbers and is restricted to a relatively small area of Jackson County, Mississippi. The bird is non-migratory and has established fairly restricted nesting, foraging, and winter roosting areas. Nesting is generally limited to semi-open, wet, savanna areas within its range. It normally feeds in wet savannas, marshes, agricultural fields, and pastures. While the majority of this crane's range occurs on National Wildlife Refuge property, it is known to forage off refuge lands. The bird's diet includes earthworms, insects, small reptiles and amphibians, small birds, mice, roots and tubers, nuts, fruits, seeds, and grain from agricultural fields. According to the EPA's data, pheasants were killed by ingesting the poisoned baits during a field application study. This chemical can also be relatively persistent in the environment. Because of zinc phosphide's persistence in the environment and the high number its registered uses, the Service believes there is a high potential for the crane to be exposed to zinc phosphide through ingestion of baits while foraging in treated fields. Accordingly, in view of the Mississippi sandhill crane's restricted distribution, low population level, and its feeding habits, it is the Service's biological opinion that the use of zinc phosphide is likely to jeopardize the continued existence of the Mississippi sandhill crane.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternatives would avoid jeopardy to the Mississippi sandhills crane: Only tamper resistant bait boxes may be used outdoors within occupied habitat of the Mississippi sandhill crane.

Incidental Take - With implementation of the reasonable and prudent alternative to preclude jeopardy to the Mississippi sandhill crane, no incidental take is anticipated and therefore none is authorized.

Nene (Hawaiian goose) - This endangered species is found only on the islands of Kauai, Maui, and Hawaii in the State of Hawaii. They feed predominantly on plant shoots, seeds, and berries, and are known to graze on golf courses and other maintained, grassy areas, and pastures where zinc phosphide application would pose a significant hazard. Gosling survival in the wild is now poor, and the wild populations of geese are supplemented regularly from captive-reared birds. Without these captive breeding programs, the species

would not survive in the wild except in areas where they receive supplemental feed and are protected from predators. Based on the avian toxicity data available on zinc phosphide, ingestion of the compound would be expected to be fatal. Because of the above-mentioned threats, it is the Service's biological opinion that use of zinc phosphide near gold courses in Hawaii is likely to jeopardize the continued existence of the nene.

Reasonable and Prudent Alternative(s)- If implemented, the following reasonable and prudent alternative would avoid jeopardy to the nene: prohibit use of zinc phosphide within the 100 yards of occupied habitat of the nene, unless it is contained in tamper resistant bait boxes.

Incidental Take- With the implementation of the reasonable and prudent alternatives to preclude jeopardy to the species, no incidental take is anticipated and, therefore, none is authorized.

Puerto Rican plain pigeon - The Puerto Rican plain pigeon would primarily be exposed to zinc phosphide while foraging in treated agricultural fields. The baits could be ingested as the pigeon forages. Ingestion of bait would be fatal, and bird kills have been documented during field studies. Due to the small population size of this species and its flocking habit of frequenting crop fields, any pesticide induced poisoning and mortality could threaten the survival of the species. Therefore, it is the opinion of the Service that the use of zinc phosphide is likely to jeopardize the continued existence of the Puerto Rican plain pigeon.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the Puerto Rican Plain pigeon: Only tamper resistant bait boxes may be used outdoors within the species' occupied habitat.

Incidental Take - Because of the chemical's toxicity and potential widespread use, and the potential for the species to expand its range, even if the above-mentioned reasonable and prudent alternatives are strictly followed, the Service anticipates that an unquantifiable level of incidental take may occur as a result of this chemical's use in areas outside the current range of the species.

Reasonable and Prudent Measure(s) - To minimize incidental take, EPA must establish a monitoring/enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

Yellow-shouldered blackbird - The yellow-shouldered blackbird would be exposed to zinc phosphide through the pesticide's registered uses on agricultural fields. These birds often flock to agricultural fields to feed. Ingestion of bait would be fatal, and bird kills have been documented during field studies. Due to the small population size of this species and its flocking habit of frequenting crop fields, any pesticide induced poisoning and mortality could threaten the survival of the species. Therefore, it is the opinion of the Service that the use of zinc phosphide is likely to jeopardize the continued existence of the yellow-shouldered blackbird.

Reasonable and Prudent Alternative(s) - If implemented, the following reasonable and prudent alternative would avoid jeopardy to the yellow-shouldered blackbird: Only tamper resistant bait boxes may be used outdoors within the species occupied habitat.

Incidental Take - Because of the chemical's toxicity and potential widespread use, and the potential for the species to expand its range, even if the above-mentioned reasonable and prudent alternatives are strictly followed, the Service anticipates that an unquantifiable level of incidental take may occur as a result of this chemical's use in areas outside the current range of the species.

Reasonable and Prudent Measure(s) - To minimize incidental take, EPA must establish a monitoring/enforcement program. The terms and conditions of such programs are outlined in the introduction section on page I-5.

RATIONALE FOR NO JEOPARDY DETERMINATIONS

Gray wolf and Grizzly bear - Zinc phosphide is registered for use on a wide variety of sites which could occur near or in gray wolf or grizzly bear habitat including orchards, rangeland, forest, agricultural crops, recreational areas, rights-of-way, and animal burrows. It is used to control mice, rats, grounds squirrels, moles, pocket gophers, prairie dogs, and muskrats. EPA provided no hazard ratios but stated that zinc phosphide is acutely toxic to mammals where they would ingest granules or bait. Also according to EPA, there should be little opportunity for predators or scavengers to be secondarily exposed to the pesticide. Even though the gray wolf and grizzly bear occurs in some of the same counties where these registered uses of zinc phosphide may occur, the Service believes that the chances of gray wolf or grizzly bear mortality as a result of them feeding on granules or bait to an extent that would result in such a mortality of the species is extremely remote. Therefore, it is the Service's opinion that the use of zinc phosphide is not likely to jeopardize the continued existence of the gray wolf or grizzly bear.

Incidental Take - Because zinc phosphide is toxic to mammals and because there are some registered uses that may occur in gray wolf and grizzly bear habitat, the Service anticipates that an unquantifiable level of incidental take may occur as a result of the gray wolf or grizzly bear consuming granules or bait.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measures for minimizing incidental take and their implementing terms and conditions should be adopted: with the exception of tamper resistant bait boxes, prohibit the application of zinc phosphide in the geographic range of the gray wolf and grizzly bear until the user has contacted the local Service office and that office has determined that there are no known wolves or grizzly bears in the general vicinity of where zinc phosphide is going to be applied.

San Joaquin kit fox - This species may be subject to zinc phosphide exposure because of the extremely wide variety of use patterns for which this chemical is registered. Areas within the kit fox range (the San Joaquin Valley of California) where zinc phosphide is likely to be used include municipalities (e.g., Bakersfield); oil fields; rangelands; agricultural areas; orchards; aqueduct, canal, and levee embankments; golf courses; and other recreational areas. However, because there appears to be little risk of secondary poisoning as a result of zinc phosphide use, kit foxes would have to consume zinc phosphide baits directly for exposure to occur. Nonetheless, several zinc phosphide bait types are likely to attract kit foxes and to be consumed, including pellets, tablets, and pet food formulations; and some permitted application methods increase the likelihood of kit fox exposure, including broadcast baiting and applications to burrows. Overall, however, potential adverse effects of zinc phosphide use on the San Joaquin kit fox appear to be relatively minimal because of the lack of secondary exposure risk, and the fact that the species is relatively wide-ranging. Zinc phosphide is widely regarded as a safe alternative for rodent control in the San Joaquin kit fox range. The Service therefore concludes that zinc phosphide use is not likely to jeopardize the continued existence of this species.

Incidental Take - Although possible exposure of the San Joaquin kit fox to zinc phosphide probably is minimal, the Service anticipates that an unquantifiable level of incidental take may occur as a result of zinc phosphide use within the range of this species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the San Joaquin kit fox will be minimized: (1) Prohibit zinc phosphide applications to burrows and outdoor broadcast applications of all pellet, tablet, and pet food zinc phosphide baits within the occupied habitat of this species; and (2) prohibit all other outdoor uses of pellet, tablet, and pet food zinc phosphide baits within the occupied habitat of this species, unless such baits are confined to tamper resistant bait boxes designed to exclude access by San Joaquin kit foxes, or a similar kit fox protection program for zinc phosphide, approved by the Service in writing, is implemented.

Utah prairie dog - Zinc phosphide is a restricted use rodenticide registered for a variety of sites that could occur in or near prairie dog habitat including rangeland, rights-of-way, and animal burrows. Existing labels require that zinc phosphide not be used within the habitat of the Utah prairie dog. With this continued label restriction on all uses of zinc phosphide, it is the Service's opinion that the use of zinc phosphide is not likely to jeopardize the continued existence of the Utah prairie dog.

Incidental Take - With the continued implementation of the label restrictions protecting the Utah prairie dog, no incidental take is anticipated and thus none is authorized.

San Clemente sage sparrow - The primary exposure to zinc phosphide from registered applications for rodents could occur if bait is ingested by this sparrow which is primarily a ground forager for insects, spiders, and seeds. It is the biological opinion of the Service that use of zinc phosphide is not likely to jeopardize the continued existence of the San Clemente sage sparrow.

Incidental Take - The service anticipates that an unquantifiable level of incidental take may occur as a result of zinc phosphide use within the occupied habitat of this species.

Reasonable and Prudent Measure(s) - If the following reasonable and prudent measures are implemented, incidental take of the San Clemente sage sparrow will be minimized: prohibit the use of zinc phosphide within the occupied habitat of the San Clemente sage sparrow, unless it is contained in tamper resistant bait boxes.

Whooping crane - Zinc phosphide is a restricted use rodenticide registered for a variety of sites that could occur in or near where whooping cranes also may occur including rangeland and agricultural crops. It is used to control a number of species of rodents including mice, rats, ground squirrels, and pocket gophers. Whooping cranes do, at times, feed in these areas and could be impacted by ingesting either granules or bait. EPA stated that zinc phosphide is acutely toxic to birds but did not provide any hazard ratios. Thus, EPA provided little information on the impact of zinc phosphide to a large bird the size of a whooping crane. However, it is anticipated that the whooping crane would feed in zinc phosphide treated areas only rarely. Previous EPA labels require that zinc phosphide not be used in whooping crane habitat. Therefore, it is the Service's opinion that the use of zinc phosphide is not likely to jeopardize the continued existence of the whooping cranes.

Incidental Take - Because of the toxicity of zinc phosphide to birds and because there is a possibility of a whooping crane occurring in areas treated with zinc phosphide, the Service anticipates that an unquantifiable level of incidental take may occur as a result of zinc phosphide use. It is unlikely that zinc phosphide use could be precluded from all whooping crane use because the species uses a wide range of habitats.

Reasonable and Prudent Measure(s) - The following reasonable and prudent measure for minimizing incidental take and its implementing term and condition should be adopted: the user should insure prior to the use of zinc phosphide that no whooping cranes have wandered into a proposed treatment area. The above measure does not apply to the use of tamper resistant bait boxes as long as the bait boxes are not used on prairie dog colonies to control prairie dogs; the food source of the black-footed ferret.

SECTION III

SPECIES

PROFILES

MASTER SPECIES LIST

The following list contains all federally listed or proposed threatened and endangered species listed prior to July 1, 1991. To provide sufficient time for review and analysis the Service chose July 1st as the cut-off date for including species in this consultation. All species proposed for listing subsequent to that date are not considered in this opinion.

All species in this list were reviewed for possible effects to all 16 vertebrate control agents. Only those species receiving a jeopardy or no jeopardy call were included in the chemical reference table at the beginning of each chemical opinion. Following the master species list are species profiles for all species receiving a jeopardy or no jeopardy call. Species profiles contain information on species biology and status. This information is used in conjunction with the chemical information to provide the background for the Service's opinions.

Common name (Scientific name) - Status	Region	Common name (Scientific name) - Status	Region
MAMMALS			
Alabama beach mouse (Peromyscus polionotus ammobates) - E	R4	Lower Keys rabbit (Sylvilagus palustris hefneri) - E	R4
Amargosa vole (Microtus californicus scirpensis) - E	R1	Mariana fruit bat (Guam pop.) (Pteropus mariannus mariannus) - E	R1
Anastasia Island beach mouse (Peromyscus polionotus phasma) - E	R4	Mexican long-nosed bat (Leptonycteris nivalis) - E	R2
Black-footed ferret (Mustela nigripes) - T	R6	Mt. Graham red squirrel (Tamiasciurus hudsonicus grahamensis) - E	R2
Caribbean monk seal (Monachus tropicalis) - E	R4	Morro Bay kangaroo rat (Dipodomys heermanni morroensis) - E	R1
Carolina northern flying squirrel (Glaucomys sabrinus coloratus) - E	R4	Ocelot (Felis pardalis) - E	R2
Choctawhatcheebeach mouse (Peromyscus polionotus allophrys) - E	R4	Ozark big-eared bat (Plecotus townsendii ingens) - E	R2
Columbian white-tailed deer (Odocoileus virginianus leucurus) - E	R1	Perdido Key beach mouse (Peromyscus polionotus trissyllepsis) - E	R4
Delmarva Peninsula fox squirrel (Sciurus niger cinereus) - E	R5	Point Arena mountain beaver (Aplodontia rufa nigra) - E	R1
Dismal Swamp southeastern shrew (Sorex longirostris fisheri) - T	R5	Red wolf (Canis rufus) - E	R4
Dugong (Dugong dugon) - E	R1	Salt marsh harvest mouse (Reithrodontomys raviventris) - E	R1
Eastern cougar (Felis concolor cougar) - E	R5	Sanborn's long-nosed bat (Leptonycteris sanborni) - E	R2
Florida panther (Felis concolor coryi) - E	R4	San Joaquin kit fox (Vulpes macrotis mutica) - E	R1
Florida salt marsh vole (Microtus pennsylvanicus dukecampbelli) - E	R4	Selkirk Mountain woodland caribou (Rangifer tarandus caribou) - E	R1
Fresno kangaroo rat (Dipodomys nitratoides exilis) - E	R1	Sonoran pronghorn (Antilocapra americana sonoriensis) - E	R2
Giant kangaroo rat (Dipodomys igens) - E	R1	Southeastern beach mouse (Peromyscus polionotus niveiventris) - T	R4
Gray bat (Myotis grisescens) - E	R3	Southern sea otter (Enhydra lutris nereis) - T	R1
Gray wolf (Canis lupus) - E	R6	Stephen's kangaroo rat (Dipodomys stephensi) - E	R1
Grizzly bear (Ursus arctos horribilis) - T	R6	Tipton kangaroo rat (Dipodomys nitratoides nitratoides) -E	R1
Hawaiian hoary bat (Lasiurus cinereus semotus) - E	R1	Utah prairie dog (Cynomys parvidens) - T	R6
Hualapai mexican vole (Microtus mexicanus hualpaiensis) - E	R2	Virginia big-eared bat (Plecotus townsendii virginianus) -E	R5
Indiana bat (Myotis sodalis) - E	R3	Virginia northern flying squirrel (Glaucomys sabrinus fuscus) - E	R5
Jaguarundi (Felis yagouaroundi cacomitli) - E	R2	West Indian manatee (Trichechus manatus) - E	R4
Key deer (Odocoileus virginianus clavium) - E	R4		
Key Largo cotton mouse (Peromyscus gossypinus allapaticola) - E	R4	**BIRDS**	
Key Largo woodrat (Neotoma floridana smalli) - E	R4	Akiapolaau (Hemignathus munroi) - E	R1
Little Mariana fruit bat (Pteropus tokudae) - E	R1	Alala (Hawaiian crow) (Corvus hawaiiensis) - E	R1
Louisiana black bear (Ursus americanus luteolus) - T	R4	Aleutian Canada goose (Branta canadensis leucopareia) - T	R1

Common name (Scientific name) - Status	Region
American peregrine falcon (Falco peregrinus anatum) - E	R7
Aplomado falcon (Falco peregrinus tundrius) - E	R2
Arctic peregrine falcon (Falco peregrinus tundrius) - T	R7
Attwater's greater prairie chicken (Tympanuchus cupido attwateri) - E	R2
Audubon's (Florida) crested caracara (Caracara cheriway audubonii) - T	R4
Bachman's warbler (Vermivora bachmanii) - E	R4
Bald eagle (Haliaeetus leucocephalus) - E	R5
Black-capped vireo (Vireo atricapillus) - E	R2
Bridled white-eye (Zosterops conspicillatus conspicillatus) - E	R1
California brown pelican (Pelecanus occidentalis californianus) - E	R1
California clapper rail (Rallus longirostris obsoletus) -E	R1
California condor (Gymnogyps californianus) - E	R1
California least tern (Sterna antillarum browni) - E	R1
Cape Sable seaside sparrow (Ammodramus maritimus mirabilis) - E	R4
Crested honeycreeper (Palmeria dolei) - E	R1
Eskimo curlew (Numenius borealis) - E	R7
Florida grasshopper sparrow (Ammodramus savannarum floridanus) - E	R4
Florida scrub jay (Aphelocoma coerulescens coerulescens) - T	R4
Florida snail kite (Rostrhamus sociabilis plumbeus) - E	R4
Golden-cheeked warbler (Dendroica chrysoparia) - E	R2
Guam broadbill (Myiagra freycineti) - E	R1
Guam Micronesian kingfisher (Halcyon cinnamomina cinnamomina) - E	R1
Guam rail (Rallus owstoni) - E	R1
Hawaii akepa (Loxops coccineus coccineus) - E	R1
Hawaii creeper (Oreomystis mana) - E	R1
Hawaiian common moorhen (Gallinula chloropus sandvicensis) - E	R1
Hawaiian coot (Fulica americana alai) - E	R1
Hawaiian dark-rumped petrel (Pterodroma phaeopygia sandwichensis) - E	R1
Hawaiian duck (Anas wyvilliana) - E	R1
Hawaiian hawk (Buteo solitarius) - E	R1
Hawaiian stilt (Himantopus mexicanus knudseni) - E	R1
Inyo brown towhee (Pipilo fuscus eremophilus) - T	R1
Ivory-billed woodpecker (Campephilus principalis) - E	R4
Kauai akialoa (Hemignathus procerus) - E	R1
Kauai nukupu (Hemignathus lucidus hanapepe) - E	R1
Kauai 'o'o (Moho braccatus) - E	R1
Kirtland's warbler (Dendroica kirtlandii) - E	R3
Large Kauai thrush (Myadestes myadestinus) - E	R1
Laysan duck (Anas laysanensis) - E	R1
Laysan finch (Telespyza cantans) - E	R1
Least Bell's vireo (Vireo bellii pusillus) - E	R1
Least tern (Sterna antillarum) [interior pop'n] - E	R6
Light-footed clapper rail (Rallus longirostris levipes) -E	R1
Marbled murrelet (Brachyramphus marmoratus) - T	R1
Mariana common moorhen (Gallinula chloropus guami) - E	R1
Mariana crow (Corvus hawaiiensis) - E	R1
Mariana gray swiftlet (Aerodramus vanikorensis bartschi) - E	R1
Mariana mallard (Anas oustaleti) - E	R1
Masked bobwhite (Colinus virginianus ridgwayi) - E	R2
Maui akepa (Loxops coccineus ochraceus) - E	R1
Maui nukupuu (Hemignathus lucidus affinus) - E	R1
Maui parrotbill (Pseudonestor xanthophrys) - E	R1
Micronesian megapode (Megapodius laperouse) - E	R1
Mississippisandhill crane (Grus canadensis pulla) - E	R4
Molokai creeper (Paroreomyza flammea) - E	R1
Molokai thrush (Myadestes lanaiensus rutha) - E	R1
Nene (Hawaiian goose) (Nesochen sandvicensis) - E	R1
Newell's Townsend's shearwater (Puffinus auricularis newelli) - T	R1
Nightingale reed warbler (Acrocephalus luscinia) - E	R1
Nihoa finch (Telespyza ultima) - E	R1
Nihoa millerbird (Acrocephalus familiarus kingi) - E	R1
Northern aplomado falcon (Falco femoralis septentrionalis) - E	R2
Northern spotted owl (Strix occidentalis caurina) - T	R1
Oahu creeper (Paroreomyza maculata) - E	R1
'O'u [Hawaiian Isl. pop.] (Psittirostra psittacea) - E	R1
'O'u [Kauai Isl. pop.] (Psittirostra psittacea) - E	R1
Palila (Loxioides bailleui) - E	R1
Piping plover (Charadrius melodus) - E/T	R6
Ponape greater white-eye (Rukia longirostra) - E	R1
Ponape mountain starling (Aplonis pelzelni) - E	R1
Po'ouli (Melamprosops phaeosoma) - E	R1
Puerto Rican Parrot (Amazona vittata) - E	R4
Puerto Rican plain pigeon (Columbia inornata wetmorei) - E	R4
Puerto Rico nightjar (whip-poor-will) (Caprimulgus noctitherus) - E	R4
Red-cockaded woodpecker (Picoides borealis) - E	R4
Roseate tern (Sterna dougallii dougallii) - E	R5
San Clemente loggerhead shrike (Lanius ludovicianus mearnsi) - E	R1
San Clemente sage sparrow (Amphispiza belli clementeae) -T	R1
Silver rice rat (Oryzomys palustris natator) - E	R4
Small Kauai thrush (Myadestes palmeri) - E	R1
Tinian monarch (Old world flycatcher) (Monarcha takatsukasae) - T	R1
Whooping crane (Grus americana) - E	R1
Wood stork (Mycteria americana) - E	R4
Yellow-shouldered blackbird (Agelaius xanthomus) - E	R4
Yuma clapper rail (Rallus longirostris yumanensis) - E	R2

Common name (Scientific name) - Status	Region
REPTILES	
Alabama red-bellied turtle (Pseudemys alabamensis) - E	R4
American alligator (Alligator mississippiensis)- T(S/A)	R4
American crocodile (Crocodylus acutus) - E	R4
Atantic salt marsh snake (Nerodia fasciata taeniata) - E	R4
Blue-tailed mole skink (Eumeces egregius lividus) - T	R4
Blunt-nosed leopard lizard (Gambelia silus) - E	R1
Coachella Valley fringe-toed lizard (Uma inornata) - T	R1
Concho water snake (Nerodia harteri paucimaculata) - T	R2
Culebra Island giant anole (Anolis roosevelti) - E	R4
Desert tortoise (Gopherus agassizii) - T	R1
Eastern indigo snake (Drymarchon corais couperi) - E	R4
Flattened musk turtle (Sternotherus depressus) - T	R4
Gopher tortoise (Gopherus polyphemus) - T	R4
Island night lizard (Xantusia riversiana) - T	R1
Mona boa (Epicrates monensis monensis) - T	R4
Mona ground iguana (Cyclura stejnegeri) - T	R4
Monito gecko (Sphaerodactylus micropithecus) - E	R4
New Mexican ridge-nosed rattlesnake (Crotalus willardi obscurus) - T	R2
Plymouth red-bellied turtle (Pseudemys rubriventris bangsii) - E	R5
Puerto Rican boa (Epicrates inornatus) - E	R4
Ringed sawback turtle (Graptemys oculifera) - T	R4
Saltwater crocodile (Crocodylus porosus) - E	R1
Sand skink (Neoseps reynoldsi) - T	R4
San Francisco garter snake (Thamnophis sirtalis tetrataenia) - E	R1
St. Croix ground lizard (Ameiva polops) - E	R4
Virgin Islands tree boa (Epicrates monensis (=inornatus) granti) - E	R4
Yellow-blotched map turtle (Graptemys flavimaculata) - T	R4
AMPHIBIANS	
Cheat Mountain salamander (Plethodon nettingi) - T	R5
Desert slender salamander (Batrachosepsaridus) - E	R1
Golden coqui (Eleutherodactylus jasperi) - T	R4
Houston toad (Bufo houstonensis)- E	R2
Puerto Rican crested toad (Peltophryne lemur) - T	R4
Red Hills salamander (Phaeognathus hubrichti) - T	R4
San Marcos salamander (Eurycea nana) - T	R2
Santa Cruz long-toed salamander (Ambystoma macrodactylum croceum) - E	R1
Shenandoah salamander (Plethodon shenandoah) - E	R5
Texas blind salamander (Typhlomolge rathbuni) - E	R2
Wyoming toad (Bufo hemiophrys baxteri) - E	R6

