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AESO/SE
2-21-94-F-192R2 September 30, 2002

Memorandum

To: Field Manager, Phoenix Field Office, Bureau of Land Management

From: Acting Field Supervisor

Subject: Biological Opinion for Five Livestock Grazing Allotments in the Vicinity of Ajo, Arizona

This biological opinion responds to your request for consultation with the U.S. Fish and Wildlife Service (FWS) pursuant to section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531-1544), as amended (Act). Your request for formal consultation was dated April 19, 2002, and received by us on April 23, 2002. At issue are impacts that may result from the proposed reauthorization of livestock grazing on the Sentinel, Cameron, Childs, Coyote Flat, and Why allotments located in Maricopa and Pima counties, Arizona. The Bureau of Land Management (BLM) has determined that the proposed action for the five allotments may adversely affect the endangered Sonoran pronghorn (*Antilocapra americana sonoriensis*), and the proposed action for the Cameron and Childs allotments may adversely affect the endangered cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*).

In your letter, you also requested our concurrence that the proposed action on the Cameron, Childs, Coyote Flat, and Why allotments may affect, but will not likely adversely affect, the endangered lesser long-nosed bat (*Leptonycteris curasoae yerbabuena*). We concur with that determination, which is based on sound analysis and guidance criteria for the species mutually agreed upon by our agencies.

This biological opinion is based on information provided during the previous consultations on this action, updated information on the proposed action provided by your agency, new information on the status of endangered species in the action area, telephone conversations, and other sources of information as detailed in the consultation history. A complete administrative record of this consultation is on file in the Phoenix, Arizona, Ecological Services Field Office (ESO).

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CONSULTATION HISTORY

The December 3, 1997, biological opinion on this action provides a history of the consultation from January 31, 1994, through the issuance of that opinion. The 1997 biological opinion concluded that proposed livestock grazing activities on the five allotments were not likely to jeopardize the continued existence of the pronghorn. The opinion also included our concurrences with BLM's determinations that the action may affect, but was not likely to adversely affect, the lesser long-nosed bat and cactus ferruginous pygmy-owl.

The 1997 biological opinion was remanded to FWS on February 12, 2001. On that date, Judge Ellen Huvelle, in response to Civil Action No. 99-927 [ESH], *Defenders of Wildlife, et al. v. Bruce Babbitt, et al.*, ruled (in part): "...that the Fish and Wildlife Service has acted in a manner that is arbitrary and capricious and contrary to law by issuing biological opinions that fail to address the impact of each defendant's activities on the pronghorn when added to the environmental baseline, 50 C.F.R. §§ 402.02, 402.12(g), and fail to include in the environmental baseline the impacts of all Federal activities in the area in which defendants are proposing or engaging in action that may affect, directly or indirectly, the pronghorn, 50 C.F.R. §402.02.

The final remanded biological opinion was issued on November 16, 2001. That opinion provided a detailed consultation history from 1998 through its issuance. The Federal action considered in that opinion was the issuance of a 10-year grazing permit on the five allotments. The opinion was issued, however, with the understanding that during January 2002, BLM would finalize their Rangeland Health Allotment Evaluations conducted during 2001, and reinitiate consultation regarding continued grazing of these allotments. The BLM estimated that the implementation of the revised project description based on these evaluations would occur by November 1, 2002. Therefore, the 2001 biological opinion analyzed the effects of the proposed action only for the interim period. The life of the project, as specified in the 2001 opinion, will expire as of November 1, 2002.

The BLM reinitiated consultation on these five allotments on April 23, 2002. The following details the history of the consultation from that date forward:

April 23, 2002:	We received BLM's request for reinitiation of consultation, revised biological assessments, and draft-final Ajo block Rangeland Health Evaluation.
July 10, 2002:	We conducted a site visit to the Ajo block allotments.
July 25, 2002:	After conversations between FWS and BLM staff, the BLM changed their original determination of the effect of the proposed action for the Sentinel Allotment on the Sonoran pronghorn to may affect, likely to adversely affect.
July 30, 2002:	We requested additional information and clarification of some aspects of the proposed action from BLM.
August 7, 2002:	BLM provided us with the information that we requested on July 30, 2002.
September 20, 2002:	BLM provided us with a list of proposed conservation measures for the Sonoran pronghorn.
September 24, 2002:	We provided a draft biological opinion to the BLM.

September 27, 2002: BLM provided comments to us on the draft opinion, including comments from their applicants.