Common name (Scientific name) - Status	Region
FISH	
Alabama cavefish (Speoplatyrhinus poulsoni) - E	R4
Amber darter (Percina antesella) - E	R4
Apache trout (Oncorhynchus apache) - T	R2
Ash Meadows Amaragosa pupfish (Cyprinodon nevadensis mionectes) - E	R1
Ash Meadows speckled dace (Rhinichthys osculus nevadensis) - E	R1
Bayou darter (Etheostoma rubrum) - T	R4
Beautiful shiner (Notropis formosus) - T	R2
Big Bend gambusia (Gambusia gaigei) - E	R2
Big Spring spinedace (Lepidomeda mollispinis pratensis) -T	R1
Blackside dace (Phoxinus cumberlandensis) - T	R4
Blue shiner (Cyprinella caerula) - T	R4
Bonytail chub (Gila elegans) - E	R6
Borax Lake chub (Gila boraxobius) - E	R1
Boulder darter (=Elk River) (Etheostoma (Nothonotus) sp.) - E	R4
Cahaba shiner (Notropis cahabae) - E	R4
Cape Fear shiner (Notropis mekistocholas) - E	R4
Chihuahua chub (Gila nigrescens) - T	R2
Clear Creek gambusia (Gambusia heterochir) - E	R2
Clover Valley speckled dace (Rhinichthys osculus oligo) -E	R1
Colorado squawfish (Ptychocheilus lucius) - E	R6
Comanche Springs pupfish (Cyprinodon elegans) - E	R2
Conasauga logperch (Percina jenkinsi) - E	R4
Cui-ui (Chasmistes cujus) - E	R1
Desert dace (Eremichthys acros) - T	R1
Desert pupfish (Cyprinodon macularius) - E	R2
Devil's Hole pupfish (Cyprinodon diabolis) - E	R1
Foskett speckled dace (Rhinichthys osculus spp) - T	R1
Fountain darter (Etheostoma fonticola) - E	R2
Gila topminnow (Poeciliopsis occidentalis) - E	R2
Gila trout (Oncorhynchus gilae) - E	R2
Goldline darter (Percina aurolineata) - T	R4
Greenback cutthroat trout (Salmo clarki stomias) - T	R6
Gulf sturgeon (Acipenser oxyrhynchus desotoi) - T	R4
Hiko White River springfish (Crenichthys baileyi grandis) - E	R1
Hutton tui chub (Gila bicolor ssp.) - T	R1
Humpback chub (Gila cypha) - E	R6
Independence Valley speckled dace (Rhinichthys osculus lethoporus) - E	R1
June sucker (Chasmestes liorus) - E	R6
Kendall Warm Springs dace (Rhinichthys osculus thermalis)-E	R6
Lahontan cutthroat trout (Salmo clarki henshawi) - T	R1
Leon Springs pupfish (Cyprinodon bovinus) - E	R2

Common name (Scientific name) - Status	Region
Little Colorado spinedace (Lepidomeda vittata) - T	R2
Little Kern golden trout (Salmo aguabonita whitei) - T	R1
Loach minnow (Tiaroga cobitis) - T	R2
Lost River sucker (Deltistes luxatus) - E	R1
Maryland darter (Etheostoma sellare) - E	R5
Moapa dace (Moapa coriaceae) - E	R1
Modoc sucker (Catostomus microps) - E	R1
Mohave tui chub (Gila bicolor mohavensis) - E	R1
Neosho madtom (Noturus placidus) - T	R6
Niangua darter (Etheostoma nianguae) - T	R3
Okaloosa darter (Etheostoma okaloosae) - E	R4
Owens pupfish (Cyprinodon radiosus) - E	R1
Owens tui chub (Gila bicolor snyderi) - E	R1
Ozark cavefish (Amblyopsis rosae) - T	R3
Pahranagat roundtail chub (Gila robusta jordani) - E	R1
Pahrump killifish (Empetrichthys latos latos) - E	R1
Paiute cutthroat trout (Salmo clarki seleniris) - T	R1
Pallid sturgeon (Scaphirhynchus albus) - E	R6
Pecos bluntnose shiner (Notropus simus pecosenis) - T	R2
Pecos gambusia (Gambusia nobilis) - E	R2
Pygmy sculpin (Cottus pygmaeus) - T	R4
Railroad Valley springfish (Crenichthys nevadae) - T	R1
Razorback sucker (Xyrauchen texanus) - E	R6
Roanoke logperch (Percina rex) - E	R5
San Marcos gambusia (Gambusia georgei) - E	R2
Scioto madtom (Noturus trautmani) - E	R3
Shortnose sucker (Chasmistes brevirostris) - E	R1
Slackwater darter (Etheostoma boschungi) - T	R4
Slender chub (Hybopsis cahni) - T	R4
Smoky madtom (Noturus baileyi) - E	R4
Snail darter (Percina tanasi) - T	R4
Sonora chub (Gila ditaenia) - T	R2
Spikedace (Meda fulgida) - T	R2
Spotfin chub (Hybopsis monacha) - T	R4
Unarmored threespine stickleback (Gasterosteus aculeatus williamsoni) - E	R1
Virgin River chub (Gila robusta seminuda) - E	R6
Waccamaw silverside (Menidia extensa) - T	R4
Warm Springs pupfish (Cyprinodon nevadensis pectoralis) - E	R1
Warner sucker (Catostomus warnerensis) - T	R1
Watercress darter (Etheostoma nuchale) - E	R4
White River spinedace (Lepidomeda albivallis) - E	R1
White River springfish (Crenichthys baileyi baileyi) - E	R1
Woundfin (Plagopterus argentissimus) - E	R6
Yaqui catfish (Ictalurus pricei) - T	R2
Yaqui chub (Gila purpurea) - E	R2
Yaqui topminnow (Poeciliopsis occidentalis sonoriensis) - E	R2
Yellowfin madtom (Noturus flavipinnis) - T	R4
SNAILS	
Alamosa springsnail (Tryonia alamosae) - E	R2
Banbury Springs limpet (Lanx n. sp.) - E	R1
Bliss rapids snail (undescribed) - E	R1
Bruneau hot spring snail (undescribed) - E	R1
Chittenango ovate amber snail (Succinea ovalis chittenangoensis) - T	R5
Flat-spired three toothed land snail (Triodopsis platysayoides) - T	R5
Idaho springsnail (Fontelicella idahoensis) - E	R1
Iowa pleistocene snail (Discus macclintocki) - E	R3
Magazine Mountain Shagreen (Mesodon magazinensis) - T	R4
Noonday snail (Mesodon clarki nantahala) - T	R4
Oahu (Hawaiian) tree snails (Achatinella spp.) - E	R1
Painted snake coiled forest snail (Anguispira picta) - T	R4
Snake River physa snail (Physa natricina) - E	R1
Socorro springsnail (Pyrgulopsis neomexicanus) - E	R2
Stock Island snail (Orthalicus reses reses) - T	R4
Tulotoma snail (Tulotoma magnifica) - T	R4
Utah valvata snail (Valvata utahensis) - E	R1
Virginia fringed mountain snail (Polygyriscus virginianus) - E	R5
CLAMS	
Alabama lamp pearly mussel (Lampsilis virescens) - E	R4
Appalachian monkeyface pearly mussel (Quadrula sparsa) - E	R4
Arkansas fatmucket (Lampsilis powelli) - T	R4
Birdwing pearly mussel (Conradilla caelata) - E	R4
Cracking pearly mussel (Hemistena (=Lastena) lata) - E	R4
Cumberland bean pearly mussel (Villosa (=Micromya) trabalis) - E	R4
Cumberland monkeyface pearly mussel (Quadrula intermedia) - E	R4
Cumberland pigtoe mussel (Pleurobema gibberum) - E	R4
Curtis' pearly mussel (Epioblasma florentina curtisi) - E	R3
Curtus' mussel (Pleurobema curtum) - E	R4
Dromedary pearly mussel (Dromus dromas) - E	R4
Dwarf wedge mussel (Alasmidonta heterodon) - E	R5
Fanshell (Cyprogenia stegaria (=irrorata)) - E	R4
Fat pocketbook pearly mussel (Potamilus capax) - E	R4
Fine-rayed pigtoe (Fusconia cuneolus) - E	R4
Green-blossom pearly mussel (Epioblasma (=Dysnomia) torulosa gubernaculum) - E	R3
Higgins' eye pearly mussel (Lampsilis higginsi) - E	R3

Common name (Scientific name) - Status	Region
Inflated heelsplitter (Potamilus inflatus) - T	R4
James River spinymussel (Pleurobema collina) - E	R5
Judge Tait's mussel (Pleurobema taitianum) - E	R4
Little-wing pearly mussel (Pegias fabula) - E	R4
Louisiana pearlshell (Margaritifera hembeli) - E	R4
Marshall's mussel (Pleurobema marshalli) - E	R4
Orange-footed pearly mussel (Plethobasus cooperianus) - E	R4
Pale lilliput pearly mussel (Toxolasma (=Carunculina) cylindrellus) - E	R4
Penitent mussel (Epioblasma penita) - E	R4
Pink mucket pearly mussel (Lampsilis orbiculata (=abrupta)) - E	R4
Purple cat's paw mussel (Epioplasma (=Dysnomia) obliquata obliquata) - E	R4
Ring pink mussel (Obovaria retusa) - E	R4
Rough pigtoe (Pleurobema plenum) - E	R4
Shiny pigtoe (Fusconaia edgariana) - E	R4
Speckled pocketbook (Lampsilis streckeri) - E	R4
Stirrup shell (Quadrula stapes) - E	R4
Tan riffle shell (Epioblasma walkeri) - E	R4
Tar River spinymussel (Elliptio (=Canthyria) steinstansana) - E	R4
Tubercled-blossom pearly mussel (Epioblasma torulosa torulosa) - E	R4
Turgid-blossom pearly mussel (Epioblasma (=Dysnomia) turgidula) - E	R4
White cat's paw pearly mussel (Epioblasma obliquata perobliqua) - E	R3
White warty-back pearly mussel (Plethobasus cicatriocosus) - E	R4
Winged mapleleaf freshwater mussel (Quadrula fragosa) - E	R3
Yellow-blossom pearly mussel (Epioblasma (=Dysnomia) florentina florentina) - E	R4
CRUSTACEANS	
Alabama cave shrimp (Palaemonias alabamae) - E	R4
California freshwater shrimp (Syncaris pacifica) - E	R1
Cave crayfish (Cambarus zophonastes) - E	R4
Hay's Spring amphipod (Stygobromus hayi) - E	R5
Kentucky cave shrimp (Palaemonias ganteri) - E	R4
Madison Cave isopod (Antrolana lira) - T	R5
Nashville crayfish (Orconectes shoupi) - E	R4
Shasta crayfish (Pacifastacus fortis) - E	R1
Socorro isopod (Thermospaeroma thermophilus) - E	R2
Squirrel Chimney cave shrimp (Palaemonetes cummingi) - E	R4
INSECTS	
American burying beetle (Nicrophorus americanus) - E	R5
Ash Meadows naucorid (Ambrysus amargosus) - T	R1
Bay checkerspot butterfly (Euphydryas editha bayensis) - T	R1
Delta green ground beetle (Elaphrus viridis) - T	R1
El Segundo blue butterfly (Euphilotes battoides allyni) - E	R1

Common name (Scientific name) - Status	Region
Kern primrose sphinx moth (Euproserpinus euterpe) - T	R1
Kretschmarr Cave mold beetle (Texamaurops reddelli) - E	R2
Lange's metalmark butterfly (Apodemia mormo langei) - E	R1
Lotis blue butterfly (Lycaeides argyrognomon lotis) - E	R1
Mission blue butterfly (Icaricia icarioides missionensis) - E	R1
Mitchell's satyr (Neonympha mitchellii mitchellii) - E	R3
Myrtle's silverspot butterfly (Speyeria zerene myrtleae) - E	R1
Northeastern beach tiger beetle (Cicindela dorsalis dorsalis) - T	R5
Oregon silverspot butterfly (Speyeria zerene hippolyta) - T	R1
Palos Verdes blue butterfly (Glaucopsychelygdamus palosverdesensis) - E	R1
Pawnee montane skipper (Hesperia leonardus montana) - T	R6
Puritan tiger beetle (Cicindela puritana) - T	R5
San Bruno elfin butterfly (Callophrys mossii bayensis) - E	R1
Schaus swallowtail butterfly (Heraclides (Papilio) aristodemus ponceanus) - E	R4
Smith's blue butterfly (Euphilotes enoptes smithi) - E	R1
Tooth Cave ground beetle (Rhadine persephone) - E	R2
Uncompahgre fritillary butterfly (Boloria acrocnema) - E	R6
Valley elderberry longhorn beetle (Desmocerus californicus dimorphus) - T	R1
ARACHNIDS	
Bee Creek Cave harvestman (Texella reddelli) - E	R2
Tooth Cave pseudoscorpion (Microreagris texana) - E	R2
Tooth Cave spider (Leptoneta myopica) - E	R2
PLANTS	
akoko (Chamaesyce celastroides var. kaenana) - E	R1
akoko (Chamaesyce kuwaleana) - E	R1
Alabama canebrake pitcher-plant (Sarracenia rubra ssp. alabamensis) - E	R4
Alabama leather flower (Clematis socialis) - E	R4
alani (Melicope mucronulata) - E	R1
Alsinodendron trinerve (No Common Name) - E	R1
Amargosa niterwort (Nitrophila mohavensis) - E	R1
American Hart's tongue fern (Phyllitis scolopendrium var. americana) - T	R4
Angular-fruited neraudia (Neraudia angulata) - E	R1
Antioch Dunes evening-primrose (Oenothera deltoides ssp. howellii) - E	R1
Arizona agave (Agave arizonica) - E	R2
Arizona cliffrose (Purshia subintegra) - E	R2
Arizona hedgehog cactus (Echinocereus triglochidiatus var. arizonicus) - E	R2
Ash Meadows blazing star (Mentzelia leucophylla) - T	R1
Ash Meadows gumplant (Grindelia fraxino-pratensis) - T	R1
Ash Meadows ivesia (Ivesia eremica) - T	R1
Ash Meadows milk-vetch (Astragalus phoenix) - T	R1
Ash Meadows sunray (Enceliopsis nudicaulis var. corrugata) - T	R1

Common name (Scientific name) - Status	Region
Ashy dogweed (Thymophylla tephroleuca) - E	R2
Aupaka (Isodendrion hosakae) - E	R1
Autumn buttercup (Ranunculus aciformis var. aestivalis) - E	R6
Bakersfield cactus (Opuntia treleasei) - E	R1
Baker's sticky seed (Blennosperma bakeri) - E	R1
Bariaco (Trichilia triacantha) - E	R4
Barneby reed-mustard (Schoenocrambe barnebyi) - E	R6
Barneby ridge-cress (Lepidium barnebyanum) - E	R6
Beach layia (Layia carnosa) - E	R1
Beautiful goetzea (matabuey) (Goetzea elegans) - E	R4
Beautiful pawpaw (Deeringothamus pulchellus) - E	R4
Black-lace hedgehog cactus (Echinocereus reichenbachii) - E	R2
Black spored quillwort (Isoetes melanospora) - E	R4
Blowout penstemon (Penstemon haydenii) - E	R6
Blue Ridge goldenrod (Solidago spithamaea) - T	R4
Bradshaw's lomatium (Lomatium bradshawii) - E	R1
Brady pincushion cactus (Pediocactus sileri) - E	R2
Brooksville bellflower (Campanula robinsiae) - E	R4
Bunched arrowhead (Sagittaria fasciculata) - E	R4
Bunched cory cactus (Coryphantha ramillosa) - T	R2
Burke's goldfields (Lasthenia burkei) - E	R1
Butte County meadowfoam (Limnanthes floccosa ssp. californica) - E	R1
California jewelflower (Caulanthus californicus) - E	R1
Canby's dropwort (Oxypolis canbyi) - E	R4
Capra rosa (Callicarpa ampla) - E	R4
Carter's mustard (Warea carteri) - E	R4
Carter's panicgrass (Panicum carteri) - E	R1
Cassia mirabilis (No Common Name) - E	R4
Chamaesyce halemanui (No Common Name) - E	R1
Chapman rhododendron (Rhododendron chapmanii) - E	R4
Chisos Mountain hedgehog cactus (Echinocereus chisoensis) - T	R2
Clay-loving wild-buckwheat (Eriogonum pelinophilum) - E	R6
Clay phacelia (Phacelia argillacea) - E	R6
Clay reed-mustard (Schoenocrambe argillacea) - E	R6
Cobana negra (Stahlia monosperma) - T	R4
Cochise pincushion cactus (Coryphantha robbinsorum) - T	R2
Contra Costa wallflower (Erysimum capitatum var. angustatum) - E	R1
Cooke's kokio (Kokia cookei) - E	R1
Cook's holly (Ilex cookii) - E	R4
Cooley's meadowrue (Thalictrum cooleyi) - E	R4
Cooley's water-willow (Justicia cooleyi) - E	R4
Cranichis ricartii (No Common Name) - E	R4
Crenulate lead-plant (Amorpha crenulata) - E	R4
Cumberland rosemary (Conradina verticillata) - T	R4
Cumberland sandwort (Arenaria cumberlandensis) - E	R4
Cuneate bidens (Bidens cuneata) - E	R1
Cyanea superba (No Common Name) - E	R1
Cyanea undulata (No Common Name) - E	R1
Daphnopsis hellerana (No Common Name) - E	R4
Davis hedgehog (Echinocereus viridiflorus var. davisii) - E	R2
Decurrent false aster (Boltonia decurrens) - T	R3
Degner's bluet (Hedyotis degeneri) - E	R1
Deltoid spurge (Euphorbia (=Chamaesyce) deltoidea ssp. deltoidea) - E	R4
Diamond Head schieda (Schieda adamantis) - E	R1
Diellia falcata (No Common Name) - E	R1
Dubautia latifolia (No Common Name) - E	R1
Dubautia pauciflorula (No Common Name) - E	R1
Dudley Bluffs bladderpod (Lesquerella congesta) - T	R6
Dwarf bear-poppy (Arctomecon humilis) - E	R6
Dwarf-flowered heartleaf (Hexastylis naniflora) - T	R4
Dwarf iliau (Wilkesia hobdyi) - E	R1
Dwarf lake iris (Iris lacustris) - T	R3
Dwarf naupaka (Scaevola coriacea) - E	R1
Eastern prairie fringed orchid (Platanthera leucophaea) - T	R3
Elfin tree fern (Cyathea dryopteroides) - E	R4
Erubia (Solanum drymophilum) - E	R4
Euphorbia (=Chamaesyce) garberi (No Common Name) - T	R4
Eureka Valley dunegrass (Swallenia alexandrae) - E	R1
Eureka Valley evening-primrose (Oenothera avita ssp. eurekensis) - E	R1
Ewa Plains 'akoko (Chamaesyce skottsbergii var. kalaeloana) - E	R1
Fassett's locoweed (Oxytropis campestris var. chartacea) - T	R3
Florida bonamia (Bonamia grandiflora) - T	R4
Florida golden aster (Chrysopsis floridana) - E	R4
Florida torreya (Torreya taxifolia) - E	R4
Florida ziziphus (Ziziphus celata) - E	R4
Four-petal pawpaw (Asimina tetramera) - E	R4
Fragrant prickly-apple (Cereus eriophorus var. fragrans) - E	R4
Fringed campion (Silene polypetala) - E	R4
Furbish lousewort (Pedicularis furbishiae) - E	R5
Garrett's mint (Dicerandra christmanni) - E	R4
Gentian pinkroot (Spigelia gentianoides) - E	R4
Geocarpon (Geocarpon minimum) - T	R3
Gibson's cyanea (Cyanea macrostegia var. gibsonii) - E	R1
Green-flowered abutilon (Abutilon sandwicense) - E	R1
Green pitcher plant (Sarracenia oreophila) - E	R4
Guthrie's ground plum (Astragalis bibullatus) - E	R4

Common name (Scientific name) - Status	Region
Gypsum wild buckwheat (Eriogonum gypsophilum) - T	R2
haha (Cyanea lobata) - P	R1
haha (Cyanea mceldowneyi) - E	R1
haha (Cyanea pinnatifida) - E	R1
Hairy rattleweed (Baptisia arachnifera) - E	R4
ha'iwale (Cyrtandra munroi) - E	R1
Haleakala silversword (Argyroxiphium sandwicense ssp. macrocephalum) - T	R1
Haplostachyshaplostachya (No Common Name)	R1
Harperella (Ptilimnium nodosum (=fluviatile)) - E	R5
Harper's beauty (Harperocallis flava) - E	R4
Hawaiian centaury-plant ('awiwi) (Centaurium sebaeoides) - T	R1
Hawaiian bluegrass (Poa sandvicensis) - E	R1
Hawaiian red-flowered geranium (Geranium arboreum) - E	R1
Hawaiian vetch (Vicia menziesii) - E	R1
Hayan lagu (serianthes) (Serianthes nelsonii) - E	R1
Hedyotis parvula (No Common Name) - E	R1
Heliotrope milk-vetch (Astragalus montii) - T	R6
Heller's blazingstar (Liatris helleri) - T	R4
Hesperomannia lydgatei (No Common Name) - E	R1
Hidden-petaled abutilon (Abutilon eremitopetalum) - E	R1
Highlands scrub hypericum (Hypericum cumulicola) - E	R4
Higo chumbo (Harrisia portoricensis) - E	R4
Higuero de Sierra (Crescentia portoricensis) - E	R4
Hillebrand's gouania (Gouania hillebrandii) - E	R1
Hinckley's oak (Quercus hinckleyi) - T	R2
Hoover's wooly-star (Eriastrum hooveri) - T	R1
Houghton's goldenrod (Solidago houghtonii) - T	R3
Howell's spineflower (Chorizanthe howellii) - E	R1
Ilex sintenisii (No Common Name) - E	R4
Jesup's milk-vetch (Astragalus robbinsii var. jesupi) - E	R5
Johnston'sfrankenia (Frankenia johnstonii) - E	R2
Jones' cycladenia (Cycladenia humilis var. jonesii) - T	R6
Kaala schiedea (Schiedea kaalae) - E	R1
kamakahala (Labordia lydgatei) - E	R1
Kanehoa Mt. stenogyne (Stenogyne kanehoana) - E	R1
Kauai hau kuahiwi (Hibiscadelphus distans) - E	R1
Kaui remya (Remya kauaiensis) - E	R1
Ka'u silversword (Argyroxiphium kauense) - PE	R1
Kearney blue star (Amsonia kearneyana) - E	R2
Kern mallow (Eremalche kernensis) - E	R1
Key tree cactus (Cereus robinii) - E	R4
kio'ele (Hedyotis coriacea) - E	R1
Knieskern's beaked-rush (Rhynchospora knieskernii) - T	R5
Knowlton cactus (Pediocactus knowltonii) - E	R6
Koki'o (Hawaii tree cotton) (Kokia drynarioides) - E	R1
ko'oko'olau (Bidens micrantha ssp. Kalealaha) - E	R1
Ko'oloa'ula (Abutilon) (Abutilon menziesii) - E	R1
Kral's water-plantain (Sagittaria secundifolia) - T	R4
Kuenzler hedgehog cactus (Echinocereus fendleri var. kuenzleri) - T	R2
kului (Nototrichium humile) - E	R1
Lakela's mint (Dicerandra immaculata) - E	R4
Lakeside daisy (Hymenoxys acaulis var. glabra) - T	R3
Lanai gahnia (Gahnia lanaiensis) - E	R1
Lanai hesperomannia (Hesperomannia arbuscula) - E	R1
Lanai sandalwood (Santalum freycinetianum var. lanaiense) - E	R1
Lanai smooth phyllostegia (Phyllostegia glabra var. lanaiensis) - E	R1
Lanai violet (Viola lanaiensis) - E	R1
Large-flowered fiddleneck (Amsinckia grandiflora) - E	R1
Large-flowered skullcap (Scutellaria montana) - E	R4
Large-fruited sand verbena (Abronia macrocarpa) - E	R2
Last Chance townsendia (Townsendia aprica) - T	R6
Leafy prairie clover (Dalea foliosa) - E	R4
Leedy's roseroot (Sedum integrifolium) - T	R3
Lee pincushion cactus (Coryphantha sneedii var. leei) - T	R2
Lepanthes eltorensis (No Common Name) - E	R4
Liliwai (Acaena exigua) - E	R1
Little Aguja pondweed (Potamogeton clystocarpus) - T	R2
Little amphianthus (Amphianthus pusillus) - T	R4
Lloyd hedgehog cactus (Echinocereus lloydii) - E	R2
Lloyd's mariposa cactus (Neolloydia mariposensis) - T	R2
lobed nehe (Lipochaeta lobata var. laptophylla) - E	R1
Lobelia niihauensis (No Common Name) - E	R1
Loch Lomond coyote-thistle (Eryngium constancei) - E	R1
Longspurred mint (Dicerandra cornutissima) - E	R4
Lyrate bladder-pod (Lesquerella lyrata) - T	R4
Lysimachia lydgatei (No Common Name) - E	R1
MacFarlane's four-o'-clock (Mirabilis macfarlanei) - E	R1
Maguire daisy (Erigeron maguirei var. maguirei) - E	R6
Maguire primrose (Primula maguirei) - T	R6
Malheur wire-lettuce (Stephanomeria malheurensis) - E	R1
Mahoe (Alectryon macrococcus) - E	R1
Mancos milk-vetch (Astragalus humillimus) - E	R6
Ma'oli'oli (Schiedea apokremnos) - E	R1
Mat-forming quillwort (Isoetes tegetiformans) - E	R4
Maui remya (Remya mauiensis) - E	R1
Mauna Kea silversword (Argyroxiphium sandwicense sandwicense) - E	R1

Common name (Scientific name) - Status	Region
McDonald's rock-cress (Arabis mcdonaldiana) - E	R1
McKittrick pennyroyal (Hedeoma apiculatum) - T	R2
Mead's milkweed (Asclepias meadii) - T	R3
Menzie's wallflower (Erysimum menziesii) - E	R1
Mesa verde cactus (Sclerocactus mesae-verdae) - T	R6
Meyen's gouania (Gouania meyenii) - E	R1
Miccosukee (Florida) gooseberry (Ribes echinellum) - T	R4
Michaux's sumac (Rhus michauxii) - E	R4
Michigan monkey-flower (Mimulus glabratus var. michiganensis) - E	R3
Minnesota dwarf trout lily (Erythronium propullans) - E	R3
Missouri bladder-pod (Lesquerella filiformis) - E	R3
Mohr's Barbara's button (Marshallia mohrii) - T	R4
Monterey gilia (Gilia tenuiflora ssp. arenaria) - E	R1
Montgomery's remya (Remya montgomeryi) - E	R1
Mountain golden heather (Hudsonia montana) - T	R4
Mountain sweet pitcher plant (Sarracenia rubra ssp. jonesii) - E	R4
Na'ena'e (Dubautia herbstobatae) - E	R1
Na Pali Beach bluet (Hedyotis st.-johnii) - E	R1
Narrowleaved haplostachys (Haplostachys haplostachya var. angustifolia) - E	R1
Narrow-leaved stenogyne (Stenogyne angustifolia var. angustifolia) - E	R1
Na'u (Hawaiian gardenia) (Gardenia brighamii) - E	R1
Navajo sedge (Carex specuicola) - T	R2
Navasota Ladies'-tresses (Spiranthes parksii) - E	R2
nehe (Lipochaeta kamolensis) - E	R1
Nehe (Lipochaeta venosa) - E	R1
Nellie's pincushion cactus (Coryphantha minia) - E	R2
Nichol's Turk's head cactus (Echinocactus horizonthalonius var. nicholii) - E	R2
nohoanu (Geranium multiflorum) - E	R1
Northeastern bulrush (Scirpus ancistrochaetus) - E	R5
Northern monkshood (Aconitum noveboracense) - T	R3
North Park phacelia (Phacelia formosula) - E	R6
Obovate alsinidendron (Alsinidendron obovatum) - E	R1
'oha wai (Clermontia oblongifolia ssp. mauiensis) - E	R1
Opuhe (Urera kaalae) - E	R1
Osterhout milk-vetch (Astragalus osterhoutii) - E	R6
Palma de manaca (Calyptronoma rivalis) - T	R4
Palmate-bracted bird's-beak (Cordylanthus palmatus) - E	R1
Palo colorado (Ternstroemia luquillensis) - E	R4
Palo de jazmin (Styrax portoricensis) - E	R4
Palo de nigua (Cornutia obovata) - E	R4
Palo de Ramon (Banara vanderbiltii) - E	R4
Palo de rosa (Ottoschulzia rhodoxylon) - E	R4
Pelos del diablo (Aristida portoricensis) - E	R4

Common name (Scientific name) - Status	Region
Pamakani (Viola chamissoniana ssp. chamissoniana) - E	R1
Papery whitlow-wort (Paronychia chartacea) - T	R4
Pedate checker mallow (Sidalcea pedata) - E	R1
Peebles Navajo cactus (Pediocactus peeblesianus var peeblesianus) - E	R2
Penland alpine fen mustard (Eutrema penlandii) - T	R6
Persistent trillium (Trillium persistens) - E	R4
Peters Mountain mallow (Iliamna corei) - T	R5
Phyllostegia mollis (No Common Name) - E	R1
Pitcher's (dune) thistle (Cirsium pitcheri) - T	R3
Poa siphonoglossa (No Common Name) - E	R1
Point Reyes clover lupine (Lupinus tidestromii var. layneae) - E	R1
Pondberry (Lindera melissifolia) - E	R3
Prairie bush-clover (Lespedeza leptostachya) - T	R3
Prairie dawn flower (Hymenoxys texana) - E	R2
Presidio manzanita (Arctostaphylospungens var. ravenii) - E	R1
Price's potato-bean (Apios priceana) - T	R4
Pygmy fringe tree (Chionanthus pygmaeus) - E	R4
Relict trillium (Trillium reliquum) - E	R4
Remy's tetramolopium (Tetramolopium remyi) - E	R1
Roan Mountain bluet (Hedyotis purpurea var. montana) - E	R4
Robbin's cinquefoil (Potentilla robbinsiana) - E	R5
Rough-leaved loosestrife (Lysimachia asperulaefolia) - E	R4
Roundleaved chaff-flower (Achyranthes splendens var. rotundata) - E	R1
Rugel's pawpaw (Deeringothamus rugelii) - E	R4
Running buffalo clover (Trifolium stoloniferum) - E	R3
Ruth's golden aster (Pityopsis ruthii) - E	R4
Sacramento prickly-poppy (Argemone pleiacantha ssp pinnatisecta) - E	R2
Sacramento Mountains thistle (Cirsium vinaceum) - T	R2
Salt marsh bird's-beak (Cordylanthus maritimus maritimus) - E	R1
San Benito evening-primrose (Camissonia benitensis) - T	R1
San Clemente Island broom (Lotus dendroideus ssp. traskiae) - E	R1
San Clemente Island bush-mallow (Malacothamnus clementinus) - E	R1
San Clemente Island indian paintbrush (Castilleja grisea) - E	R1
San Clemente Island larkspur (Delphinium kinkiense) - E	R1
San Diego mesa mint (Pogogyne abramsii) - E	R1
Sandplain gerardia (Agalinis acuta) - E	R5
San Francisco peaks groundsel (Senecio franciscanus) - T	R2
Sanicula mariversa (No Common Name) - E	R1
San Joaquin wooly threads (Lembertia congdonii) - E	R1
San Mateo thornmint (Acanthomintha obovata ssp. duttonii) - E	R1
San Rafael cactus (Pediocactus despainii) - E	R6
Santa Ana River wooly-star (Eriastrum densifolium ssp. sanctorum) - E	R1
Santa Barbara Island liveforever (Dudleya traskiae) - E	R1

Common name (Scientific name) - Status	Region
Santa Cruz cypress (Cupressus abramsiana) - E	R1
Schiedea haleakalensis (No Common Name) - E	R1
Schoepfia arenaria (No Common Name) - T	R4
Schweinitz's sunflower (Helianthus schweinitzii) - E	R4
Scrub blazing star (Liatris ohlingerae) - E	R4
Scrub lupine (Lupinus aridorum) - E	R4
Scrub mint (Dicerandra frutescens) - E	R4
Scrub plum (Prunus geniculata) - E	R4
Scutellaria floridana (No Common Name) - T	R4
Sebastopol meadowfoam (Limnanthes vinculans) - E	R1
Sentry milk vetch (Astragalus cremnophylax var. cremnophylax) - E	R2
Shale barren rock-cress (Arabis serotina) - E	R5
Short's goldenrod (Solidago shortii) - E	R4
Siler pincushion cactus (Pediocactus sileri) - E	R6
Silene perlmanii (No Common Name) - E	R1
Slender-horned spineflower (Dodecahema leptoceras) - E	R1
Slender-leaved nehe (Lipochaeta tenuifolia) - E	R1
Slender-petaled mustard (Thelypodium stenopetalum) - E	R1
Slender rush-pea (Hoffmanseggia tenella) - E	R2
Small-anthered bittercress (Cardamine micranthera) - E	R4
Small's milkpea (Galactia smallii) - E	R4
Small whorled pogonia (Isotria medeoloides) - E	R5
Snakeroot (Eryngium cuneifolium) - E	R4
Sneed pincushion cactus (Coryphantha sneedii var. sneedii) - E	R2
Solano grass (Tuctoria mucronata) - E	R1
Sonoma spineflower (Chorizanthe valida) - E	R1
Spineless hedgehog cactus (Echinocereus triglochidiatus var. inermis) - E	R6
Spreading avens (Geum radiatum) - E	R4
Spring-loving centaury (Centaurium namophilum) - T	R1
Steamboat Springs buckwheat (Eriogonum ovalifolium var. williamsiae) - E	R1
Stenogyne campanulata (No Common Name) - E	R1
St. Thomas prickly ash (Zanthoxylum thomasianum) - E	R4
Swamp pink (Helonias bullata) - T	R5
Tennessee yellow-eyed grass (Xyris tennesseensis) - E	R4
Tennessese purple coneflower (Echinacea tennesseensis) - E	R4
Terlingua Creek cat's-eye (Cryptantha crassipes) - T	R2
Ternstroemia subsessilis (No Common Name) - E	R4
Tetramolopium lepidotum var. lepidotum (No Common Name) - E	R1
Texas poppy-mallow (Callirhoe scabriuscula) - E	R2
Texas snowbell (Styrax texana) - E	R2
Texas trailing phlox (Phlox nivalis var. texensis) - T	R2
Texas wildrice (Zizania texana) - E	R2
Thread-leaved tetramolopium (Tetramolopium filiforme) - E	R1
Tiny polygala (Polygala smallii) - E	R4
Toad-flax cress (Glaucocarpum suffrutescens) - E	R6
Tobusch's fishhook cactus (Ancistrocactus tobuschii) - E	R2
Todsen pennyroyal (Hedeoma todsenii) - E	R2
Truckee barberry (Mahonia sonnei) - E	R1
Tumamoc globeberry (Tumamoca macdougalii) - E	R2
Uhiuhi (mezoneuron) (Caesalpinia kavaiense) - E	R1
Uinta Basin hookless cactus (Sclerocactus glaucus) - T	R6
Ute ladies'-tresses (Spiranthes diluvialis) - T	R6
Vahl's boxwood (Buxus vahlii) - E	R4
villous water-fern (ihi ihi) (Marsilea villosa) - E	R1
Viola helenae (No Common Name) - E	R1
Virginia round-leaf birch (Betula uber) - E	R5
Virginia spiraea (Spiraea virginiana) - T	R5
Walker's manioc (Manihot walkerae) - E	R2
wawae'iole (Huperzia mannii) - E	R1
Welsh's milkweed (Asclepias welshii) - T	R6
Western prairie fringed orchid (Platanthera praeclara) - T	R3
Wheeler's peperomia (Peperomia wheeleri) - E	R4
White birds-in-a-nest (Mcbridea alba) - T	R4
White-haired goldenrod (Solidago albopilosa) - T	R4
White irisette (Sisyrinchim dichotomum) - E	R4
Wide-leaf warea (Warea amplexifolia) - E	R4
Wireweed (Polygonella basiramia) - E	R4
Wright fishhook cactus (Sclerocactus wrightiae) - T	R6
Xylosma crenatum (No Common Name) - E	R1
Zapat's bladderpod (Lesquerella pallida) - E	R2
Zuni fleabane (Erigeron rhizomatus) - T	R2

MAMMALS

ALABAMA BEACH MOUSE *(Peromyscus polionotus ammobates)* - E

SPECIES INFORMATION: A subspecies of the oldfield mouse *(Peromyscus polionotus)*, the Alabama beach mouse has a small body, haired tail, relatively large ears, and protuberant eyes. Its head and body length are 2.7 to 3.4 inches with a tail length of 1.6 to 2.3 inches. The upper body is pale gray, the sides and underparts are white, and the tail is white with an incomplete dorsal stripe.

Historically, the Alabama beach mouse was known only from Baldwin County, Alabama, where it was found on coastal dunes form Fort Morgan to Alabama Point, and on Ono Island. Presently survives on disjunct tracts of the sand dune system from Fort Morgan State Park to the Romar Beach area, but has apparently disappeared from most of its original range including all of Ono Island.

The habitat is restricted to the mature coastal barrier sand dunes along the Gulf. The depth of the habitat extending inland may be as much as several hundred meters from the primary dune line, depending on the configuration of the sand dune system and the vegetation present. There are commonly several rows of dunes paralleling the shoreline and occasionally ranging up to 46 feet in height. The beach mice dig burrows mainly on the lee side of the primary dunes and in other secondary and interior dunes where the vegetation provides suitable cover. These mice are seminomadic over a relatively small range, digging as many as 20 burrows into the sand dunes for nesting, food storage, and safety refuges form predators. The mice may also use ghost crab burrows.

The Alabama beach mouse feeds mostly on beach grass and sea oats and on invertebrates, especially in late winter and early spring. The mouse seems to be monogamous as long as both partners remain alive, producing litters about once a month. The litter size ranges from two to seven, averaging about four, with the young reaching reproductive maturity as early as 6 weeks of age. The life span for a related species was estimated at 5 months.

SPECIES STATUS AND TRENDS: Tropical storms and loss of habitat are considered to be primary factors for the mouse's decline. It is estimated that less than half of the original habitat still remains suitable. The major threat to the habitat continues to be human destruction of the coastal sand dune ecosystem for commercial and residential development. In addition, recreational use of the sand dunes by pedestrians and vehicles can destroy vegetation essential for dune development and maintenance. Such loss of vegetation results in extensive wind and water erosion, reducing the effectiveness of coastal dunes as a protective barrier and ultimately destroying beach mouse habitat.

House mice *(Mus musculus)*, which are associated with human dwellings, may compete with the beach mouse for food, but the evidence is not conclusive at present. The presence of feral house cats may also pose a threat to beach mouse populations. The absence of a beach mouse population on Ono Island may be attributable to cat predation.

Recent trapping efforts in specific areas of preferred habitat indicate that Alabama beach mice populations are currently stable in those areas. However up to date estimates of population size are not available. Based on data form 1985 the population was at that time estimated to be about 850 mice.

PESTICIDE/SPECIES INTERFACE: The Alabama beach mouse may be affected by pesticides used to control rodents such as house mice or black rats. Toxic baits placed in or adjacent to areas of preferred habitat would be a potential threat to the beach mouse.

AMARGOSA VOLE *(Microtus californicus scirpensis)* - E

SPECIES INFORMATION: The Amargosa vole is a small, cinnamon-colored rodent that is a subspecies of the California vole. The range is endemic to Amargosa River drainage of the Mohave Desert. The habitat is marsh habitat of bulrush and saltgrass where the vole feeds on underground parts of plants. This species has small home ranges, all remaining habitats are less than 5 acres in size, vegetation provides microhabitats. It generally remains underground in summer. Critical habitat has been designated on 4,520 acres in the northern Mojave desert of extreme southeastern Inyo County, which is the entire known range of the animal.

SPECIES STATUS AND TRENDS: The exact number of this population is not known. The reasons for decline include loss of wetlands, continued groundwater pumping, and establishment of saltcedar and consequent displacement of food source plants. There is a potential for geothermal development in the area. Most habitats are on private lands. BLM has land use limitations, The Nature Conservancy has a private reserve to manage seeps and marshes that provide water.

PESTICIDE/SPECIES INTERFACE: A golf course is proposed nearby, therefore rodenticides and pesticides could be used in adjacent habitat.

ANASTASIA ISLAND BEACH MOUSE *(Peromyscus polionotus phasma)* - E

SPECIES INFORMATION: A subspecies of the oldfield mouse *(Peromyscus polionotus)*, the Anastasia Island beach mouse has a small body, relatively large ears, and protuberant eyes. One of the largest species of beach mice, it averages 5.4 inches in length and 2.1 in tail length. This beach mouse is much paler than most inland races of oldfield mice. The coloration consists of a light buff colored back, pure white underparts, and indistinct white markings on the nose and face.

The Anastasia Island beach mouse was known historically from the mouth of the St. Johns River, Duval County south to Matanzas Inlet, St. Johns County, Florida. It currently occurs only on Anastasia Island, primarily at the north (Anastasia Island State Recreation Area) and south (Fort Matanzas National Monument) end of the island. The original distribution was over about 50 linear miles of beach; current viable populations occupy only about three linear miles of beach.

This subspecies is restricted to coastal dunes and adjacent inland scrub. The habitat is characterized by sand dunes vegetated with sea oats, dune panic grass or broomsedge, and adjacent inland areas covered by woody vegetation such as palmetto, oak, and sand pine. Little specific information exists about this subspecies burrowing habits, however, they are presumed to be similar to other beach mice species. Burrows are usually located on the sloping side of a dune, and consist of an entrance tunnel, nest chamber, and an escape tunnel. Individual mice may use up to 20 burrows. Occasionally, beach mice may also use ghost crab burrows.

Beach mice typically feed on the seeds of beach grasses and sea oats. Small invertebrates are probably eaten from time to time, especially in late spring and early summer when seeds are scarce. Beach mice are nocturnal, with most activity occurring on moonlit nights and less activity under stormy conditions or moonless nights. The breeding season appears to start in November and end in early January. The female, which may reach reproductive maturity at 6 weeks of age, produces two to seven beach mice per litter. A female beach mouse can usually produce litters at 26-day intervals, but mortality is high. Most of the progeny will not survive over 4 months.

SPECIES STATUS AND TRENDS: The Anastasia Island beach mouse is primarily threatened by beach and residential development that eliminates suitable habitat. Predators include raccoons, skunks, snakes, and feral dogs and cats. Competitors, such as house mice, are also threats. Estimates on population size include several hundred beach mice occurring at Fort Matanzas National Monument, and a few thousand on all of Anastasia Island. Densities range from 6-50 mice per hectare. Continued loss of suitable habitat will likely result in declining population levels.

SPECIES/PESTICIDE/INTERFACE: The Anastasia Island beach mouse may be affected by pesticides used to control rodents such as house mice or black rats. Toxic baits placed in or adjacent to areas of preferred beach mouse habitat would pose a potential threat to this subspecies.

BLACK-FOOTED FERRET *(Mustela nigripes)* - E

SPECIES INFORMATION: The Black-footed ferret is a weasel-like mammal that has yellow-buff coloration with black feet, tail tip, and eye mask. The ferret has a body length of 15 to 18 inches. Black-footed ferrets formerly ranged from the Great Plains of Canada to intermontane regions of the interior Rocky Mountains and Southwest in all of portions of the States of Colorado, Arizona, Utah, New Mexico, Kansas, Montana, Nebraska, Oklahoma, Texas, Wyoming, North Dakota, and South Dakota, as well as the Provinces of Alberta and Saskatchewan, Canada. The Meeteetse, Wyoming ferret population was removed and placed at the Wyoming Deparment's captive breeding facility at the Sybille Wildlife Research and Conservation Educaion Center from 1985 through 1987. There are currently no known wild populations of this species. The likelihood of ferrets being found in the wild is considered low, however, the occurrence of ferrets within the historic range of the species must still be considered possible.

The close association of black-footed ferrets and prairie dogs is well documented. Black-footed ferrets rely on prairie dogs for both food and shelter. Historically, ferrets have been found on grassland plains and surrounding basins up to 10,500 feet elevation. Besides feeding on prairie dogs, which comprise its major food source, ferrets also are known to eat rabbits, mice, voles, ground squirrels, pocket gophers, birds, and insects. It is believed to take an occupied black-tailed prairie dog colony or complex of between 61 and 294 acres (midrange of 104 acres) to support a single ferret, while between 196 and 475 acres of white-tailed prairie dogs is believed to be required to support a single black-footed ferret in white-tailed prairie dog habitat.

SPECIES STATUS AND TRENDS: As stated above, there are currently no known wild populations of black-footed ferrets. There are approximately 130 ferrets located in captive breeding facilities at Sybille near Laramie, Wyoming; Henry Doorly Zoo in Omaha, Nebraska; the Conservation and Research Center near Front Royal, Virginia; the Louisville Zoological Park in Louisville, Kentucky; and the Cheyenne Mountain Zoo in Colorado Springs, Colorado.

Since the turn of the century, the ferret's habitat (prairie dog colonies) has decreased by as much as 98 percent, primarily as a result of land use changes and practices that include prairie dog control. From over 100 million acres in the late 1800's, prairie dog colonies are estimated to have been reduced to about 2 million acres, only a portion of which may be suitable for ferret survival and recovery. As prairie dog colonies become smaller and their spacing more distant, ferret populations likely suffered the following consequences: (1) reduced gene pool; (2) decreased ability to disperse to new colonies; and (3) lowered mating success. If some ferrets still remain in the wild, the probability of their continued survival and viability in the wild is considered low primarily because of the following factors: (1) the catastrophic effect of canine distemper on ferrets and their susceptibility to this disease; (2) the dynamics of ferret habitat (prairie dog colonies as influenced by plague and continued government and private poisoning programs; (3) other stochastic environmental events which may adversely influence the survival of ferrets and their habitats; and (4) the continued segmentation and eradication of the habitat which forces genetic isolation and elimination of food source and habitat of the species. Non-Federal actions that are likely to adversely impact the ferret are those that result in the loss of prairie dog habitat on private lands.

PESTICIDE/SPECIES INTERFACE: Pesticides used to control prairie dogs and other mammals or that are toxic directly or indirectly to mammals are likely to continue to adversely impact the black-footed ferret either through direct toxicity or indirectly through the loss of the ferrets food source.

CAROLINA NORTHERN FLYING SQUIRREL *(Glaucomys sabrinus coloratus)* - E

SPECIES INFORMATION: The Carolina northern flying squirrel is a small nocturnal gliding mammal some 260 to 305 millimeters (10 to 12 inches) in total length and 95 to 140 grams (3-5 oz.) in weight. It possesses a long, broad, flattened tail (80 percent of head and body length), prominent eyes, and dense, silky fur. The broad tail and folds of skin between the wrist and ankle form the aerodynamic surface used for gliding. Adults are gray with a brownish, tan, or reddish wash on the back, and grayish white or buffy white ventrally. Juveniles have uniform dark, slate-gray backs, and off-white undersides. The northern flying squirrel can be distinguished from the southern flying squirrel by its larger size; the gray base of its ventral hairs as opposed to a white base in the southern species; the relatively longer upper tooth row; and the short, stout baculum (penis bone) of the males. The closest relative of the northern flying squirrel is *Glaucomys sabrinus fuscus*, also classified as endangered. *G. s. fuscus* is known only from a few areas in Virginia and West Virginia.