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

Proposed Action

The Federal action is the reissuance of 10-year grazing permits on five allotments, totaling 213,616 acres (ac), within the management authority of BLM's Phoenix Field Office in Maricopa and Pima counties. The five allotments consist of the Cameron Allotment (67,234 ac), Childs Allotment (102,480 ac), Coyote Flat Allotment (11,520 ac), Why Allotment (10,506 ac), and Sentinel Allotment (21,876 ac) (Figure 1).

The Sentinel Allotment is just south of Interstate 8 and separated from the other four allotments by the Barry M. Goldwater Range (BMGR), which forms the southern boundary of the allotment. The other four allotments form a block of land that surrounds the towns of Ajo and Why, Arizona. This block of allotments (Ajo allotments) has its northern boundary and the northern portion of its western boundary with the BMGR, the majority of the western boundary with Cabeza Prieta National Wildlife Refuge (NWR), the southern boundary with Organ Pipe Cactus National Monument (NM), and the eastern boundary with the Tohono O'Odham Nation. State Route 85 (SR 85) bisects the Childs, Cameron, and Coyote Flat allotments and a small portion of the Why allotment.

The five allotments are classified as perennial/ephemeral, meaning they have a base allocation of animal unit months (AUMs) (the amount of forage required to feed a cow with a calf for one month) for year-long operation. Perennial/ephemeral allotments are generally cow-calf operations, but may also graze steers during years of favorable ephemeral forage growth.

Cameron Allotment

BLM will adjust permitted use from 2,532 to 684 AUMs (57 cows year long) annually. Year-round use of this allotment will continue. Cattle will be rotated between use areas, which are centered around the following water developments: Highway Tank, Bob's Tank, Cameron Tank, Darby Well, Valentine Well, and a proposed pipeline (discussed below). Water sources will not be used during the same season in consecutive grazing years. From September 16- April 1, cattle will use the entire allotment. Summer grazing (May 1-September 15) will not be authorized in the southern portion of the allotment, south of the fence to be constructed as shown in Figure 2. North of the fence, summer grazing would be authorized in even-numbered years in the Highway Tank area, and in odd-numbered years in the Darby Well and Valentine Well areas (Figure 2). However, the grazing practices described above will not apply to ephemeral grazing authorizations, which are temporary non-renewable authorizations for use ephemeral forage in those years when such forage is available.

Proposed range improvements on the Cameron Allotment include the construction of a pipeline from T13S, R6W, section 6 to troughs in T13S, R6W, sections 17 and 19. An existing, nonfunctional well in T13S, R6W, section 14, NW 1/4 will also be redeveloped to supplement an existing seasonal earthen tank. The redevelopment will consist of a submersible pump, a 10,000-gallon storage tank, approximately three miles of PVC pipe, and a water trough. A pipeline will connect the storage tank to a water trough in either section 34 or 35. Troughs will installed at 3 livestock wells to provide water for pronghorn. In addition, BLM proposes to construct a

pronghorn-friendly fence in the northern portion of the allotment to contain livestock during the summer grazing season.

To protect the Cameron locality of Acuna cactus (*Echinomastus erectrocentrus* var. *acunensis*), barriers to routes leading to the population will be rehabilitated and/or constructed. This may include fencing. Due to drought, all cattle have been removed from the Cameron allotment since August 1, 2002.

Childs Allotment

Permitted use on the Childs Allotment will remain at the current level of 3,802 AUMs (317 cows year long). Year-round use of this allotment will continue. The permitted number of AUMs is based on historical use and mutual agreement with the permittee and was originally set in 1973. For the past 10 years, the permittee has not grazed the Childs Allotment at full preference. Mean actual use during this period was 926 AUMs, approximately 25 percent of full preference. The BLM stated that the preference for this allotment may be adjusted when and if actual use increases, as indicated by monitoring data.

BLM also proposes to construct a pronghorn-friendly boundary fence between BMGR and BLM-administered lands west of SR 85 and north of the town of Ajo. Due to drought, the stocking rate on the Childs allotment was cut to 60 head in 2002.

Coyote Flat and Why allotments

BLM will adjust permitted use on the Why and Coyote Flat allotments from 456 to 132 AUMs (11 cows year long on each allotment) annually. Year-round use of these allotments will continue; however, summer grazing will be authorized on the Coyote Flat Allotment in even-numbered years, and on the Why Allotment in odd- numbered years. Due to drought, cattle have been removed from the Why and Coyote Flat allotments since April 1, 2002.

Sentinel Allotment

Permitted numbers on the Sentinel Allotment will remain 360 AUMs (30 cows year-round). This level of permitted use was originally set in 1981. No system of grazing management is proposed. The Sentinel allotment has been, and currently remains, in non-use (no cattle) for several years.