The northern flying squirrel is known from five isolated localities: three in the western mountains of North Carolina (Yancey County, Haywood County, and in the vicinity of Mt. Mitchell (exact county undetermined)), and two localities in the eastern mountains of Tennessee (Carter and Sevier Counties). The northern flying squirrel is typically a species found in more northern areas, and it was well into the 20th century before the species was found to occur in the eastern United States to the south of New York. The northern flying squirrel was first described from specimens taken in the Appalachians of eastern Tennessee and western North Carolina. Only a very few specimens have been captured since that time. It is possible that this subspecies may have been declining since the last ice age, when the climate slowly began warming and left the remaining suitable habitat limited to a few scattered areas at high elevations. No population estimates are available, but the northern flying squirrel seems to be extremely rare, and also extremely difficult to collect and study. Most captures have come from Roan Mountain on the North Carolina and Tennessee border, where a total of 25 individuals have been taken since 1968.

The northern flying squirrel occurs primarily in the ecotone, or vegetation transition zone, between the coniferous and northern hardwood forests. Both forest types are used in the search for food, while the hardwood areas are needed for nesting sites. Because of the flying squirrel's small size, the climatic severity of its habitat, and the abundance of avian and mammalian predators, nesting sites represent critical resources. During the cooler months, squirrels commonly occupy tree cavities and woodpecker holes, but may also construct and use leaf nests - especially in the summer. The interior of both types of nests is lined with lichens, moss, or finely chewed bark. Preliminary results from a study presently underway in West Virginia indicate that these squirrels sometimes enter burrows in the ground, although the extent of their use is not yet known.

Over much of its range, the northern flying squirrel can apparently subsist on lichens and fungi, but also eats certain seeds, buds, fruit, staminate cones, insects, and other animal material.

Little reproductive information is available for this subspecies. Investigators working with more northern subspecies mention two litters of 2 to 6 young per year and a gestation period of 37 to 42 days). However, trapping data from the southern Appalachians suggest a single annual litter in early spring. Two captive females taken in North Carolina each bore four young. Northern flying squirrels are relatively gregarious and are known to share nests; however, the spectacular winter nesting aggregations reported for the southern flying squirrel (up to 50 in a nest) are unknown for this species. Northern flying squirrels apparently live in family groups of adults and juveniles, for in those areas where the species has been located, it has often been possible to trap two to six individuals within a 300 by 400 meter area.

SPECIES STATUS AND TRENDS: Because the northern flying squirrel is adapted to cold, boreal conditions, its range has probably been shrinking due to natural conditions since the last ice age. Populations are now restricted to isolated areas at high elevations, separated by vast areas of unsuitable habitat. In these

last occupied zones, the squirrel and its habitat are coming under increasing pressure from human disturbance, such as logging and development of skiing and other recreational facilities.

Logging and other clearing activity has also resulted in the colonization of former northern flying squirrel habitat by the southern flying squirrel. Regrowth in cleared areas, if any, has tended to be deciduous forest favored by the more aggressive southern flying squirrel. Recent research on captive animals suggests that the northern flying squirrel may be displaced by the southern subspecies in certain hardwood habitats where their ranges overlap The southern flying squirrel, though smaller than the northern flying squirrel, is more aggressive, more active in territorial defense, and dominant in competition for nests. When the two squirrels meet in an ecotone between coniferous and deciduous forest, the southern subspecies would be expected to force the northern flying squirrel out into the purely coniferous zone, which lacks favorable nesting sites and would therefore reduce reproduction by the northern flying squirrel. Also, the southern flying squirrel is apparently the natural host for a nematode parasite, *Strongeloides robustus*, and has developed an immunity to its ill effects. However, when the northern and southern flying squirrels were held together in captivity, the parasite was transferred to the nothern flying squirrel with lethal results. Recent contact between the two squirrels, as a result of habitat disruption, has created conditions suitable for spreading the parasite to the northern flying squirrel and may be contributing to its demise.

PESTICIDE/SPECIES INTERFACE: The Carolina northern flying squirrel would most likely be affected by pesticides applied within the species' occupied habitat. Where forestry, rights-of-way, agricultural activities, and other land use changes encroach on the species' habitat, there would be potential for the squirrel to come in contact with rodenticides and insecticides. Broadcast application of flavored poisoned bait would pose a significant threat to the squirrel.

CHOCTAWHATCHEE BEACH MOUSE *(Peromyscus polionotus allophrys)* - E

SPECIES INFORMATION: The Choctawhatchee beach mouse has a small body, haired tail, relatively large ears, and protuberant eyes. Head and body length is 2.7 to 3.5 inches; tail length is 1.7 to 2.5 inches. The upper parts are colored orange-brown to yellow-brown, the underparts are white, and the tail has a variable dorsal stripe.

Historically known from Okaloosa, Walton and Bay Counties, Florida, the Choctawhatchee beach mouse was originally found along the Gulf on mature coastal dunes between Choctawhatchee and St. Andrew Bays. Its current distribution is apparently limited to two areas: (1) approximately 4.9 miles of beach from around Morrison Lake eastward to Stalworth Lake (Topsail Hill area, Walton County), and (2) Shell Island at St. Andrews Bay in Bay County.

The habitat is restricted to the mature coastal barrier sand dunes along the Gulf. The depth of the habitat extending inland may vary depending on the configuration of the sand dune system and the vegetation present. There are commonly several rows of dunes paralleling the shoreline and within these rows there are generally three types of micro-habitat. The frontal dunes are sparsely vegetated with sea oats, bunch grass, beach morning glory and railroad vine. The interdunal areas contain sedges, rushes and salt-grass. The dunes farther inland support growths of slash pine, sand pine, scrubby shrubs and oaks.

The beach mice dig burrows mainly on the lee side of the primary dunes and in other secondary and interior dunes where the vegetation provides suitable cover. The mice may also use ghost crab burrows. A nocturnal herbivore, this beach mouse probably feeds primarily on the seeds of sea oats and bunch-grass. Arthropods are eaten seasonally in spring and summer.

A population of Choctawatchee beach mice is capable of producing a maximum of six generations per year. Breeding may occur at any time, but reaches its peak during fall and winter. Litter size may range from two to seven. Their average lifespan is 180 days. Females reach sexual maturity at 6 weeks of age.

SPECIES STATUS AND TRENDS: Destruction of Gulf coast sand dune ecosystems for commercial and residential development has destroyed about 60 percent of the original habitat. A 1979 survey indicated that the beach mouse had been extirpated from 7 of 9 previously known habitat areas, although this loss was mitigated somewhat by the discovery of a new population on Shell Island. Results of this survey also suggested that the house mouse, through competition for food and cover, may have displaced the beach mouse in the mainland portion of St. Andrews State Recreation Area (across the channel from Shell Island). Human dwellings in the vicinity of beach mouse habitat serve as points of introduction for house mice. Predation by feral house cats associated with residential development may also occur.

Tropical storms periodically devastate sand dune communities, dramatically altering or destroying habitat, drowning beach mice, and concentrating the mice on high scrub dunes where they are exposed to predators. Habitat loss and fragmentation from development increases the potential impact from this threat.

In 1979, the species' total population was conservatively estimated at 515, consisting of 357 beach mice on Shell Island, and 158 mice in the Topsail Hill area. In addition to that estimate, in 1987-88, thirty Choctawhatchee Beach Mice were reestablished on Grayton Beach State Recreation Area. Surveys indicate that these mice are reproducing.

PESTICIDE/SPECIES INTERFACE: The Choctawhatchee beach mouse may be affected by pesticides used to control rodents such as house mice and black rats. Toxic baits placed in or adjacent to beach mice habitat would be a potential threat.

DELMARVA PENINSULA FOX SQUIRREL *(Sciurus niger cinereus)* - E

SPECIES INFORMATION: The Delmarva Peninsula fox squirrel is a large squirrel, weighing up to two pounds. Its coat is a light, grizzled, grayish color with a steel-blue cast dorsally and a white cast ventrally. The feet are white and the tail has a pronounced black stripe on the outer edge. The squirrel is presently restricted to local disjunct populations found on the Delmarva Peninsula in Maryland, Virginia, and Delaware. This species is found mostly in mixed stands of mature (mast-producing) hardwoods. Habitats include groves of trees along streams and in agricultural areas, and mature loblolly pine forests adjacent to salt marshes. The Delmarva fox squirrel feeds heavily on mast-producing trees, such as oak, hickory, beech, walnut and loblolly pine. During the spring, they feed extensively on buds and flowers of trees, and will also consume fungi, insects, fruit, seeds, and occasionally bird eggs and young. Two peaks occur during the breeding season -- one in February/March and the other in July/August. The fox squirrels are polygamous, and the female raises the average litter of three by herself, usually in a tree den. The young are weaned between nine to twelve weeks of age.

SPECIES STATUS AND TRENDS: Populations exist at Blackwater, Eastern Neck, Chincoteague, and Prime Hook National Wildlife Refuges, totaling approximately 800 in 1987. Populations on state and private land are not known. The Delmarva fox squirrel is adversely impacted by destruction of its mature woodland habitat from timber cutting, agricultural clearing, construction and development, and competition with the gray squirrel.

PESTICIDE/SPECIES INTERFACE: Delmarva fox squirrels are not normally affected by most pesticides, because they consume foods in the mature stage after pesticide application may occur. However, there is the possibility of accidental poisoning through ingestion of granules or drinking water having dissolved pesticide material in solution. Exposure to certain rodenticides might also pose a risk.

FLORIDA PANTHER *(Felis concolor coryi)* - E

SPECIES INFORMATION: The Florida panther is a large, long-tailed cat with a great deal of color variation: pale brown or rusty upper parts, dull white or buffy under parts; tail tips, back of ears, and sides of nose dark brown or blackish. Mature male panthers examined in the wild in Florida since 1978 have weighed from 106 to 154 pounds, and measured nearly 7 feet from nose to tip of tail. Females were considerably smaller, with a weight range of 65 to 100 pounds and measuring about 6 feet. Data on panther kitten development indicate that males 6-10 months of age weighed in at 34-55 pounds; 14-19 months, 85-86 pounds; and 24-36 months, 92-93 pounds. Females 6-10 months weighed 31-49 pounds; 14-20 months, 56-70; and 24-48 months, 50-80 pounds.

The historic range included eastern Texas or western Louisiana and the lower Mississippi River valley east through the Southeastern States in general (Arkansas, Louisiana, Mississippi, Alabama, Florida, Georgia, and parts of Tennessee and South Carolina). Even though numerous sighting reports continue to surface annually throughout its historic range, it is unlikely that viable populations of the Florida panther presently occur outside Florida. In general, panther population centers appear to indicate a preference toward large remote tracts with adequate prey, cover, and reduced levels of disturbance. A telemetry study on the Florida panther was initiated in south Florida by the Florida Game and Fresh Water Fish Commission (Commission) in 1981. This initial study has since been expanded by the Commission, and the National Park Service initiated additional studies in 1986. One of the goals of these telemetry projects is to learn more about panther habitat. As of July 1989, data had been gathered from 33 radio-instrumented panthers.

Data from panthers monitored by the Commission in southwest Florida since 1985 indicate that, overall, habitat use is highly diverse and varies from north to south. Diversity of habitats used by panthers is greater in northern parts of the study area and dominated by uplands (hardwood hammocks, low pinelands, and palm forests). Lower diversity and predominately wetland habitat use are characteristic of southern areas (mixed swamp and cypress swamp). Appropriate cover is an important component of habitats used, especially during hunting, denning and day-bedding. Saw palmetto was the dominant cover in 72 percent of observed day bedding-sites. Home range sizes of 13 instrumented panthers in southwest Florida averaged 255 square miles for adult males and 135 square miles for adult females.

Preliminary analyses of panther diets in the southwest Florida study area indicate they subsist on a variety of mammalian prey dominated by white-tailed deer, wild hog, and in some areas raccoon. Analysis of 83 scats and 22 kills since 1986 indicate a difference in food habits between the north and south portions of the study area. Deer and hogs accounted for 42 percent and 22 percent, respectively, in the south, and 23 percent and 63 percent, respectively, in the north. Occurrence of small prey appeared similar between areas.

Only preliminary data is available on Florida panther reproduction. Existing data indicates a breeding season of November to April, a gestation period of around 90-95 days, litter sizes of 1-4 kittens, a breeding cycle of 2 years for females, and kitten dispersal at 18 months. A female has successfully reproduced at 22-23 months, and a male has possessed fertile sperm and exhibited reproduction at 26-30 months. Male panthers examined to date exhibit an exceedingly high proportion of abnormal sperm forms (more than 90 percent), with the major defect involving the acrosome or head of the spermatozoa. In addition, 4 to 12 (33 percent) males examined since 1984, have exhibited cryptorchidism (one testicle does not descend properly into the scrotum). As part of the genetic preservation effort, a sperm bank was established in 1988, to cryopreserve (freeze-store) semen collected from free-ranging males.

SPECIES STATUS AND TRENDS: The only known viable population occurs in south Florida, generally within the Big Cypress Swamp and Everglades physiographic region in Collier, Dade, Glades, Hendry, Lee, and Monroe Counties. Scattered verified sign has recently been documented (late 1980's) along the St. Johns River drainage from northern Okeechobee County north to southern Putman County. Telemetry data suggests the present population of panthers may be at or near the carrying capacity for existing habitat

conditions. Currently, the wild population is estimated to be 30-50 animals. However, the death of even one panther would pose a serious threat to the species' survival. Losses could result in population reduction below a level necessary to maintain the demographic and/or genetic health of the species. The status of the panther is further exacerbated by the cumulative effects of human encroachment including current and proposed agricultural and mining operations impacting available habitat.

PESTICIDE/SPECIES INTERFACE: Although the opportunity for the panther to come in contact with pesticides is remote because of the species habits, there are several possible routes of exposure. Panthers may prey on cattle treated for pest control or scavenge on dead livestock that had been treated; secondary poisoning by scavenging on poisoned rodents or birds can occur when the panthers typical large prey species are scarce; because these big cats occasionally venture outside a given home range, contact with pesticide treated citrus groves, sugarcane or other crop fields may also occur.

FLORIDA SALT MARSH VOLE *(Microtus pennsylvanicus dukecampbelli)* - E

SPECIES INFORMATION: The Florida salt marsh vole is a small (178-198 mm in total length), short-tailed rodent with a blunt head and short ears. Its fur is black-brown dorsally and dark gray ventrally. It is closely related to the meadow vole *(M. p. pennsylvanicus)* but can be distinguished by its larger size, darker coloration, relatively small ears, and by certain skull characteristics.

The Florida salt marsh vole is known only from one site at Waccasassa Bay in Levy County, Florida, where it is found in a salt marsh with vegetation consisting of smooth cordgrass, black rush, and saltgrass. Very little is known about the species' biology and life history. It is presumed that the Florida salt marsh vole feeds primarily on seeds and succulent plant parts.

SPECIES STATUS AND TRENDS: The Florida salt marsh vole presently exists only in extremely low numbers (only one salt marsh vole was found during intensive trapping in 1987 and 1988) and has a very restricted range. Any natural or human induced adverse impact to this species could result in its extinction.

PESTICIDE/SPECIES INTERFACE: Pesticide use for rodent control and/or mosquito control could potentially occur within or adjacent to the Florida salt marsh vole's habitat and could pose a serious threat to this species. Exposure to rodenticides would likely occur through ingestion of poison baits; and exposure to other pesticides could occur through ingestion of food items contaminated by direct spray application or drift deposition of the pesticides.

GRAY WOLF *(Canis lupus)* - E/T

SPECIES INFORMATION: The Gray wolf occurs as a result of natural recolonization which is presently occurring in Idaho, north-central Washington, and northwestern Montana. Successful reproduction of wolves has been recorded in southeast British Columbia, Canada, along the North Fork of the Flathead River, Glacier National Park, and other areas in northwest Montana, and the north Cascades of Washington. The gray wolf also inhabits the northeastern third of Minnesota, portions of the northern third of Wisconsin, and portions of the Upper Peninsula and Isle Royale of Michigan.

The key components of wolf habitat include: (1) a sufficient, year-round prey base of ungulates (big game) and alternate prey, (2) suitable and somewhat secluded denning and rendezvous sites, and (3) sufficient space with minimal exposure to humans. The primary prey for wolves in Minnesota, Wisconsin, and Michigan include deer, moose, and beaver as are wolves in the Rocky Mountains which also feed on elk, bison, ground squirrels, snowshoe hare, and grouse. On a biomass basis, ungulates comprise the bulk (more than 90 percent) of the wolves' diet during summer and fall in the Rocky Mountains.

In the Northern Rockies, wolf pups are born any time from late March to late April or possibly early May. Most wolves appear particularly sensitive to human activity near den sites and may abandon them if disturbed.

SPECIES STATUS AND TRENDS: The wolf population in and adjacent to Montana as of March 1991 is estimated to be about 50 wolves in 5 packs. No more than 15 wolves were believed to be present in central Idaho as of August 1987. There are no recent population figures for the gray wolf (eastern timber wolf) but it is estimated that there are approximately 1,200 to 1,300 of these wolves occurring in Minnesota, Wisconsin, and Michigan. The population decline of the eastern timber wolf was a result of (1) intensive human settlement, (2) direct conflict with domestic livestock, (3) a lack of understanding of the animal's ecology and habits, (4) fears and superstitions concerning wolves, and (5) the extreme control programs designed to eradicate the wolf. These factors apply to the decline in all wolf populations in the United States. Reasons for the decline of the Northern Rocky Mountain wolf also are given as land development, loss of habitat, poisoning, trapping, and hunting. Non-Federal actions adversely impacting the wolves include primarily hunting and trapping of wolves on non-federal lands.

SPECIES/PESTICIDE INTERFACE: Pesticides used to control coyotes (e.g., sodium cyanide, sodium fluroacetate) and other mammals (e.g., ground squirrel control) could adversely impact the gray wolf.

GRIZZLY BEAR *(Ursus arctos horribilis)* - T

SPECIES INFORMATION: Grizzly bear populations in the conterminous United States are restricted to northcentral and northeastern Washington, northern and eastern Idaho, western Montana, and northwestern Wyoming. Only six areas are known to sustain either self-perpetuating or remnant populations, excluding southern Colorado, where a grizzly bear was killed in the fall of 1979 in a remote section of the San Juan National Forest. These areas include the Yellowstone Grizzly Bear Ecosystem (YGBE), the Northern Continental Divide Grizzly Bear Ecosystem (NCDGBE), the Cabinet-Yaak Grizzly Bear Ecosystem (CYGBE), the Selkirk Mountains Grizzly Bear Ecosystem (SMGBE), the Selway-Bitterroot Grizzly Bear Ecosystem (SBGBE), and the North Cascades Grizzly Bear Ecosystem (NCGBE).

The primary components of grizzly bear habitat include food, cover, and denning habitat. Grizzly bears are successful omnivores, and in some areas may be almost entirely herbivorous. Grizzly bears must avail themselves for foods high in protein or carbohydrates in excess of maintenance requirements in order to survive denning and post-denning periods. They are opportunistic feeders and will prey or scavenge on almost any available food including ground squirrels, ungulates, carrion, and garbage. This search for food is a prime influence on movements. Upon emergence from the den, they seek the lower elevations, drainage bottoms, avalanche chutes, and ungulate winter ranges, where their food requirements can be met.

Limited reproductive capacity of grizzly bears precludes any rapid increase in the population. Mating appears to occur from late May through mid-July, with a peak in mid-June. The age of first reproduction and litter size varies and may be related to the nutritional state of the bear. Litter sizes range from 1 to 4 with the mean of about 2.

SPECIES STATUS AND TRENDS: The current population of grizzly bears is estimated at between 800 and 1,000 bears. The YGBE population is estimated at between 200 and 350 while the NCDGBE population is believed to be between 440 and 680 bears. The decline in the bear population has been related to habitat loss and direct and indirect human-caused mortality. Most of the actions adversely impacting the grizzly bear occur on Federal lands. Some non-Federal actions that would adversely impact the grizzly bear include habitat destruction and direct human-caused mortality (e.g., both legal and illegal shooting of bears) on private lands.

PESTICIDE/SPECIES INTERFACE: Pesticides toxic to mammals and especially those toxicants use to control coyotes and other mammals could adversely impact the grizzly bear directly or indirectly by reducing the grizzly bears' food source.

HUALAPAI MEXICAN VOLE *(Microtus mexicanus hualpaiensis)* - E

SPECIES INFORMATION: The Hualapai Mexican vole is a small cinnamon-brown, mouse sized mammal with a short tail and long fur that nearly covers its small, round ears. The Hualapai vole is one of three subspecies found in Arizona. The hualapai vole is now found only in moist, grass/sedge along permanent or semi-permanent waters, but may be capable of occupying drier areas when grass/forb habitats are available. This species probably feeds on green plant material when available. Hualapai voles have been observed during both day and night and are likely active year-round. No data exist on the reproductive biology of this species although they are assumed to be similar to other subspecies which have small litters.

This species is known from only the Hualapai Mountains in Mohave County, Arizona. Three general locales that total 255 acres have been identified as vole habitat. Three populations have been located within these areas and a fourth population in Pine Canyon has been reported south of the known locales.

SPECIES STATUS AND TRENDS: The Hualapai vole is extremely rare and has among the most restricted habitats of any North American mammal. From 1923 to the present, only 15 specimens are known to have been captured in the Hualapai Mountains. The most recent status survey investigated 59 potential sites but found voles in only 2 places and sign alone in one other. Each site was only 3-5 meters across and 75-400 meters long. These areas are thought capable of supporting a minimum of 44 voles. Past incompatible land management practices and periods of drought have combined to cause the deterioration of most of the habitat of the vole. The present main threat to the habitat appears to be the elimination of ground cover or grasses, sedges, rushes and forbs around open water and seeps, primarily by grazing and heavy recreational use.

PESTICIDE/SPECIES INTERFACE: This species could be adversely impacted from the use of rhodenticides, insecticides, or herbicides within occupied habitat.

JAGUARUNDI *(Felis yagouaroundi cacomitli)* - E

SPECIES INFORMATION: The Jaguarundi is a long-bodied, short-legged, uniformly colored cat. It measures 35 to 54 inches (90 to 137 cm) from head to tail, with the tail nearly as long as the head and body. Its pelt is either reddish or bluish gray. It is about twice the size of the ordinary house cat and weighs 15 to 18 pounds (7 to 8 kg) as an adult. The females are smaller than the males. The jaguarundi is chiefly nocturnal but also hunts by day. It feeds mostly on small birds and mammals. It climbs trees and is able to pursue its prey through dense underbrush. It follows regular trails to drinking places. The young have been observed in both summer and winter, suggesting that they have no regular breeding time or produce two litters per year. Two or three young are produced at a time. The jaguarundi live in brushy areas and thorn thickets. In the United States, they are only found in extreme southern Texas. There is no federally designated critical habitat. The U.S. Fish and Wildlife Service's "Counties of Occurrence" list includes Bee, Cameron, Hidalgo, Jim Wells, Kennedy, Kleburn, San Patricio, and Willacy Counties, Texas.

SPECIES STATUS AND TRENDS: Jaguarundi apparently migrated to southern Texas from South America by way of Mexico and established a small population. Their numbers are extremely low in the United States.

PESTICIDE/SPECIES INTERFACE: Because of the intensive agriculture surrounding and interspersed with the habitat it is highly likely that a number of the chemicals considered in this request will affect this species.

KEY LARGO COTTON MOUSE *(Peromyscus gossypinus allapaticola)* - E

SPECIES INFORMATION: A small mouse, the Key Largo cotton mouse is brown on top with white underparts. It has large ears, proturberant eyes, and a furry tail. Evidence indicates that most cotton mice live less than a year.

This species was once known throughout the uplands of Key Largo, Monroe County, Florida. Currently, however, it is restricted to approximately the northern one-third of this area. In 1970, the mouse was introduced into the Lignumvitae Key State Botanical Site. Its present status there is uncertain because a 1984 trapping effort failed to detect the species. An estimated 18,000 cotton mice may still exist in the remaining 2,100 acres (851 hectares) of forested habitat on north Key Largo. The Key Largo cotton mouse is most abundant in mature, tropical, hardwood hammocks with trees of 10 to 12 inches trunk diameter. It is rarely found in young or recovering hammocks. Common plant species in typical habitat are gumbo-limbo *(Bursera simaruba)*; pigeon plum *(Cocoloba diversifolia)*; soldierwood *(Colubrina elliptica)*; crabwood *(Gymnanthes lucida)*; black ironwood *(Krugiodendron ferreum)*; wild coffee *(Pschotria undata)*; marlberry *(Ardisia escallonioides)*; and white stopper *(Eugenia axillaris)*. Hammock vegetation develops only on the higher ground, 6 to 15 feet above sea level. At lower elevations there is a rapid transition to mangrove wetlands.

This mouse is a noctural feeder, existing on the buds, fruits, and seeds of many plant species. Based on one study reproduction is seasonal and apparently begins in June. The mice construct small, spherical, leaf-lined nests in logs, tree hollows, and crevices in the limestone rock. Females have two or three litters a year, with litter sizes ranging from two to six young and averaging four. Weaning takes place at about 4 weeks of age. Females are ready to mate when slightly over 70 days old.

SPECIES STATUS AND TRENDS: Destruction and alteration of tropical hardwood hammock forest have been identified as the primary factors in the extirpation of the Key Largo cotton mouse from the southern part of Key Largo. Pressure for development will continue to be a threat.

PESTICIDE/SPECIES INTERFACE: The Key Largo cotton mouse would be most vulnerable to rodent control agents used for black and Norway rats and house mice. Toxic baits placed in or near the cotton mouse habitat would be a potential threat to the species.

KEY LARGO WOODRAT *(Neotoma floridana smalli)* - E

SPECIES INFORMATION: The Key Largo woodrat is a medium-sized (200-260 gram) rat with a gray-brown back and head. Its belly, chest, and throat are white, and the tail is hairy. This species once ranged throughout Key Largo, but now is restricted to about the northern one-third of the area. The woodrat was introduced into Lignumvitae Key, a State botanical site, in 1970; but, populations there were estimated to be very low in 1988. An estimated 6,500 woodrats still exist in the remaining 851 hectares (2,100 acres) of forested habitat on north Key Largo. The Key Largo woodrat is most abundant in mature, tropical, hardwood hammocks with trees of 10 to 12 inches trunk diameter, and is rarely found in young or recovering hammocks. Common plant species in typical habitat are gumbo-limbo *(Bursera simaruba)*; Pigeon plum *(Cocoloba diversifolia)*; soldierwood *(Colubrina elliptica)*; crabwood *(Psychotria undata)*; marlberry *(Ardisis escallonioides)*; and white stopper *(Eugenia axillaris)*. Hammock vegetation develops only on the higher ground, 6 to 15 feet above sea level. At lower elevations there is a rapid transition to mangrove wetlands. In mature hammocks, woodrats occur at a density of about 0.8 to 1 animal an acre and have a home range of about 0.6 of an acre.

This species is a nocturnal herbivore, feeding on the buds, leaves, and fruit of many plant species. Food may be stored in its stick nests. Like other members of its genus, the Key Largo woodrat builds one or more large stick houses for protection from predators and for nesting. The nests are made of dead limbs and sticks, but they may contain miscellaneous articles (glass, metal, paper, bones). Nests may be used for several generations and become as large as 4 feet high and 6 to 8 feet in diameter. The interior of the nest contains a small globular nest chamber made of plant fibers and grasses. Several entrances lead to the next chamber. One woodrat may utilize several nests, but adults do not nest together. Females have two litters a year, consisting of one to four young with an average of two. Sexual maturity occurs at about 5 months of age.

SPECIES STATUS AND TRENDS: Destruction and alteration of tropical, hardwood hammocks have been identified as the primary factors in the extirpation of the Key Largo woodrat from the southern part of Key Largo. There are presently several residential projects planned or under construction on northern Key Largo in areas near or within woodrat habitat. Pressure for development is expected to be a continuing threat in the future.

PESTICIDE/SPECIES INTERFACE: The Key Largo woodrat would be susceptible to rodenticides used to control black and Norway rats. Toxic bait placed in or near the woodrat's habitat could pose a threat to the woodrat.

LOUISIANA BLACK BEAR *(Ursus americanus luteolus)* - T

SPECIES INFORMATION: The Louisiana black bear is a large, bulky mammal with long black hair, with occasional brownish or cinnamon color phases. The tail is short and well haired. The facial profile is rather blunt, the eyes small and the nose pad broad with large nostrils. The muzzle is yellowish brown and a white patch is sometimes present on the lower throat and chest. There are five toes on the front and hind feet with short curved claws. Large males may weigh more than 600 pounds but weight varies considerably throughout the species range. Its skull can be distinguished from other black bears in that it is relatively long, narrow, and flat in comparison, and has proportionately large molar teeth.

The Louisiana black bear historically occurred throughout southern Mississippi, eastern Texas, all of Louisiana and possibly the southern most counties of Arkansas. However, it is now confined to small numbers in Mississippi close to the Mississippi River, and to core populations in the Tensas and Atchafalaya River basins in Louisiana. Only large stands of woodlands (bottomland hardwoods) are considered as bear habitat, though marshes and agricultural fields (sugarcane, soybeans) are also used by the Louisiana black bear. The Louisiana black is omnivorous and will forage on most any vegetable or animal food item it can find or catch, including carrion.

SPECIES STATUS AND TRENDS: The Louisiana black bear has suffered extensive habitat loss and modification, with suitable habitat having been reduced by more than 80 percent by 1980. As of 1991, this percentage is likely much higher. In 1980, it was estimated that only 5,000,000 of the original 25,000,000 acres of bottomland forest in the Mississippi River Valley remained, with another 165,000 acres being lost each year. Presently, only approximately 100,000 acres (15%) of the original stands of the once extensive bottomland forests of the Tensas basin remain; and in the Atchafalaya basin only about 518,000 acres remain in the lower portion of the basin and only 100,000 to 128,000 acres in the upper or northern portion. Due to the difficulties in accurately censusing bear numbers, present population levels within these river basins are unknown but are expected to continue declining as remaining habitat is cleared and reduced in quality by fragmentation due to construction, forestry, and agricultural activities.

PESTICIDE/SPECIES INTERFACE: The Louisiana black bear would primarily be affected by pesticides used for rodent or predator control and those pesticides applied to livestock to control insect infestations. Due to the bear's opportunistic feeding habitats, there exists a potential for direct poisoning due to ingestion of poison baits and secondary poisoning from ingestion of contaminated prey, so use of these pesticides in bear habitat is a potential threat to this subspecies. Some contact with pesticides used on sugarcane or other crops may also occur.

LOWER KEYS RABBIT *(Sylvilagus palustris hefneri)* - E

SPECIES INFORMATION: The Lower Keys rabbit is a subspecies of the marsh rabbit, a species widespread in the southeastern U.S. The Lower Keys rabbit is distinguished from other rabbits, in skull proportions and sculpturing and in its darker coloration. The Lower Keys rabbit is about sixteen inches in length, with brownish dorsal and greyish ventral fur. The rabbit is most active at night, in early morning or late afternoon, or during overcast weather. It feeds on a variety of plants, including leaves, shoots, buds, and flowers of grasses, herbaceous, and woody plants. Breeding behavior includes chasing of inferior males and receptive females by dominant males. In late summer, adult rabbits may chase young from the nest area. The Lower Keys rabbit builds mazes of runs, dens, and nests in its coastal (saline to brackish) or freshwater, inland marsh habitats. Two plant species, fringe rush and bottonwood, are always present in the rabbit's habitat. In freshwater marshes, cattails and sedges are common associates. Sometimes, spikerush is also found. In coastal marshes, common associates include cordgrass, saltwort, glasswort, sawgrass, and sea oxeye. The rabbit's runs, dens and nests are made in cordgrass or sedges. Nests are lined with belly hair.

SPECIES STATUS AND TRENDS: This species originally ranged throughout the larger, lower Florida Keys. Presently, the rabbit is known from only 13 sites on lower Sugarloaf, Welles, Annette, Hopkins, Geiger, Boca Chica, and Big Pine Keys. Historically, the species may also have existed on Cudjoe, Ramrod, Middle Torch, Big Torch, and Key West Keys; but, it has been extirpated from these areas. The species is known to have occurred on Saddlebunch, but because most of the appropriate habitat has been destroyed, it probably has been extirpated there. Known localities for the rabbit are on privately-owned land; State land owned by the Florida Department of Transportation; and Federal land owned by the National Key Deer Refuge or the Key West Naval Air Station. The current population of the species, based on pellet counts, is estimated at 259 individuals.

Natural marsh habitats are limited in the Florida Keys, and have declined due to development. Since the rabbit occurs in small, relatively disjunct populations, has a low population density, and does not occur east of the Seven Mile Bridge, the species is in danger of extinction. Predation by introduced house cats is a problem. Some road mortality occurs as rabbits attempt to move among increasingly isolated Lower Keys marshes. In the past, the Lower Keys rabbit was often hunted by man; this is not known to be a current threat. A U.S. Navy-sponsored study is underway at Boca Chica Naval Air Station to determine the basic biological needs of the species, and to determine what management would be beneficial.

PESTICIDE/SPECIES INTERFACE: The Lower Keys rabbit may be exposed to pesticides used for mosquito control in areas of marsh habitat. Direct contact with treated areas and ingestion of contaminated water are likely routes of exposure. The rabbit may also come in contact with rodenticides used for control of black and Norway rats or mice in areas adjacent to the rabbit's habitat. Broadcast poison baits would be particularly hazardous to the rabbit.

MORRO BAY KANGAROO RAT *(Dipodomys heermanni morroensis)* - E

SPECIES INFORMATION: The Morro Bay kangaroo rat is a species is a small rodent weighing about 50-70 grams (mean 66 g). In 1922, habitat for the species was less than 4 square miles at Morro Bay, California. By 1980, less than 320 acres in four parcels remained. A 50-acre California Department of Fish & Game Reserve at Morro Dunes has no remaining animals. Also none remain in Montana de Oro State Park's 70-acre reserve. Habitat includes coastal dune scrub, without a thick, woody overstory. Also, the vegetative cover includes a patchy, but significant unvegetated sand component. This species feeds on buckwheat, croton, other forbs. Breeding season is generally between March-October, but young are known to occur at other times of the year as well. Estrus occurs 18-20 days, and gestation 30-33 days. This is a subspecies of the Heermann's kangaroo rat.

SPECIES STATUS AND TRENDS: the status of the species is unknown, but the population occurs only on one privately owned parcel. This population was censused in 1985. At that time the population was estimated to comprise less than 50 individuals. This last wild population occurs on approximately 50 acres of a 200 acre location in Los Osos. Individuals in the captive colony all appear to be past reproductive age. Reasons for decline are habitat loss and fragmentation. Anticipated trends are an HCP in progress with the Service and San Obispo County. However, both HCP and recovery efforts are currently frustrated by landowner refusal to allow resource agency personnel on the property containing the last known population. Non-Federal impacts to this species include additional habitat loss and degradation.

PESTICIDE/SPECIES INTERFACE: Rodenticides and other pesticides can affect remaining animals. Interface is unknown due to inability of access to the species.

OCELOT *(Felis pardalis)* - E

SPECIES INFORMATION: The Ocelot is a medium-sized cat, tawny in color, with dark, elongated markings. Its head and body are 27 to 35 inches (69 to 89 cm) long, and its tail is 13 to 15 inches (33 to 38 cm) long. The cat weighs 20 to 40 pounds (9 to 18 kg). The young are born in the autumn, normally two in a litter. The ocelot is believed to be nocturnal. It preys on rabbits, wood rats, mice, and occasionally domestic animals. The U.S. ocelot population is estimated to be 12 to 60 animals. This cat is found only in Cameron County, Texas, on approximately 50,000 acres (20,200 hectares) of native brushland; it is fond of dense thickets of thorny shrubs. Approximately 30,000 of these acres (12,000 hectares) are privately owned, currently used for lease hunting and livestock grazing (cattle and goats). The remaining 20,000 acres (8,090 hectares) are in the Laguna Atascosa National Wildlife Refuge. The U.S. Fish and Wildlife Service's "Counties of Occurrence" list include Cameron, Hidalgo, Kleberg, Jim Wells, Kennedy, Starr, Willacy, and Zapata Counties, Texas.

SPECIES STATUS AND TRENDS: The loss of habitat caused by the clearing of brush for citrus, cotton, and vegetables has contributed greatly to the decline of the ocelot in Texas. The ocelot's great commercial value has contributed to increased poaching and other illegal activities.

PESTICIDE/SPECIES INTERFACE: Because of the intensive agriculture interspersed with and surrounding ocelot habitat, it is highly likely that a number of chemicals (especially vertebrate control agents) will adversely affect this species.

PERDIDO KEY BEACH MOUSE *(Peromyscus polionotus trissyllepsis)* - E

SPECIES INFORMATION: A subspecies of the oldfield mouse *(Peromyscus polionotus)*, the Perdido Key beach mouse has a small body, haired tail, relatively large ears, and protuberant eyes. Its head and body length is 2.7 to 3.3 inches; the tail length is 1.7 to 2.5 inches. The upper parts are colored grayish fawn to wood brown with a very pale yellow hue and an indistinct middorsal stripe. The white of the underparts reaches to the lower border of the eyes and ears, and the tail is white to pale grayish brown with no dorsal stripe.

The Perdido Key beach mouse currently survives on the western part of Perdido Key including the Gulf State Park, Baldwin County, Alabama; and until the passage of Hurricane Frederick in September 1979, survived on the eastern part of the key at the Gulf Islands National Seashore, Escambia County, Florida. The mouse has been reestablished on the Gulf Island National Seashore. The species is presumed to have once inhabited the entire key. The Perdido Key State Preserve is located in the central part of Perdido Key. Beach mouse habitat exists in the Preserve, although it is less than optimum in terms of average dune height.

The habitat is restricted to the mature coastal barrier sand dunes along the Gulf. The depth of the habitat extending inland may vary depending on the configuration of the sand dune system and the vegetation present. There are commonly several rows of dunes paralleling the shoreline and within these rows there are generally three types of microhabitat. The frontal dunes are sparsely vegetated with sea oats, bunch grass, beach morning glory and railroad vine. The interdunal areas contain sedges, rushes and salt-grass. The dunes farther inland from the Gulf support growths of slash pine, sand pine, scrubby shrubs and oaks.

The Perdido Key beach mouse is seminomadic over a relatively small range, digging as many as 20 burrows into the dunes for nesting, food storage and refuge from predators. Burrows are dug mainly on the lee side of the primary dunes and in other secondary and interior dunes where the vegetation provides suitable cover. The mice may also use ghost crab burrows.

This species is nocturnal, feeding primarily on the seeds of sea oats and beach grass. When these seeds are scarce, especially in the late winter or early spring, beach mice may consume invertebrates or fruiting bodies of sea rocket.

Reproduction may occur throughout the year, but likely it peaks during November, December, and January. Beach mice litters range from two to seven, and the young may reach sexual maturity by 6 weeks of age. Studies show that female beach mice are capable of producing litters every 26 days, and they may produce 80 or more young in their lifetimes. Beach mouse life spans are short, ranging from less than 5 months in the wild to over 3 years.

SPECIES STATUS AND TRENDS: Loss of habitat is considered to be the primary factor for the mouse's decline. It is estimated that approximately 34 percent of the island has been developed and is no longer suitable habitat. Commercial and residential development, especially if the latter is high density multiple housing, isolates small areas of beach mouse habitat thereby fragmenting populations and upsetting gene flow. Such barriers also prevent recolonization of an area should a population segment be extirpated.

Tropical storms periodically devastate Gulf Coast sand dune communities, dramatically altering or destroying habitat, and either drowning beach mice or forcing them to concentrate on high scrub dunes where they are exposed to predators. The Gulf State Park area was severely flooded by Hurricane Frederick on September 13, 1979. Washovers completely destroyed mouse habitat on all dunes less than 11.5 feet high, leaving only the dune ridges in excess of this height as habitat. At the eastern end of the Key in Gulf Islands National Seashore, 80 percent of the area was overwashed during the hurricane.

Associated with residential and commercial development are house mice and feral cats. Feral house cats may prey on beach mice, and house mice can compete with beach mice for food and cover.

Trapping at Gulf State Park in 1983 yielded 13 beach mice at a relative density of 3.3 mice per 100 trap-nights. Trapping conducted in Perdido Key State Preserve and Gulf Islands National Seashore did not produce any mice. An earlier study conducted prior to Hurricane Frederick indicated a total population of approximately 26 beach mice at Gulf State Park (relative density of 3.3 mice/100 trap-nights), and 52 mice at the Gulf Islands National Seashore.

PESTICIDE/SPECIES INTERFACE: The Perdido Key beach mouse may be affected by pesticides used to control rodents such as house mice and black rats. Toxic baits placed in or adjacent to beach mouse habitat would be a potential threat to the species.

POINT ARENA MOUNTAIN BEAVER *(Aplodontia rufa nigra)* - E

SPECIES INFORMATION: The endangered Point Arena mountain beaver lives on the Mendocino coast in the Point Arena area, California. They feed upon succulent herbaceous plant material, deciduous tree bark and leaves that form vegetative understories (sword fern, cow parsnip, salal, nettle, salmonberry and lupine). Point Arena mountain beavers live 6+ years becoming mature during their second year. They mate during a 5-7 week period in mid to late winter. The females have one litter per year consisting of 2-3 (rarely 4) pups which are born in late February and March after a 28-30 day gestation period.

Point Arena mountain beavers are restricted in geographic distribution to cool, moist areas receiving heavy rainfall (25-60 inches per year). Within this geographic distribution populations are found in four basic habitat types: coastal scrub; coniferous forest; riparian; and stabilized dunes.

SPECIES STATUS AND TRENDS: Fewer than 100 individuals are estimated to exist in the ten known populations of Point Arena mountain beavers. Four populations live on Manchester State Beach (privately owned [AT&T site]). The other populations occur on Minor Road (privately owned), Lagoon Lake (private), Point Arena (privately and state owned), Alder Creek (private & state), Irish Gulch (private & state) and Mallo Creek (private and state).

PESTICIDE/SPECIES INTERFACE: The Point Arena mountain beaver could be adversely impacted due to the registered use of vertebrate control agents within or adjacent to occupied habitat of this species.

SALT MARSH HARVEST MOUSE *(Reithrodontomys raviventris)* - E

SPECIES INFORMATION: The Salt marsh harvest mouse is found in pickleweed dominated tidal and non-tidal wetlands of the San Francisco Bay estuary in Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara, and San Mateo counties.

SPECIES STATUS AND TRENDS: The northern subspecies, *R. r. halicoetes*, occurs north of Point San Pedro (Marin) and Point Pinole (Contra Costa) in tidal and non-tidal wetlands bordering San Pablo Bay, the Petaluma and Napa Rivers, and Suisun Bay east to Collinsville and Antioch. The southern subspecies, *R. r. raviventris*, occurs in tidal and non-tidal wetlands from Points Pinole and San Pedro south to the Alviso district. Both subspecies have been adversely affected by loss of habitat associated with diking, filling, and conversion of their habitat for agricultural use, salt production, urbanization, and mosquito control. This loss has been particularly acute in the South San Francisco Bay area.

PESTICIDE/SPECIES INTERFACE: This mouse could be adversely impacted due to the registered use of vertebrate control agents within or adjacent to occupied habitat of this species.

SAN JOAQUIN KIT FOX *(Vulpes macrotis mutica)* - E

SPECIES INFORMATION: The San Joaquin kit fox is a small canid that weighs approximately 5 pounds. Foraging for a variety of rodents and lagomorphs typically occurs at night, although animals have been observed stalking California ground squirrels *(Spermophilus beecheyi)* during daylight hours, and pups may be observed during the day at den sites. Dens are usually constructed on gentle slopes or level areas. As few as one or as many as 32 or more entrances may be excavated at each site. Kit fox will also opportunistically utilize man-made structures such as culverts or pipes, or may enlarge abandoned ground squirrel burrows as denning sites.

Females produce 1 litter per year, averaging 4 pups. The pups are born in February through early May. Both males and females sexually mature in their second year. The San Joaquin kit fox home range is estimated at 1 to 2 square miles. Considerable overlap between individual home ranges is believed to occur.

SPECIES STATUS AND TRENDS: This species was historically distributed within an 8,700 square mile area in central California, extending in the north from the vicinity of Tracy in the San Joaquin Valley, south to the general vicinity of Bakersfield. Kit fox are currently limited to remaining grassland, saltbush, open woodland, and alkaline sink valley floor habitats, and similar habitats located along western bordering foothills and adjacent valleys and plains. However, some agricultural areas such as range land, irrigated pastures, and citrus orchards, may support these animals. Intensive agriculture, oil and gas development, urbanization, and other land-modifying actions have eliminated its habitat over extensive portions of this area.

PESTICIDE/SPECIES INTERFACE: This species could be adversely impacted due to the registered use of vertebrate control agents and insecticides within or adjacent to occupied habitat of this fox. The species could be impacted through direct exposure (i.e., dermal contact, inhalation of sprays or mists, and ingestion of contaminated baits) or secondary poisoning from feeding on contaminated food items.

SILVER RICE RAT *(Oryzomys palustris natator (=Oryzomys argentatus)* - E

SPECIES INFORMATION: The Silver rice rat is of generalized rat-like appearance with a slender skull, coarse fur, colored silver-grey along its back, and having a sparsely haired tail. This species inhabits wetlands, utilizing salt rather than freshwater marsh; its habitats include intermittently flooded high marsh vegetated with sea oxeye and buttonwood, saltmarsh flats covered with low grassy vegetation, and low intertidal areas supporting mangroves. The silver rice rat maintains large home ranges, about 50 acres, and occur at low densities. The rat feeds on seeds, plant parts, and animal foods such as arthropods. This small mammal is restricted to the Lower Keys of Monroe County, Florida.

SPECIES STATUS AND TRENDS: The silver rice rat is known to occur on eight keys, generally at low population levels. These rats are found on Big Torch, Johnston, Middle Torch, Raccoon, Saddlebunch, Little Pine, Summerland, and Water Keys. Although no population numbers are available, surveys have provided capture rates that have varied from a 0.48 percent trap-night capture rate to a 9.5 percent capture rate. Much silver rice rat habitat has been lost because of commercial and residential development. This species has recently been extirpated from Cudjoe Key. It is believed that the species recently occurred on Big Pine and Boca Chica Keys, where suitable habitat still exists but where biologists have been unable to trap rice rats. Predation by raccoons, and competion with the black rat for food and living space may have contributed to the disappearance of the silver rice rat from Cudjoe, Big Pine, and Boca Chica Keys. Further habitat fragmentation, due to development, could reach a point where genetic variability is no longer sufficient to assure long-term survival of the species.

PESTICIDE/SPECIES INTERFACE: The silver rice rat could be exposed to pesticides that are used for the control of rodents and mosquitos. Poison baits broadcast in or adjacent to the silver rice rat's habitat would pose a threat to the species.

SOUTHEASTERN BEACH MOUSE *(Peromyscus polionotus niveiventris)* - T

SPECIES INFORMATION: The Southeastern beach mouse is one of six existing coastal subspecies of the oldfield mouse *(Peromyscus polionotus)*. The oldfield mouse is a wide-ranging species in the Southeast. The Southeastern beach mouse is the largest beach mouse; it averages 139 millimeters in total length and 52 millimeters in tail length. Although it is darker and more buffy than the Anastasia Island beach mouse, it is still lighter than most inland subspecies of the oldfield mouse. Breeding activities may be similar to those of beach mice on the Gulf Coast. The breeding season for beach mice appears to start in November and end in early January. The female, which may reach reproductive maturity at 6 weeks of age, produces two to seven beach mice per litter. A female beach mouse can usually produce liters at 20-day intervals, but mortality is high. Most of the progeny will not survive over 4 months.

Predictably, beach mice feed on sea oats and beach grasses. The sea oats must be blown to the ground for the mice to eat. During the spring and early summer when seeds are scarce, beach mice may eat invertebrates.

The Southeastern beach mouse inhabits sand dunes which are vegetated by sea oats and dune panic grass. The scrub adjoining these dunes is populated by oaks and sand pine or palmetto. A study conducted on Merrit Island indicated that the Southeastern beach mouse may prefer open sand habitat with clumps of palmetto and sea grapes, or dense scrub habitat dominated by palmetto, sea grape, and wax myrtle; over seaward habitat with sea oats. Little specific information exists about this species' burrowing habits, although they are presumed to be similar to those of beach mice on the Gulf Coast. Sometimes beach mice use the former burrows of ghost crabs, but usually they dig their own. Burrow entrances are generally found on the sloping side of a dune at the base of a clump of grass. The burrows are used for nesting and food storage as well as a refuge.

SPECIES STATUS AND TRENDS: The Southeastern beach mouse is primarily threatened by beach and residential development which has eliminated suitable habitat. Predators such as raccoons, skunks, snakes, great-blue herons, dogs, and cats pursue the species. Competitors, such as house mice, are also threats. The control of free-ranging housecats has been identified as important to the species' survival.

The historic range of the threatened Southeastern beach mouse was north Florida's Mosquito (Ponce) Inlet in Volusia County to south Florida's Hollywood Beach in Broward County. Now, the Southeastern beach mouse has apparently been eliminated from the southern section of its habitat at Jupiter Island, Palm Beach, Lake Worth, Hillsboro Inlet, and Hollywood Beach. Beach mice also may be gone from the East Peninsula. Humphrey (1987) sighted only a few small, fragmented populations between Sebastian Inlet to Hutchinson Island. The healthiest populations appear to occur on public lands: Cape Canaveral National Seashore; Merritt Island National Wildlife Refuge; Cape Kennedy Air Force Station; the southern half of Sebestian Inlet State Recreation Area, and Pepper Park. Most of the remaining habitat for the species is on public land, and management efforts have centered around the control of house mice. Facilities for the public have been located inland of the dune grassland. This includes campgrounds, park concessions, refuse dumpsters, or anywhere else where house mice could survive.

PESTICIDE/SPECIES INTERFACE: The Southeastern beach mouse may be affected by pesticides used to control rodents such as house mice and black rats. Toxic baits placed in or adjacent to beach mouse habitat would be a potential threat to the species.

STEPHEN'S KANGAROO RAT *(Dipodomys stephensi)* - E

SPECIES INFORMATION: The Stephen's kangaroo rat is a small rodent about 40-80 grams, mean of approximately 65 g (based on > 500 animals). The range is endemic to select portions of western Riverside County, a part of northern San Diego County, and extreme southwestern San Bernardino County. Federal land includes Camp Pendleton, Naval Weapons Station (Fallbrook Annex), March Air Force Base. The habitat includes annual grasslands with low forb and sparse perennial cover (early successional habitat) due to fire, agriculture, and/or grazing. The food of this species includes forbs, seeds, and insects. The reproductive habits are multiple litters/year throughout the seasons. It is a desert-adapted species that does not require free water for survival.

SPECIES STATUS AND TRENDS: The exact number of this population are not known. The reasons for decline include habitat loss and fragmentation due to urbanization and industrial development. Occupied and potential habitat are mostly all in private hands. The loss of many movement corridors between existing populations is likely. Many instances of illegal "take" of animals and habitat have been documented by Service biologists. The non-federal impacts of the species include an interim HCP in place.

PESTICIDE/SPECIES INTERFACE: Species may invade open agricultural fields, and adjacent habitat is also at risk to drift of herbicides and pesticides. This species is susceptible to rodenticides used for *Spermophilus* control.

TIPTON KANGAROO RAT *(Dipodomys nitratoides nitratoides)*, FRESNO KANGAROO RAT *(Dipodomys nitratoides exilis)*, GIANT KANGAROO RAT *(Dipodomys ingens)*

SPECIES INFORMATION: The Tipton kangaroo rat, Fresno kangaroo rat, and the Giant kangaroo rat, as with other members of this rodent genus, are highly adapted for bipedal locomotion and survival in arid environments. They typically are active at night.

They are all found in the San Joaquin Valley in central California. They all typically feed on seeds forbes including red stem filaree, arabian grass, and pepper grass. They also forage on the parts of these plants during the growing season. The San Joaquin Valley kangaroo rats produce one to two litters per year, between January and June. Fresno and Tipton kangaroo rats probably have an average of 2 young per litter. The giant kangaroo rat has between 4-6 young per litter. These species are not long lived in the wild. Williams estimated that the Tipton kangaroo rat only produce between one and two litters in its life time.

The Tipton kangaroo rat weighs about 37 grams. It does not exhibit hording behavior to the extent that giant kangaroo rats do. This species forages year round and consumes about 3 to 4 grams per day. Their home range is an estimated 0.4 - 0.8 acres (1-2 hectares).

The Fresno kangaroo rat weighs about 34 grams. It feeding habitats are similar to the Tipton kangaroo rat. The home range is estimated to be about 2.5 to 5 acres.

The giant kangaroo rat is the heaviest of all kangaroo rats, with a weight of about 130 grams. They ingest between 5 to 10 grams per day. They also forage, collecting and storing food in their burrow systems. They later feed on this supply when food availability is low. The home range of the giant kangaroo rat is estimated at 0.30 acres.

SPECIES STATUS AND TRENDS: The Tipton kangaroo rat was historically limited to the Tulare Basin portion of the San Joaquin Valley, extending from Lemoore and Hanford (Kings County) in the north; southeast along State Route 99 from Tipton to Pixley (Tulare County), Delano, Bakersfield, and Arvin (Kern County); westward to the southern, eastern, and north shores of the former Buena Vista Lake (Kern County); and then northward along the Antelope Plain from Buttonwillow to Lost Hills (Kern County) to Kettleman City (Kings County), north to Westhaven (Fresno County). The current distribution consists of approximately 63,000 acres of alkaline sink habitats widely dispersed within areas of intensive agricultural production.

The original geographic range of the Fresno kangaroo rat extended from north-central Merced central Fresno Counties. Approximately 10,000 acres of alkali sink habitats favored by this subspecies are currently extant, principally in scattered parcels varying in size from less than 100 to over 1,000 acres.

The original distribution of the giant kangaroo rat extended from southern Merced County, through the San Joaquin Valley, to southwestern Kern County and northern Santa Barbara County. Preferred habitat is native annual grassland with sparse vegetation, good drainage, fine loamy soils, and a slope of less than 10 percent. Significant populations survive in only a few areas within remaining habitat, including the Panoche Hills, Cuyama Valley, and Carrizo and Elkhorn Plains. All three species have been adversely affected by the conversion of their habitat to agricultural and urban use.

PESTICIDE/SPECIES INTERFACE: These species could be adversely impacted due to the registered use of vertebrate control agents and insecticides within or adjacent to occupied habitat of these kangaroo rats. These kangaroo rats could be impacted through direct exposure (i.e., dermal contact, inhalation of sprays or mists, and ingestion of contaminated food items).

UTAH PRAIRIE DOG *(Cynomys parvidens)* - T

SPECIES INFORMATION: The Utah prairie dog is a burrowing rodent in the squirrel family. This species is confined to disjunct areas in southwest Utah including Beaver, Garfield, Iron, Kane, Sevier, Washington, and Wayne Counties. There is a positive correlation between available moisture and prairie dog abundance and density. Prairie dogs appear to prefer swale type formations where moist herbage is available even during drought periods. A well-drained area is necessary for home burrows. Prairie dogs must be able to inhabit a burrow system approximately 3.3 feet underground without becoming wet. The vegetative height within the colony must be low enough to allow standing prairie dogs to scan their environment for predators.

Prairie dogs are predominantly herbivores. Grasses are preferred food items during all seasons. The flowers and seeds of forbs also are preferred. Although forbs other than alfalfa are not always highly preferred items, they may be critical to a prairie dog town's survival during drought. Cicada insects are a preferred animal food item and are readily taken when available. In colonies at low elevations where moist herbage is available, breeding occurs in the early spring and lactation continues into June. Females are capable of giving birth annually to litters that average three to four young usually born in April.

SPECIES STATUS AND TRENDS: The Utah prairie dog population was estimated to be about 95,000 in the 1920's, declining to a 1976 spring count of 2,160 adult animals. Overall numbers have increased during the period 1976-1989 with the 1989 spring count of 7,377. The summer of 1989 population was estimated at approximately 33,700 animals. In 1990, Utah prairie dog numbers on public lands (two-thirds of the total population in 1989) declined 61 percent.

The decline of the Utah prairie dog was caused by human-related habitat alteration and by posioning, which resulted from the belief that prairie dogs compete with domestic livestock for forage. At present, the Utah prairie dog is still threatened by loss of habitat over much of its range. In addition, the damage caused by local concentrations of prairie dogs has provoked farmers in some areas to kill them illegally to protect crops and cropland.

PESTICIDE/SPECIES INTERFACE: Registered species uses that may occur in the vicinity of Utah prairie dog habitat include, but are not limited to, rangeland, pastures, noncrop land, rights-of-way, alfalfa, barley, oats, clover, and control of prairie dogs, ground squirrels, pocket gophers, and other mammals. Pesticides that are toxic to mammals would have an adverse impact to the Utah prairie dog.

BIRDS

ATTWATER'S GREATER PRAIRIE-CHICKEN *(Tympanuchus cupido attwateri)* - E

SPECIES INFORMATION: Attwater's greater prairie-chicken is a brown, hen-like bird, 17 to 18 inches (43 to 45.7 cm) in length. Its feathers are heavily barred, and it has a short, rounded, dark tail. The males have orange neck sacs and black pinnae that are used in courtship. Prairie-chickens are mainly herbivorous, preferring forbs and agricultural crop seeds, but they will also consume insects. Breeding takes place on flat, broad areas with little cover, called leks or booming grounds. These can be natural or artificial. For example, the prairie-chicken has been observed using runways and roads as breeding areas. The males gather at the leks in the spring and attract the females by strutting and calling. Leks are used year after year. Breeding starts in late February and continues until early May. Nests, usually a shallow depression lined with dead leaves and grasses, are built near leks, in medium to tall grasses. Clutch size ranges from 5 to 15 eggs. Pheasants often disrupt breeding activities and will occasionally lay their eggs in prairie-chicken nests. Prairie-chickens prefer diversified coastal prairie grassland, where short, mid-size and tall grasses are evident. These grasslands can be maintained by moderate cattle grazing and prescribed burning. Vegetation preferred by the prairie-chicken includes tall dropseed *(Sporobolus asper)*, little bluestem *(Schizachyrium scoparium)*, and ragweed *(Ambrosia psilostachya)*. The historic range of the species once extended from the Nueces River in Texas to Abbeyville, Louisiana. Today, however, the species is found in only a fraction of its former range. Texas has two national wildlife refuges with Attwater's greater prairie-chicken management areas-the Attwater's Prairie Chicken National Wildlife Refuge and the Tatton Unit of the Aransas National Wildlife Refuge. The U.S. Fish and Wildlife Service's "Counties of Occurrence" list includes Austin, Fort Bend, Galveston, and Refugio Counties, Texas.

SPECIES STATUS AND TRENDS: The greatest threat to this species is habitat loss. Maintenance of the coastal prairie is essential to the survival of the prairie-chicken. The goal of the recovery plan is to maintain viable, self-sustaining populations of Attwater's greater prairie-chickens to the point where the species may be downlisted to threatened and then eventually delisted. The tentative delisting goal is the year 2000. To accomplish the recovery objective, the plan advocates providing and protecting adequate habitat (19,000 additional hectares), protecting the species from predation and disruption (especially by pheasants and other exotic game birds), and implementing public education programs.

PESTICIDE/SPECIES INTERFACE: Because of the intensive agriculture surrounding this species habitat, exposure and possible adverse impacts are anticipated by using many of the subject chemicals.

AUDUBON'S CRESTED CARACARA *(Polyborus plancus audubonii)* - T

SPECIES INFORMATION: Audubon's crested caracara is about the size of an osprey, but with shorter wings. It has a length of about 21 to 23 inches, and a wingspread of about 48 inches. The caracara has long, yellow legs and a massive bluish bill. Sexes are similarly plumaged; younger birds are browner than adults. The caracara is an opportunistic feeder; its diet includes both carrion and living prey. The living prey are usually small turtles and turtle eggs. In addition to these items, caracaras prey on insects, fish, frogs, lizards, snakes, birds, and small mammals. A pair will sometimes join forces to subdue a larger animal such as a rabbit or egret.

The crested caracara is a bird of open country. Dry prairies with wetter areas and scattered cabbage palm comprise typical habitat. Caracaras also occur in some improved pasture lands and even in lightly wooded areas with more limited stretches of open grassland. Adult caracaras maintain large territories, usually with their mates. Pair bonds are strong, persisting until one of the mates dies. As the breeding season approaches, the pair begins to spend more time at the nest site. The nest site, a bulky structure of slender vines and sticks, is usually located in a cabbage palm. The breeding peak is from January to March, with the usual clutch being two or three eggs. Incubation lasts about 32 days, and the young leave the nest at about 8 weeks of age. The family group usually remains together for 2 to 3 months after the young fledge.

The region of greatest abundance for the Florida population is a five-county area north and west of Lake Okeechobee. Caracaras occur in the following Florida counties: Glades, DeSoto, Highlands, Okeechobee, and Osceola. Some of the birds might also occur in Charlotte, Hardee, and Polk Counties. Historically the Florida population was more widespread. The Florida population of Audubon's crested caracara is geographically isolated from other members of its subspecies. Other populations occur in northern Baja California, southwestern Arizona, southern Texas south to Panama, and also in Cuba and the Isle of Pines. The subspecies also occurs occasionally in southern New Mexico and southwestern Louisiana.

SPECIES STATUS AND TRENDS: At one time the crested caracara was a common resident in the prairie region of central Florida. The birds were sighted from northern Brevard County in the north, south to Fort Pierce, Lake Okeechobee, Rocky Lake (Hendry County), the Okaloosa Slough, and the Everglades (Collier County). Smaller numbers have been reported from as far north as Nassau County, and from as far south as the lower Florida Keys (Monroe County). At present the birds are rarely found north of Orlando or east of the St. John's River. Data gathered from 1973 to 1978 show the existence of about 150 active territories (300 adults) and about 100 immatures, giving a total population in Florida of between 400 and 500 individuals. Most caracaras occur on privately-owned lands in Florida. A few birds may wander east to Merritt Island, Cape Canaveral, and Patrick Air Force Base, or north to Ocala National Forest, but these would be transients. The only Federal land on which the bird might permanently reside is the Air Force's Avon Park bombing range in Polk and Highlands County. However, bombing range personnel informed the U.S. Fish and Wildlife Service that, although caracaras are occasionally seen in the area, none have nested there in recent years. Without any significant areas of habitat under State or Federal protection, long-term survival of the Florida population will depend largely upon finding innovative means of preserving the extensive tracts of prairie habitat in private ownership.

The primary cause for the decline of the crested caracara has been habitat loss. Real estate development, citrus groves, tree plantations, improved pastures, and other agricultural uses are all vying for the same habitat. Less significant factors may include: illegal killing and trapping; increased numbers of road kills due to a rising volume of traffic; slow recovery from population losses because of the caracara's low reproductive rate; and possible loss of genetic variability (due to the relatively small population), thus making the caracara more vulnerable to stresses than would otherwise be the case. The scarcity of the birds, combined with their scattered territories, makes it difficult to detect changes in numbers.

PESTICIDE/SPECIES INTERFACE: Exposure of the caracara to pesticides, rodenticides or other agricultural use chemicals would occur primarily through ingestion of contaminated prey or carrion. Pesticides, avicides, and rodenticides that have potential for being lethal to birds would pose a threat to the caracara if the bird were to be exposed to the toxic agent.

CALIFORNIA CONDOR *(Gymnogyps californianus)* - E

SPECIES INFORMATION: This large, formerly widespread vulture has an historic range that includes the California Coastal Ranges, Central Transverse Range, Southern Sierra Nevada mountains, to Arizona, New Mexico, and Texas. California condor habitat includes rocky cliffs and trees for roosting, open grasslands and oak woodlands for foraging. Reproduction occurs at 6 years of age, with a low reproductive rate. A nesting pair only raises one chick/year and 6 months is required for young to fledge.

SPECIES STATUS AND TRENDS: Only 52 birds remain including 50 in captivity at the San Diego and Los Angeles Zoos, and 2 released into wild. Decline of the species has occurred as a result of shooting, lead poisoning, secondary poisoning from coyote control, loss of foraging areas due to suburbanization, and agricultural development. Limited release of captive birds was initiated in October 1991 by the Service. Along with successful captive breeding, the number of birds may increase in the wild.

PESTICIDE/SPECIES INTERFACE: This species could be adversely affected due to the applications of avicides and secondary poisoning is possible from carrion killed by rodenticides that have persistent effects.

HAWAIIAN COOT *(Fulica americana alai)* - E

SPECIES INFORMATION: The Hawaiian coot is a subspecies of the common American coot but is smaller and has a white frontal shield distinctly larger than the mainland form. This waterbird occurred historically on all the major Hawaiian islands except Lanai and Kahoolawe. Currently, it is most numerous on Oahu, Maui and Kauai. It's habitat includes thickly vegetated marshland with associated open water. The coot feeds on seeds or invertebrates near the surface of the water or by diving or foraging in mud or sand. They nest on scattered open fresh and brackish water ponds or reservoirs, on irrigation ditches, and on small openings of marsh vegetation. Nesting occurs mostly from March through September, although some nesting apparently occurs during all months of the year.

SPECIES STATUS AND TRENDS: The loss of wetland habitat is the primary cause of the decline of the Hawaiian coot. Other threats include the encroachment of introduced plants, the introduction of exotic mammalian predators, and sudden or major changes in water levels. Further expansion of housing and other urban development in and around wetland areas will continue to threaten the survival of the Hawaiian coot. Annual statewide censuses from 1968 through January 1983 averaged 996 individuals for all habitats surveyed. Populations increased in the late 1970's with population counts ranging between 422 and 2,330 birds.

PESTICIDE/SPECIES INTERFACE: Pesticide runoff into streams and ponds in the Hawaiian Coot habitat is a threat to the coot's survival. This species could also be adversely impacted from vertebrate control agents when applied in the form of granules, pellets, or grain baits; or from the applications of avicides.

HAWAIIAN CROW *(Corvus hawaiiensis)* - E

SPECIES INFORMATION: The Hawaiian crow is a large black-brown passerine. It ranges exclusively on the island of Hawaii. Historically, the crow occurred in lower forests and parklands. Currently, it exists in a single population along the coastal slope of Mauna Loa. It's habitat includes parkland forests consisting primarily of ohia and koa with an understory or mixture of native trees and shrubs. The crow feeds on the fruits of trees and shrubs, mice, small lizards, nestlings of small passerine birds and nectar from flowers. Breeding pairs nest usually in the same tree or vicinity in succeeding years. The crow's breeding season starts from March and extends into July.

SPECIES STATUS AND TRENDS: One cause of the crow's decline is the destruction of it's habitat. This includes the clearing of forest areas, browsing and grazing by cattle, horses, goats, and sheep. Other threats include avian diseases and parasites, introduced rats, mongoose, feral cats and dogs, and hunting.

The total estimated population of the Hawaiian Crow in 1990 is approximately 12 birds in the wild and 10 held in captivity. The crow is critically endangered. Unless recovery action can be effectively implemented, the species may soon become extinct.

PESTICIDE/SPECIES INTERFACE: Pesticides sprayed in pasture land could threaten the Hawaiian Crow. This species could also be adversely impacted from some vertebrate control agents when applied in the form of granules, pellets, or grain baits; or from the applications of avicides. The crow is also susceptible to secondary poisoning from eating contaminated prey items.

HAWAIIAN DUCK *(Anas wyvilliana)* - E

SPECIES INFORMATION: The Hawaiian duck is a close relative of the mallard. The Duck is historically found on all the main Hawaiian Islands except Lanai and Kahoolawe. It is currently found on Kauai, Oahu, and the Island of Hawaii. It's habitat includes freshwater marshlands, flooded grasslands, coastal ponds, streams, mountain pools, mountain bogs, and forest swamplands. The duck feeds on various types of snails, dragonfly larvae, earthworms, grass seeds, rice, green algae, and seeds and leaf parts of other wetland plants. The duck nests on the ground near water. Breeding occurs year-round with a peak from December to May.

SPECIES STATUS AND TRENDS: The primary causes of the decline of the Hawaiian Duck include loss of wetland habitat due to change in agricultural practices, predators, and hunting. In addition, genetic "pollution" by feral Mallards is swamping the gene pool of the Hawaiian Ducks. The last estimated population of the ducks on Kauai is 3,000 in the mid-60's. There was an estimated 53 birds on Oahu in 1983.

PESTICIDE/SPECIES INTERFACE: Pesticide runoff into streams and ponds threaten the Hawaiian Duck. This species could also be adversely impacted from some vertebrate control agents or insecticides when applied in the form of granules, pellets, or grain baits; or from the applications of avicides.

HAWAIIAN HAWK *(Buteo solitarius)* - E

SPECIES INFORMATION: The Hawaiian hawk is a small, broad-winged buteo endemic to the Hawaiian Islands. Currently, the hawk is widely distributed on the island of Hawaii and is known to breed only there. There were also rare historical observations on the islands of Kauai, Oahu, and Maui. The hawk is found in both open or parkland forests and dense rain forests. They are also frequently seen in agricultural areas, such as papaya and macadamia nut orchards, and adjacent to sugarcane fields. Hawks nest in a wide variety of habitats, ranging from lowland agricultural areas and exotic forests to upper elevation pasturelands and native rain forests. Nesting occurs from March through September. The hawks diet primarily consists of rats, mice, and a wide assortment of both native and introduced bird species.

SPECIES STATUS AND TRENDS: The primary cause of the hawk's decline is the harassment of nesting birds and shooting. Harassment of breeding birds can result in nest abandonment. Disturbance of nests can also cause young to leave the nest prior to normal fledging. Habitat destruction is also a major threat to the hawks. Hawaii's forests have been drastically reduced as the result of cutting for firewood, timber, croplands, and pasture. In 1984, the total hawk population was estimated to be between 1,400 and 2,500 on the island of Hawaii.

PESTICIDE/SPECIES INTERFACE: There may be secondary poisoning by feeding on rats, mongoose, birds, or other prey that has been targeted for poisoning. This species could also be adversely impacted from the applications of avicides.

MARIANA CROW *(Corvus kubaryi)* - E

SPECIES INFORMATION: The Mariana crow is the only corvid in Micronesia and is the only native Guam forest bird with populations still existing in the wild. It is a small, black crow that was formerly common on Guam and Rota, where it was confined to forested areas and coconut plantations. Presently, crows on Guam are found in forest areas from Ritidian Point to Anao along the northern cliffline, in Northwest Field, and in the Convention Weapons Storage Areas. They are no longer found in south and central Guam, but are still fairly common on Rota. The crow is generally restricted to mature, native forest and is absent from areas of human habitation. It is an omnivorous, opportunistic feeder that is known to feed on insects, lizards, hermit crabs, fruits, seeds, flowers, and, according to Jenkins (1983), occasionally foliage and bark. The crow forages on the ground as well as in the forest canopy and may also feed on other birds' eggs. Little is known about the crow's reproductive biology, but it apparently nests year-round with clutch sizes ranging between one and two eggs.

SPECIES STATUS AND TRENDS: The primary cause of the decline of the Mariana crow is predation by the introduced brown tree snake on Guam. Other possible causes of its decline are habitat degradation due to increasing development on both Guam and Rota, typhoons, competition from introduced avian species, pesticides, hunting and avian disease. The last sightings of the crow in the south of Guam occurred in the mid-1960's, and they have been absent from central Guam since the mid-1970's. A USFWS survey in 1981 estimated a population of 357 crows, distributed primarily over the northern cliffline forests. In 1985, it was estimated that there were less than 100 crows left on Guam. The total population on Rota, where there is no predation by the brown tree snake, was estimated to be 1,318 birds in 1982.

PESTICIDE/SPECIES INTERFACE: Pesticides have been used extensively in the past for agriculture and vector control on Guam. Following World War II and up until 1970, DDT and other insecticides were applied as often as once a week by the military. Pesticides sprayed in pasture land could threaten the Mariana Crow. This species could also be adversely impacted from some vertebrate control agents when applied in the form of granules, pellets, or grain baits; or from the applications of avicides. The crow is also susceptible to secondary poisoning from eating contaminated prey items.

MISSISSIPPI SANDHILL CRANE *(Grus canadensis pulla)* - E

SPECIES INFORMATION: Mississippi sandhill cranes resemble great blue herons *(Ardea herodias)*. A major distinguishing characteristic is that cranes are completely gray. Great blue herons usually have white on their heads and dark colored underparts. When standing erect, cranes are about 4 feet tall. Male and female cranes are similar in appearance. All cranes have long necks, and adult cranes possess a bald red forehead. The species vocalizations are loud and clattering Cranes are also unique in that they require separate nesting, foraging, and roosting habitats.

Most Mississippi sandhill cranes survive on the Mississippi Sandhill Crane National Wildlife Refuge in Jackson County, Mississippi. This bird's present range is restricted to the Pascagoula River (east), to the Jackson County line (west), to about Simmons Bayou (south), to 4 miles north of the town of Vancleave (north). Savannas are the preferred habitat of the Mississippi sandhill Crane and are inhabited year round. These wet grasslands are predominated by wiregrass *(Aristida spp.)* with scattered longleaf pine *(Pinus palustris)*, slash pine *(P. elliottii)*, and cypress *(Taxodium ascendens)* trees. Other associated plants include pitcher plants *(Sarracenia spp.)*, sundew *(Drosera spp)*, clubmoss *(Lycopodium alopecuroides)*, and pipeworts *(Eriocaulon spp.)*. Cranes also utilize wooded depressions (swamps or ponds) dominated by cypress, longleaf, and slash pine trees with an understory of swamp cyrilla *(Cyrilla racemiflora)*, buckwheat tree *(Cliftonia monophylla)*, wax myrtle *(Myrica cerifera)*, and several species of holly *(Ilex spp.)*.

Crane feeding habits vary with the seasons. In the summer, the birds feed upon the natural foods found in swamps, savannas, and open forests. These include adult and larval insects, earthworms, crayfish, small reptiles, frogs and other amphibians, and possibly small birds and mammals. Cranes also consume roots, tubers, nuts, seeds, fruits, and leaves. During the other three seasons, the birds eat small corn and chufa, an introduced plant. In the early fall, cranes usually feed on corn until the kernels become scarce. Chufa is used year round. Pecans are often eaten from September through December.

Although some nesting occurs in forested areas, most takes place in open savannas and swamp openings. These areas vary from dry to being covered in shallow water. Nests are constructed on the ground of vegetation gathered in the immediate vicinity. Paired cranes select a breeding territory for courtship, mating, and nesting, and may defend it from other cranes. Territory size probably depends on the quality and type of the habitat, the age of the paired cranes, and the population density of other cranes. Only one pair of birds has been observed to nest during a season in each open savanna; but, where clearings are separated by forested areas, cranes have nested within one-half mile of each other. Nesting territories are generally used for more than 1 year, some for 10 to 17 years. Cranes also tend to reuse nests for up to 3 consecutive years. When new nests are constructed, they are often located close to the previous nests.

The age of sexual maturity for the Mississippi sandhill is thought to be 3 or 4 years of age. Females become active a year or so later than males. Data is available showing that Mississippi sandhill cranes first lay eggs between the ages of 3 to 6 years. Frequently, these cranes will raise only one chick a year. Hatching begins in April, peaks during the first 3 weeks of May, and ends by mid-August. An August hatching may be the result of renesting. Data through 1988 indicates that 73 of a total 142 wild eggs have hatched or 51 percent. However, since 1982, hatching success has apparently declined. Information was compiled for 70 eggs that failed to hatch. Most of the eggs, a total of 43, failed because of infertility or other unknown causes. Only 11 subadult Mississippi sandhill cranes have been spotted during the winter since 1980. This supports the theory that the species productivity has been low.

SPECIES STATUS AND TRENDS: With population estimates of less than 100 birds since 1929, the Mississippi Sandhill Crane's status has always been precarious. During the 1950's thousands of acres of the crane's favored savanna habitat were drained and converted to slash pine plantations. Dense understories developed underneath the mature pine trees, and the once open, undisturbed habitat became unsuitable for cranes. Commercial and residential development also progressed, and the human population increased.

Eight paved highways now transect or border the crane's range. These roads have further depleted habitat, caused pollution problems, and eased public access to the cranes. Sporadic crane shootings were reported in the 1960's and 1970's. In addition, roadsides are usually sprayed with herbicides or other pollutants. Until recently, fire ants were eliminated with Mirex. A dead crane was discovered in 1974 with Mirex residues in the breast muscle and brain.

Eighteen of the cranes necropsied by the Patuxent Wildlife Research Center since 1981 have had tumors. Suspected causes have been infectious viruses or parasites, naturally occurring toxins, and genetic predisposition. The crane's susceptibility to tumors may have resulted from a decrease in genetic variability. Low genetic variability may also be responsible for a decrease in hatching success, and for deformities in the captive population. Natural causes, such as flash floods, hurricanes, and droughts, have also caused some deaths.

Most of the current crane population and its habitat is protected on the 19,273-acre Mississippi Sandhill Crane National Wildlife Refuge. The Grand Bay National Wildlife Refuge has been acquired southeast of the original refuge, and a second population of cranes may be introduced there if more land can be obtained.

A captive population was established at the Patuxent Wildlife Research Center in Laurel, Maryland. Developed with wild Mississippi sandhill crane eggs, the captive population numbered 32 adults in 1989. Captive releases to the Mississippi Sandhill Crane Refuge began in 1981, and by 1983 there were 13 free-flying captive-raised cranes on the refuge. A total of 96 captive-raised cranes had been released by 1989, and 53 of these had survived. By 1990, eight captive-raised cranes had attempted to nest.

PESTICIDE/SPECIES INTERFACE: Any pesticide, including rodenticides, that are known to be toxic to birds would be a serious threat to the Mississippi sandhill crane if applied when the cranes forage off Refuge land in adjacent crop fields (e.g. corn, grains, pasture, pecans).

NENE (HAWAIIAN GOOSE) *(Nesochen sandvicensis)* - E

SPECIES INFORMATION: The Nene (Hawaiian goose) is a medium-sized goose historically found on the islands of Hawaii and Kauai. It is currently found on the islands of Hawaii, Maui, and Kauai. It's habitat includes rugged lava flows in vast areas of upland scrub growth during nesting season and pasture land during their non-breeding season. The Hawaiian goose feeds primarily on green vegetation and small berries. Nesting often occurs on an island of vegetation surrounded by lava during the period of October through February. The same nest site is usually occupied in successive years.

SPECIES STATUS AND TRENDS: The primary causes of the Nene's decline are hunting and disturbance by humans, introduced predators, competition from introduced birds, effects of introduced plants on their habitat, modification of habitat, and low productivity of existing birds. Current estimated population include 300 birds on Hawaii and 100-150 birds on Maui. The populations appear stable. They may possibly increase if the Nene become reestablished in lowland pasture.

PESTICIDE/SPECIES INTERFACE: Pesticide sprayed in areas where the Nene feed or nest, such as golf courses, pastures, and ranchland, will threaten the Hawaiian goose. This species could also be adversely impacted from some vertebrate control agents or insecticides when applied in the form of granules, pellets, or grain baits; or from the applications of avicides.

PUERTO RICAN PLAIN PIGEON *(Columba inornata wetmore)* - E

SPECIES INFORMATION: The Puerto Rican plain pigeon is a large pigeon about the size and shape of a domestic pigeon. At a distance the species appears pale blue-gray. The head, hindneck, breast, and the top central part of the folded wing are washed with vinaceous. The wing coverts are margined with white. Legs and feet are dark red. A variety of fruits and seeds, and livestock feed provide nourishment for this species. Approximately 70 percent of the foods come from tree branches, and 30 percent from the ground. Principal foods at Cidra are royal palm, mountain immortelle, West Indies trema and white prickle. Water is usually taken from the axils of bromeliads or from water-retaining blossoms of the African tulip-tree.

General habitat types used in the past include lowland swamps and woodland, open woodland and cultivated land in the mountains, limestone karst, and coffee plantations in upland hills. The presently occupied habitat is located in the lower montane rainforest zone. Breeding occurs throughout the year but peaks in late winter and spring. Some nests are flimsy platforms of twigs, occasionally placed on unused rat nests or on an accumulation of litter in a crotch or tangle of vines. More typically, nests are built on a bare forking tree branch or near the top of a bamboo stalk. The plain pigeon lays only one egg, but a female has been observed to produce three broods in a year. The minimum observed incubation period is 14 days. The mean fledging period at eight nests was 23 days. Chicks are dependent on the adults for several days after fledging. Because of the very close nest attendance typical of the species, it suffers few losses of eggs and young to predators. Apparently, flocking can occur at any time food is locally abundant. Adult pigeons congregate in small flocks for feeding and drinking during the breeding season. Larger aggregations regularly form for roosting and feeding in the fall.

SPECIES STATUS AND TRENDS: At present, there are a minimum of 204 individuals in the wild and 124 pigeons in captivity. A captive flock was established at the University of Puerto Rico's Humacao Campus in 1987. The plain pigeon historically was widespread in the western foothills and valleys of Puerto Rico. Old records exist from Utuado, Lares, Anasco, Morovis (cave deposits), and Ponce (cave deposits). A pair was observed at Anasco in 1926, and then no further sightings were officially reported until 1963, when some of the birds were seen near the town of Cidra in east central Puerto Rico. Surveys conducted since 1973 indicate that the only existing population occurs near Cidra, and ranges into the surrounding municipalities, particularly Cayey. A few of the birds have also been recently reported at Gurabo and Utuado. The area surrounding Cidra and Cayey was densely wooded until 1910, when it was cleared for lumber and farmland. Practically all of the open land is now in some form of agriculture.

Extensive destruction of natural forest habitat and overhunting are postulated as causes for the decline. Today, habitat loss due to the rapid development of the Cidra area is the most serious threat to the species' existence. Disturbance is a concomitant problem. The majority of nest failures observed during investigations between December 1973 and September 1975 were the result of human-caused disturbances. Severe storms and hurricanes are considered a potential threat in that they could destroy essential habitat and kill the birds. Some pigeons are still being shot despite a Commonwealth Regulation (1967) closing Cidra to hunting. Establishment of new populations apparently has been limited by the bird's reluctance to colonize new areas.

PESTICIDE/SPECIES INTERFACE: The Puerto Rican plain pigeon is known to frequent agricultural fields and plantations. The bird may be exposed to pesticides applied to crops (e.g., various vegetables, coffee, bananas, sugarcane), livestock, and also for mosquito control. Rodenticides and avicides may also affect the pigeon when these toxic agents are used in agricultural areas frequented by the birds.

SAN CLEMENTE LOGGERHEAD SHRIKE *(Lanius ludovicianus mearnsi)* - E

SPECIES INFORMATION: The San clemente loggerhead shrike is a subspecies of the widespread loggerhead shrike. This subspecies is endemic to San Clemente Island, California. Most pairs are in the southwestern canyons on the island. habitat: contiguous stands of shrubs and trees required for nesting, forages over wider open areas. food habits: various insects, side-blotched lizards, small birds; reproductive habits: breeding season starts in January, clutches were completed through May. other pertinent info: see Scott, T.A. and M.L. Morrison. 1990. Natural History and Management of the San Clemente Loggerhead Shrike. Proc. of the West. Found. of Vert. Zool., 4(2):1-57. The California Channel Islands Species Recovery Plan was written in 1984.

SPECIES STATUS AND TRENDS: The current population: one of the most endangered vertebrate species in North America, thought to be down to about four pairs in 1990; the race is on the brink of extinction. The reasons for decline are loss of nesting habitat due to the introduction of feral goats. Also, predation by ravens, domestic cats, and island foxes resulting in a high fledgling mortality. The anticipated trends: will probably require removal of eggs and/or young to facilitate double clutching. Captive breeding may be necessary to better insure long-term survival of this subspecies.

PESTICIDE/SPECIES INTERFACE: Pesticides sprayed within occupied habitat could threaten this species. The San Clemente loggerhead shrike species could be adversely impacted from the applications of avicides, and is also susceptible to secondary poisoning from eating contaminated prey items.

SAN CLEMENTE SAGE SPARROW *(Amphispiza belli clementeae)* - T

SPECIES INFORMATION: The San Clemente sage sparrow is a small gray bird with black streaks on the sides and a single black spot on the chest, dark cheeks, moustache streaks on sides of the throat, a white line over the eye, and white corners to the tail. This sparrow is a nonmigratory subspecies of the more widespread sage sparrow. This subspecies is endemic to San Clemente Island, California. The sparrow apparently occupies four discontinuous areas of a maritime desert scrub community that is primarily composed of cactus and *Lycium* sp. The subspecies is primarily a ground dweller and rarely occurs at an elevation of more than 30 to 40 meters above sea level. The sparrow feeds predominantly on the ground and uses the shrub canopy for feeding, protection, roosting, song perches, and nesting. Nests are generally constructed about four decimeters above the ground in dense foliage.

The San Clemente sage sparrow begins the reproductive cycle in late January or early February with singing, courtship, and territorial confrontation. Breeding behavior intensifies until actual nesting is initiated, which extends from approximately mid-March through at least mid-June. Male maintain moderate-sized (~0.65 hectare) territories. Nests are normally located in low dense shrubs 76-127 centimeters above the ground. Nests of this insular subspecies usually contains 1-3 eggs. While the incubation period is unknown, it is believed to be similar to the 13-14 days of mainland sage sparrows.

Postbreeding adults and juveniles congregate to form foraging flocks containing as little as 3-4 individuals, but as many as 20-25 individuals. San Clemente sage sparrows are primarily ground and stem gleaners that feed on fruits of cactus (*Opuntia* and *Bergerocactus*), *Atriplex semibaccata* seeds, grass inflorescences, insects, and possibly spiders.

SPECIES STATUS AND TRENDS: The San Clemente sage sparrow was apparently more abundant formerly and has since experienced a population decline. Currently the population appears to be stable or slightly increasing at 250-400 individuals (possibly as high as 500 individuals). Suggested reasons for the decline in the population of this subspecies include: 1) a reduced food supply, 2) habitat destruction due to exotic, feral goats and pigs, or human activity, 3) inter-specific competition, 3) predation of nests and young by feral cats, island fox, American kestrels, red-tailed hawks, northern harriers, and barn owls, and 4) nest parasitism from brown-headed cowbirds which have been observed on the island as recently as 1980.

PESTICIDE/SPECIES INTERFACE: Pesticides sprayed within occupied habitat could threaten this species. The San Clemente sage sparrow could be adversely impacted from the applications of avicides, or vertebrate control agents that are applied in the form of granules, pellets, or treated baits.

WHOOPING CRANE *(Grus americana)* - E

SPECIES INFORMATION: The Whooping crane is the tallest North American bird approaching five feet tall when standing erect. There are two populations of these species including the wild population which nests in Wood Buffalo National Park, Canada, and migrates through the Plain States from northeast Montana, North Dakota, South Dakota, Nebraska, Kansas, and Oklahoma to its winter grounds in and adjacent to Aransas National Wildlife Refuge on the Texas coast. A second flock have been cross-fostered with sandhill cranes at Gray's Lake National Wildlife Refuge in Idaho and migrate with their foster parents to Bosque del Apache National Wildlife Refuge in central New Mexico. These whooping cranes feed and/or loaf in grain fields during migration through Idaho, Wyoming, Utah, Colorado, and New Mexico.

Whooping cranes are territorial birds that require undisturbed wetlands with open sand and gravel bars for nightly roosting. Critical habitat has been designated in seven national wildlife refuges including Monte Vista and Alamosa in Colorado, Gray's Lake in Idaho, Quivira in Kansas, Bosque del Apache in New Mexico, Salt Plains in Oklahoma, and Aransas, Texas. Cheyenne Bottoms State Waterfowl Management Area in Kansas also has been designated as critical habitat. In the winter, most foraging occurs in brackish bays, marshes, and salt flats lying between the mainland and barrier islands. Occasionally, whooping cranes will fly to upland sites when attracted by foods such as acorns, snails, crayfish, and insects, and then return to the marshes to roost. A portion of the whooping crane flock uses upland sites frequently in most years but agricultural croplands adjacent to Aransas National Wildlife Refuge are very rarely visited. Foods utilized during migration include frogs, fish, plant tubers, crayfish, insects, and waste grains in harvested fields.

Whooping cranes mate for life, and breeding starts at age 4 to 6. Nests are built of soft grass on a mound of reeds or sod. Two eggs are laid, incubation lasts 30 days, and the young are precocial.

SPECIES STATUS AND TRENDS: The wild whooping crane populations consist of 146 birds in the Aransas-Wood Buffalo flock and 13 birds in the Rocky Mountain flock. Nine whooping cranes have disappeared from Aransas National Wildlife Refuge during the winter of 1990-91. Man appears to have been directly or indirectly responsible for the decline of the species. Most of the losses of whooping cranes (about 66 percent) occurred during migration as a result of hunting, especially between the 1880's and 1920's. Since that time, most of the losses have been a result of habitat modification and human disturbance. For example, between 1956 and 1986, collisions with powerlines are known to have accounted for the death or serious injury of at least 15 whooping cranes. Most of the deaths of the Gray's Lake flock have been the result of collisions with powerlines or fences. The Gray's Lake is steadily declining from a maximum population of 30 birds in 1987 to the present population of 13 birds. Until the loss of the nine birds this winter, the Aransas-Wood Buffalo flock had been slowing increasing and we would except this to continue. Non-Federal actions that also may impact this species are unknown.

PESTICIDE/SPECIES INTERFACE: There are numerous pesticide uses that may occur in the vicinity of whooping crane habitat including, but not limited to, rangeland, pastures, mosquito control, noncrop land, rights-of-way, cotton, wheat, sorghum, soybeans, oats, barley, rye, and alfalfa. These pesticide uses could impact the whooping crane in several ways. Whooping cranes may ingest insects or other food items contaminated with pesticides and pesticide runoff and direct application through spray drift or by accident could reduce the food population of the crane. Cranes could be expected to forage in fields increasing their risk of exposure. Drinking water sources also could be expected to be contaminated either through direct application, runoff, or drift. Additional impacts could be expected with cranes preening themselves and receiving oral doses of a pesticide.

YELLOW-SHOULDERED BLACKBIRD *(Agelaius xanthomus)* - E

SPECIES INFORMATION: In size the Yellow-shouldered blackbird is slightly smaller than the red-winged blackbird. Adults and juveniles of both sexes have all black plumage with yellow epaulettes. Juveniles can be distinguished from adults by black speckling over the edges of the epaulettes. Adult males are significantly larger, about 17 percent by weight, than the females.

The yellow-shouldered blackbird is endemic to Puerto Rico and nearby Mona Island. While once widespread throughout Puerto Rico, the species is now limited to three areas: the coastal southwestern area; a small coastal eastern area; and Mona Island. Estimated populations in 1976 were 200 in eastern Puerto Rico; 2,000 in southwestern Puerto Rico; and 200 on Mona Island. A 1976 estimate that the population in the Southwest was declining at a rate of approximately 20 percent per year. More recent estimates (1989 and 1990) indicate that there are approximately 350 individuals in the southwest, less than 25 in eastern Puerto Rico, and from 400 to 500 in Mona Island. There is some evidence that the yellow-shouldered blackbird once occurred throughout Puerto Rico, although more commonly in the coastal zone. Studies of southwestern Puerto Rico, the population center for the species, indicated that during the nesting season (May to September) most of the birds stay either in the mangrove zone or the arid coastal fringe. Nesting occurs in mangroves along the coast and on small off-shore islands. Other nesting habitat includes large deciduous trees, primarily oxhorn bucida *(Bucida buceras)* in dry lowland pastures; coconut trees *(Cocos nucifera)*; royal palms *(Roystonea borinquena)*; and on Mona, the sheer coastal cliffs which surround the island.

Although this species is omniverous, it can be basically characterized as an arboreal insectivore. During the nesting season the young's diet is about 90 percent arthropod material. At bird feeders and around domestic animals, this blackbird has been observed to take cattle ration, dog food, monkey chow, nectar, fruit, cooked rice, and granulated sugar. The nesting season in southwestern Puerto Rico is April to October. Open, cup-shaped nests typical of the genus are usually constructed in trees. Blackbirds at the eastern end of Puerto Rico also use cavities or hollows in dead mangroves, and those on Mona Island place their nests on the ledges or in crevices of the sheer coastal cliffs. Nesting pairs often aggregate, and in several cases, nests have been located in the same tree as close together as 3.5 meters. All incubation and breeding is handled by the female, with the pair sharing equally with feeding the young. Usually only one nesting is attempted per year. The females are known to reach breeding age during their first year, but there are no data available for males.

SPECIES STATUS AND TRENDS: One of the principal reasons for the decline is attributed to parasitism by the shiny cowbird *(Molothrus bonariensis)*, which lays its eggs in the blackbird's nest and sometimes punctures the host's eggs. The shiny cowbird is an exotic species that managed to reach Puerto Rico in about 1955 from other antillean islands to the southeast. A 1975 survey of mainland blackbird nests showed 73.7 percent were parasitized by the cowbird. Comparisons between parasitized and unparasitized nests revealed that only 25 percent of the former produced young, whereas 50 percent of the unparasitized nests were productive. Three introduced pest species, the black rat *(Rattus rattus)*; Norway rat *(Rattus norvegicus)*; and the mongoose *(Herpestes javanicus)* have contributed to the decline by preying on the blackbird's nest. Habitat modification and destruction played an important role in the decline, eliminating both foraging and nesting areas. Fowl pox infects about 19 percent of the adult population and may also be contributing to the decrease. Today, an important factor is the threatened loss of habitat, especially the coastal and offshore island mangroves where about 86 percent of the nesting now occurs.

PESTICIDE/SPECIES INTERFACE: The yellow-shouldered blackbird would be exposed to agricultural pesticides used on sugarcane, pineapple, coffee, various vegetables, citrus and livestock. Rodenticides, avicides, and mosquito control applications may also affect the species when used in agricultural areas frequented by the birds.

REPTILES

BLUNT-NOSED LEOPARD LIZARD *(Gambelia silus)*

SPECIES INFORMATION: The Blunt-nosed leopard lizard is a large, robust, iguanid lizard that may exceed 15 inches in length. The species often conspicuously basks along the edges of secondary dirt roads, open alkaline soil areas, or embankments. The blunt-nosed leopard lizard typically is active when air temperatures are between 77° and 95° F, generally between the months of April through September, although hatchling activity can extend into October. Both adults and hatchlings remain underground in rodent burrows during the winter months. Their diet includes hymenoptera, orthopterans, cicadas, and larval lepidopterans.

SPECIES STATUS AND TRENDS: The blunt-nosed leopard lizard was historically distributed throughout the San Joaquin Valley and adjacent interior foothills and plains, extending from central Stanislaus County south to extreme northeastern Santa Barbara County. Preferred habitat consists of open grassland, saltbush shrubland, and alkaline sink communities. The area occupied by this species has been significantly reduced and fragmented by agricultural, urban, and other man-induced actions.

PESTICIDE/SPECIES INTERFACE: This species could be adversely impacted from burrow fumigants that are targeted for rodents and applied in the same burrows as those occupied by the lizards.

COACHELLA VALLEY FRINGE-TOED LIZARD *(Uma inornata)* - T

SPECIES INFORMATION: The Coachella Valley fringe-toed lizard is a medium-sized lizard approximately 150-240 millimeters in total length. The species is restricted to remaining windblown sand deposits in the Coachella Valley from near Cabazon to near Thermal. In 1979, perhaps only 99 square miles of habitat remained. This species habitat is sand dunes with scattered creosote, mesquite, and desert willows and it feeds on plants and insects. It is known to use rodent burrows or construct its own burrows.

SPECIES STATUS AND TRENDS: The exact number of the current population is not known. The reasons for decline includes urbanization leading to habitat loss and fragmentation, agricultural development, windbreak construction (holds back sand), flood control, and golf course development. Anticipated trends include continued habitat loss. Non-federal impacts to the species include habitat loss.

PESTICIDE/SPECIES INTERFACE: This species could be adversely impacted from burrow fumigants that are targeted for rodents and applied in the same burrows as those occupied by the lizards. The lizard is also susceptible to poisoning or sublethal effects from eating vegetation contaminated with insecticides or herbicides applied within occupied habitat.

DESERT TORTOISE *(Gopherus agassizii)* - T

SPECIES INFORMATION: The Desert tortoise is a large terrestrial turtle which has ranged historically over most of the southern California deserts, into Arizona and the southern part of Utah. By 1980 it was eliminated from the Coachella and Imperial Valleys of California. In its desert habitat it feeds on cactus, annual forbs, grasses, and flowers. Ten to 20 years is required to reach breeding age, rate of reproduction is low, young are soft-shelled and heavily preyed upon, especially by ravens. The species forages from March to June, estivates during the summer in burrows, may emerge in fall, and hibernates from October to March

SPECIES STATUS AND TRENDS: The exact number of the species is unknown. Reasons for the species' continued decline includes urbanization, off-road vehicle use, mining, energy development, upper respiratory disease (URDS) that has resulted in an estimated 50% of present mortality, loss as pets, vandalism, and the population explosion of ravens resulting in increased predation on the tortoise.

PESTICIDE/SPECIES INTERFACE: This species could be adversely impacted from burrow fumigants that are targeted for rodents and applied in the same burrows as those occupied by tortoises. Tortoises are also susceptible to poisoning or sublethal effects from eating vegetation contaminated with insecticides or herbicides applied within occupied habitat. They are also at some risk from dermal exposure to certain insecticides.

EASTERN INDIGO SNAKE *(Drymarchon corais couperi)* - T

SPECIES INFORMATION: The Eastern indigo snake is a large, docile, non-poisonous snake growing to a maximum length of about 8 feet. The color in both young and adults is shiny bluish-black, including the belly, with some red or cream coloring about the chin and sides of the head. Indigo snakes probably reach sexual maturity at 3 to 4 years of age. Based on observations of captive indigos at Auburn University, mating begins in November, peaks in December, and continues into March. Clutches averaging eight to nine eggs laid in late spring hatch approximately 3 months later. The snakes remain active to some degree throughout the winter, often emerging from their dens whenever air temperatures exceed 50 degrees Fahrenheit.

This species is currently known to occur throughout Florida and in the coastal plain of Georgia. Historically, the range also included southern Alabama, southern Mississippi, and the extreme southeastern portion of South Carolina. The indigo snake seems to be strongly associated with high, dry, well-drained sandy soils, closely paralleling the sandhill habitat preferred by the gopher tortoise. During warmer months, indigos also frequent streams and swamps, and individuals are occasionally found in flat woods. Gopher tortoise burrows and other subterranean cavities are commonly used as dens and for egg laying. The home range of indigos varies considerably according to season. Based on a study conducted in southwest Georgia, an average seasonal range of 4.8 hectares during the winter (December through April), 42.9 hectares during late spring or early summer (May through July), and 97.4 hectares during late summer and fall (August through November). The most extensive monthly movements occurred during August. Of a total of 108 den sites located, 77 percent were in gopher tortoise burrows, 18 percent were in or under decayed stumps and logs, and 5 percent were under plant debris. The study area included windrows of debris piled up in the 1960's during site preparation for a slash pine plantation. The snakes showed some tendency to prowl and locate their dens near these windrows. This same study also indicated that during May-July that at least 10 percent, and in August-November at least 5 percent, of all indigo snake activity occurred within 150 feet of agricultural fields. Food items include snakes, frogs, salamanders, toads, small mammals, birds, and occasionally young turtles. The indigo snake subdues its prey (including venomous snakes) through the use of its powerful jaws, swallowing the prey usually still alive.

SPECIES STATUS AND TRENDS: The eastern indigo snake population is declining. The decline is attributed primarily to a loss of habitat due to such land use changes as farming, construction, forestry, pasture, etc., and to over-collecting for the pet trade. The snake's large size and docile nature have made it much sought after as a pet. The effect of Rattlesnake Roundups on the indigo snake are speculative. Both indigos and rattlers utilize the burrows of gopher tortoises at certain times. Rattlesnake hunters often pour gasoline down these burrows to drive out the snakes. While some indigos may be killed by this practice, the actual degree of impact on the population is unknown. Recovery tasks currently being implemented include habitat management through controlled burning, testing experimental miniature radio transmitters for tracking of juvenile indigo snakes, maintenance of a captive breeding colony at Auburn University, recapture of formerly released snakes to confirm survival in the wild, presentation of education lectures and field trips, and efforts to obtain landowner cooperation in indigo snake conservation efforts.

PESTICIDE/SPECIES INTERFACE: The eastern indigo snake would primarily be exposed to pesticide uses on crops such as cotton, corn, soybeans, small grains, alfalfa, hay, pasture, forestry/silviculture. Direct exposure to treated areas and secondary exposure by ingestion of contaminated prey can occur. Secondary exposure to rodenticides may also occur, as the indigo snake is found in or near agricultural activity, fields or structures that would typically be treated for rodent control.

GOPHER TORTOISE *(Gopherus polyphemus)* - T

SPECIES INFORMATION: The Gopher tortoise is a large, 5.9 to 14.6 inches long, dark-brown to grayish-black terrestrial turtle with elephantine hind feet, shovel-like forefeet, and a gular projection beneath the head on the yellowish, hingeless plastron or undershell. The sex of individual turtles can usually be determined by shell dimensions. A male turtle has a greater degree of lower shell concavity, and a longer gular projection.

This turtle feeds primarily on grasses, grass-like plants, and legumes. Its diet may also include mushrooms, fleshy fruits, and possibly some animal matter. Sometime between late April and mid-July, the female digs a nest in sandy soil, lays a clutch of 4 to 12 eggs, and after refilling the hole leaves the eggs for incubation by the sun's heat. Hatching occurs in August and September. The juvenile tortoises suffer a heavy natural predation loss of almost 97 percent through the first 2 years of life. Those that survive grow to sexual maturity slowly over a period of 13 to 21 years, depending on the portion of the range and the sex of the turtles. Females usually reach reproductive maturity at 19 to 21 years old. The low reproductive rate is accentuated by the fact that there is some evidence to indicate that not all females nest every year. The juveniles that are born and survive may live an average of 40 to 60 years, sometimes 80 to 100.

The gopher tortoise most often lives on well-drained sandy soils in transitional (forest and grassy) areas. It is commonly associated with a pine overstory and an open understory with a grass and forb groundcover and sunny areas for nesting. Most of the gopher tortoise's life is spent in and around the burrow. The gopher tortoise establishes a well-defined home range which increases in size as the tortoise grows older and larger. For refuge the tortoises dig burrows which average around 5 to 10 feet in depth and may be 10 to 20 feet (or more) in length. The burrow becomes a more or less permanent home although there may be alternate burrows in the area. Several other species may also share gopher tortoise burrows. Some commonly known burrow sssociates include the eastern indigo snake, the eastern diamondback rattlesnake, and the gopher frog. The species occurs in sandy coastal plain areas from extreme southern South Carolina to the southeastern corner of Louisiana, and throughout most of Florida.

SPECIES STATUS AND TRENDS: Less than 20 percent of the historically available habitat remains for the western population of the gopher tortoise. The population segment from the Tombigbee and Mobile Rivers in Alabama, westward, is classified as threatened, and for convenience is termed the western population. This entire western population is within the the original range of the longleaf pine. Using statistics of the U.S. Department of Agriculture, the Fish and Wildlife Service estimates that present ownership distribution of gopher tortoise habitat is approximately two-tenths in National Forest, one-tenth in other public ownership, three-tenths in forest industry, and four-tenths in other private ownership. No estimate is available for the gopher tortoise's total population size. Biologists have estimated a population density of 0.713 tortoises per hectare in Mississippi and 0.97 tortoises per hectare in Alabama in 1975, whereas other estimates indicate a density of 0.107 and 0.32 per hectare in those states, respectively, in the early 1980's. Biologists were also able to document only 11 active burrows in Louisiana in 1981, and only one remaining in 1984. There is an indicated decline in population densities ranging from 67 percent in Alabama to 91 percent in Louisiana.

Conversion of gopher tortoise habitat to urban areas, croplands, and pasturelands along with adverse forest management practices has reduced the western portion of the historic range. Taking gopher tortoises for sale or use as food or pets has also had a serious effect on some populations. The seriousness of the loss of adult tortoises is magnified by the length of time required for tortoises to reach maturity and their low reproductive rate. Current estimates of human predation and road mortality alone are at levels that could offset any annual addition to the population. A number of other species also prey upon gopher tortoises including the raccoon, who is the primary egg and hatchling predator; gray foxes; striped skunks; armadillos; dogs; snakes; and raptors. Imported fire ants also have been known to prey on hatchlings. Reported clutch and hatchling losses often approach 90 percent.

PESTICIDE/SPECIES INTERFACE: The gopher tortoise would primarily be exposed to pesticides that are applied to various crops including cotton, soybeans, alfalfa, hay, pasture, as well as applications for forestry/silviculture practices. The tortoise may be at risk from direct contact with treated areas and ingestion of contaminated vegetation.

ISLAND NIGHT LIZARD *(Xantusia riversiana)* - T

SPECIES INFORMATION: The Island night lizard is a 5 to 6 inch broad-headed, brownish, sometimes striped lizard. The species is endemic to Santa Barbara, San Clemente, and San Nicolas Islands of California. It occurs under shrub cover and feeds on small insects, spiders, scorpions, and on terminal leaves and blossoms of island plants. It has an extremely low metabolic rate in comparison with other lizards. It is not nocturnal, but secretive by day. The California Channel Islands Species Recovery Plan was written in 1984.

SPECIES STATUS AND TRENDS: The exact number of the night lizard is not known. The reasons for decline include introduction of exotic goats, pigs, and rabbits have removed shrub cover required for shading. Introduced rats and cats also have reduced populations. Goat and pig control is underway on San Clemente Island.

PESTICIDE/SPECIES INTERFACE: This species could be adversely impacted from burrow fumigants that are targeted for rodents and applied in the same burrows as those occupied by the lizards.

PUERTO RICAN BOA *(Epicrates inornatus)* - E

SPECIES INFORMATION: The Puerto Rican boa's color is somewhat variable but usually ranges from pale to dark brown, sometimes grayish, with 70 to 80 darker colored blotches along the back from neck to vent. These dorsal blotches are generally dark-bordered with the centers of a lighter hue. Maximum size is approximately 6 and a half feet. Observations of captive specimens suggest that under natural conditions the diet of sub-adults and adults consists of birds, small mammals and lizards. Biologists also report bat predation by the Puerto Rican boa. The boa feeds by seizing the prey in its jaws, wrapping several coils around the victim, and then constricting until the prey has suffocated. The prey is then swallowed head first. The feeding habits of the very young are unknown. Two pregnant females captured and held in captivity at University of Puerto Rico facilities gave birth to 23 live young in one case, and 26 in the other. Reproduction presumably occurs once a year.

This species exists only in Puerto Rico. The forested limestone hill area seems to be the boa's preferred habitat. The boas utilize ground level retreats for sleeping during the day, and apparently hunt most of their prey in nearby trees at night.

SPECIES STATUS AND TRENDS: Although no population estimates are available, a series of casual observations were made during the period of 1972 to 1977 recorded 75 boas at 18 different localities. Historic records, some dating back to the 1700's, indicate that during the first few centuries of Spanish colonization in Puerto Rico the boa was relatively abundant, and oil produced from the snake's fat was utilized extensively as an export. Impacts to the boa resulting from the oil trade were undoubtedly heightened by a concurrent reduction of habitat. Deforestation of the island began during this period and continued until, by the early 1900's, very little natural forest remained. When an expedition from the U.S. Natural Museum visited Puerto Rico in 1900, the boa had become so rare that no specimens could be collected. Predation by the mongoose, introduced into Puerto Rico in the 1900's, has been postulated as a further cause for the boa's present status, but there is no direct evidence to support this idea. There is an indication that the boa has recovered somewhat in recent years, although not to the degree that protective measures can be dropped. Some illegal hunting is apparently occurring at present for the snake's oil, which is used locally for medicinal purposes.

PESTICIDE/SPECIES INTERFACE: The Puerto Rican boa may be exposed to pesticides that are applied to crop fields (e.g., coffee, sugarcane, various vegetables, pineapples), adjacent to habitat that supports boas. Boas may come in direct contact with treated areas while hunting for prey, or ingest contaminated prey. Rodenticides may also pose a risk if the snake were to ingest a poisoned rodent.

SAN FRANCISCO GARTER SNAKE *(Thamnophis sirtalis tetrataenia)* - E

SPECIES INFORMATION: The San Francisco garter snake is a slender serpent of the family Colubridae. Historically, San Francisco garter snakes occurred in scattered freshwater wetland and pond areas on the San Francisco Peninsula from approximately the San Francisco County line south along the eastern and western bases of the Santa Cruz Mountains, at least to the Upper Crystal Springs Reservoir, and along the coast south to Año Nuevo Point, San Mateo County, and Waddell Creek, Santa Cruz County, California. Recent studies have documented garter snake movement over several hundred yards away from wetlands into upland hibernation habitats in small mammal burrows.

SPECIES STATUS AND TRENDS: Recently confirmed populations of the San Francisco garter snake occur at Año Nuevo State Reserve, Pescadero Marsh Natural Preserve, San Francisco State Fish and Game Refuge (including both lower and upper Crystal Springs Reservoirs), Sharp Park Golf Course (Laguna Salada), Mori Point, Cascade Ranch, and Millbrae (San Francisco Airport). The following reported locations and/or "populations" have not been confirmed as extant by the Service or the California Department of Fish and Game: San Bruno Mountain, Whitehouse Creek, Denniston Creek, La Honda Creek, Colma Creek, San Gregorio Creek, San Mateo Creek, Sanchez Creek, and near Edgewood and Canada roads. Additional San Francisco garter snakes have been reported from agricultural ponds situated along the immediate coast between Pescadero Point and the Cascade Ranch.

PESTICIDE/SPECIES INTERFACE: This species could be adversely impacted from burrow fumigants that are targeted for rodents and applied in the same burrows as those occupied by the garter snakes.

VIRGIN ISLANDS TREE BOA *(Epicrates monensis granti)* - T

SPECIES INFORMATION: The Virgin Islands tree boa grows to slightly less than a meter in length (snout to vent). The adult body color is light plumbeous brown with darker brown blotches partially edged with black. The dorsal blotches are angulate and frequently reach the ventral scales. The dorsal surface has a general blue-purple iridescence. The ventral surface is grayish-brown speckled with darker spots. On juveniles of this subspecies, the dorsal ground color is light grey punctuated with black blotches.

The Virgin Island tree boa is distributed on several islands of the Puerto Rico Bank east of Puerto Rico (including Cayo Diablo, Eastern St. Thomas, Tortola, Guana, Greater Camanoe, Necker Cay, and Virgin Gorda). On St. Thomas, it is found in xeric forest habitat characterized by steep slopes with poor rocky soils. On Tortola and Guana Islands it is reported to inhabit rocky cliffs. It is also found on low profile islands, like Cayo Diablo, where the tallest vegetation is open stands of sea grape *(Coccoloba uvifera)*. These snakes can be found in almost every type of vegetation except very low succulent cover close to the high tide line. The Virgin Island tree boa is most often active after dark, and during the day often seeks concealment on the ground under rocks, logs, leaf axils of *Cocos nucifera*, loose sections of termite nests, sheets of cardboard, etc. The bulk of their diet consists of lizards *(Anolis cristatellus)*, but they also likely feed on small birds and mammals.

SPECIES STATUS AND TRENDS: This species' present status is unknown. The decline of the species throughout a large portion of its historical range has been attributed to the effects of predation by the introduced Indian mongoose and introduced rats. Habitat destruction/disturbance due to increasing human, dog, and housecat populations are also likely having an adverse effect on the surviving boa populations.

PESTICIDE/SPECIES INTERFACE: Pesticide use for mosquito control is likely to occur within or adjacent Virgin Island tree boa habitat and has the potential to adversely affect this species. Ingestion of contaminated prey items and water; or absorption of the pesticides through their skin following direct contact with the spray or contact with contaminated surfaces are all likely means of exposure. Rodenticides may also pose a risk if the snake were to ingest a poisoned rodent.

INSECTS

EL SEGUNDO BLUE BUTTERFLY *(Euphilotes battoides allyni)* - E

SPECIES INFORMATION: The El Segundo blue butterfly ranges in two small areas in Los Angeles County -- two acres of a Chevron oil refinery, and 300 acres at the western end of the Los Angeles International Airport. The species feeds and lays eggs on a sand dune species of buckwheat.

SPECIES STATUS AND TRENDS: The exact number of this population is not known. The reasons for decline include loss of dune habitat in western Los Angeles County. A golf course is proposed for large part of airport dunes. The Chevron site is managed to protect this species. Non-federal impacts of the species include a golf course and other proposed developments.

PESTICIDE/SPECIES INTERFACE: This butterfly could be adversely impacted from the dispersion of burrow fumigants applied in nearby burrows as vertebrate control agents to soil occupied by larvae or from insecticides applied within the species' extremely restricted habitat.

Anticoagulants

Rodenticide Use on Black-tailed Prairie Dogs and Unintended Consequences to Non-target Wildlife

Prairie dogs are considered a keystone species because they have a unique and substantial influence on plant and animal communities in the grassland ecosystem. Furthermore, prairie dogs themselves serve as prey for predatory mammals and birds, and their burrows provide shelter for many species (Power et al. 1996; Kotliar et al. 1999; Miller et al. 2000). Prairie dogs also are also regarded as competitors with livestock for forage on grasslands and efforts to eradicate or contain them have been an ongoing effort for decades (Derner et al. 2006, Forrest and Luchsinger 2006).

Most efforts to control or eradicate prairie dogs involve some type of poison. In 2005, the first anticoagulant-based rodenticide was registered for use in poisoning black-tailed prairie dogs (*Cynomys ludovicianus*). Although there is always some risk for unintended poisoning of non-target wildlife when using rodenticides, the use of anticoagulants can be especially harmful to animals that eat poisoned prairie dogs such as eagles, large hawks, and mammalian predators like swift fox and black-footed ferrets. Many of the non-target species that are unintentionally poisoned with anticoagulants aimed at prairie dogs are protected by wildlife conservation laws such as state and federal Endangered Species Act laws, the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act. Please contact local law enforcement if you suspect possible wildlife exposure to poisoned prairie dogs or observe dead or injured wildlife in the area where rodenticides have been used.

Black-tailed prairie dogs do not hibernate through the winter in most of their range and are active above ground when weather permits. This allows the use of certain anticoagulants registered to control black-tailed prairie dogs to be used during the period of October 1 through March 15 of the following year. Anticoagulants are presented to prairie dogs in grain baits that must be placed at least 6 inches down in prairie dog burrows. Prairie dogs feed on the anticoagulant bait multiple times before death with symptoms (e.g. loss of attentiveness, lethargy, swollen or closed eyes) generally manifesting just days after ingestion (Yoder 2008). Unlike other poisons that act quickly, anticoagulants work slowly by preventing the production of clotting factors, leading to hemorrhaging, and death typically occurs one to three weeks after application.

Exposure of non-target animals to the anticoagulants occurs either by directly feeding on the bait or secondarily by consuming poisoned prey. Because of the duration of time it can take for a prairie dog to die, prairie dogs can accumulate the poison in their tissues from multiple feedings over time (Erickson and Urban 2004; Eason et al 2008). During this time, the prairie dogs often come above ground (Bruening 2007), but because of their debilitated state, they become easy targets for hungry predators. Additionally, some prairie dogs will die above ground which attracts scavengers.

In addition to the toxic effects from eating anticoagulants in food items, wildlife may also be negatively affected from prairie dog control when it results in loss of other species or the habitat that is linked to their survival. For example, the federally-endangered northern aplomado falcon *(Falco femoralis septentrionalis)* may become sick or die if it eats anticoagulant-poisoned prey. Furthermore, northern aplomado falcons do not build their own nests, but use nest sites constructed by other raptors or ravens that may

Meadowlark showing hemorrhaging after ingestion of chlorophacinone bait applied to a black-tailed prairie dog town, which lead to its death. / N. Vyas, USGS

Black-tailed prairie dog in a moribund condition after the ingestion of chlorophacinone bait. / N. Vyas, USGS

Dead black-tailed prairie dog on ground surface after the ingestion of chlorophacinone bait. / USFWS

also become depleted from exposure to anticoagulants, thereby reducing nests for alpomado falcons.

The number of non-target animals, such as raptors and predators, that die from anticoagulant poisons is believed to be much higher than what is located because of the extended time it takes for an animal to succumb to the poison (Vyas 1999; Colvin et al. 2008; Ruder et al. 2008). Prior to death, the non-target animal remains mobile, can continue consuming poisoned prey or bait, and often will seek a place to hide off-site, making detection of non-targets very difficult and unlikely (Colin et al. 1988; Vyas 1999; 2010). Also, even though the label requires frequent searches and removal or burial of any poisoned prairie dog carcass, applicators may not have the resources to do so, further increasing the likelihood that non-target animals will consume poisoned prairie dogs. To date non-target animals include badger, raccoon, bald eagles, hawks, owls, turkeys, meadowlark, coyotes,and kit fox (CAHFS 2009; USFWS 2007, 2009, 2011).

Although efforts to control prairie dogs may be warranted under some circumstances, we must ensure that the methods are used in the most responsible manner possible, including adherence to label instructions regarding bait placement, monitoring, and carcass removal. Smarter pest control tools that specifically target pest species specifically need to be implemented to reduce the number of non-target animal deaths. We encourage prairie dog control to include an Integrated Pest Management approach to prevent unneccesary applications when good altneratives to pesticides exist (see http://www.fws.gov/contaminants

Turkey vulture scavenging on a chlorophacinone-poisoned black-tailed prairie dog town. / N. Vyas, USGS.

Bald eagle that succumbed to cholorophacinone poisoning. / USFWS

Prairie grassland ecosystems are one of the most biologically productive ecosystems and one of our Nation's most splendid assets. / USFWS

U.S. Fish & Wildlife Service
http://www.fws.gov

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