For the Ajo allotments, BLM estimated that, if allotments were stocked at the 2001 preference levels, utilization rates could approach 40 percent. The BLM now proposes to change their target utilization to 30 percent. BLM believes that the reduction of permitted use levels on the Cameron, Why, and Coyote Flat allotments will result in the desired 30 percent utilization rates. However, if monitoring data indicate use is exceeding 30 percent, livestock numbers will be reduced, distribution of cattle will be adjusted, or other measures will be taken to resolve overutilization.

Additional livestock grazing may be authorized for ephemeral use under a supplemental grazing license when sufficient forage is present and such use does not conflict with other resources or damage the perennial vegetation base. There are no set AUMs for ephemeral use. Ephemeral permits are considered upon request and dealt with separately from the perennial permit. The

ephemeral stocking rate is based on the amount of annual vegetation present at the time of the request. However, to protect pronghorn, BLM has proposed to authorize ephemeral grazing on the Cameron, Why, Coyote Flats allotments, and Childs allotment west of SR 85 only under certain conditions (see "Proposed Conservation Measures , page 7).

According to the guidelines for permitting ephemeral grazing, the following criteria must be met:

1. Presence of ephemeral vegetation in draws, washes, and under shrubs.
2. Sufficient surface and subsurface soil moisture for continued plant growth.
3. Ephemeral forage has grown to useable levels by the time grazing begins.
4. Enough serviceable waters exist to provide good grazing distribution on the allotment for the number of livestock to be authorized.
5. All range improvements and livestock facilities needed for proper administration of authorized grazing use are properly maintained.
6. The level of grazing use allows for sufficient annual vegetation to remain on site to satisfy other resource concerns (i.e., watershed, wildlife, wild horses and burros).

If there are known resource conflicts with livestock grazing (such as habitat for special-status species) ephemeral authorizations will be limited to a maximum of 30 days per authorization (see Attachment 5 of the Sentinel Allotment biological evaluation for more details).

The Cameron, Childs, and Sentinel allotments are currently considered "maintain allotments (allotments that are less intensively managed due to their low resource potential, lack of conflicts, or other considerations). Under the proposed action the Cameron Allotment will be changed from a "maintain to an "improve selective management c ategory (allotments that have resource conflicts and range condition and/or present management are not satisfactory). The Coyote Flat and Why allotments are "custodial allotments (allotments for which only limited management occurs).

At the start of each grazing season, the permittees determine how much of their permitted amount of AUMs to use. Because the amount may vary on a yearly basis and is based on a number of factors, it is difficult to predict future livestock use on the allotments. Regardless of past use, the operator may use a portion or all of his permitted amount of AUMs every year and, in addition, may activate ephemeral use in years in which conditions permit the emergence of abundant annual forage (subject to conditions outlined in the Proposed Conservation Measures, pages 7-8). Table 1 shows the amounts of AUMs from 1970 to 2001 for each of the allotments.

According to BLM, livestock use within the five allotments has been relatively low for the past ten years. In southern Arizona, livestock forage use during the late winter/early spring period is typically on annual forage. Depending upon climatic conditions, May-June use is mainly on perennial forage (trees, shrubs, grasses, and forbs) supplemented by annuals. Dry annuals are used in all seasons, as available. Late summer forage use is derived primarily from the foliage and beans of trees and shrubs, such as palo verde (*Parkinsonia* spp.), catclaw acacia (*Acacia greggii*), and mesquite (*Prosopis velutina* and *P. glandulosa*).

For the Ajo allotments, BLM will update all range improvement authorizations and cooperative agreements to ensure all range improvements are functional/operational and meet BLM standards. Further, BLM will abandon all range improvements that can not become operational through normal maintenance. The BLM will ensure water is available for wildlife at all water developments, and escape ramps are installed on all water troughs in accordance with the Lower Gila South Resource Management Plan.

Existing range improvements will be maintained on all allotments. Maintenance, typically conducted by the permittee, will consist of replacing or repairing pipelines, pumps, storage tanks, fencelines, refurbishing or redrilling wells, and excavating silted-in tanks. Fencelines, pipelines, and above-ground storage tanks will be inspected annually and repaired and replaced as necessary. Maintenance of pumps will occur approximately every two years and will range from servicing motors to redrilling new wells. Dirt tanks will be excavated approximately every 10 years with heavy equipment. Additionally, several roads on the Cameron, Why, and Coyote Flat allotments require periodic maintenance.

Between June and August of 2000, 18 miles of fencing between the Cameron, Why, and Coyote Flat allotments were modified to allow passage of pronghorn by replacing the bottom strand of barbed wire with a strand of smooth wire, 18 inches above ground level (M. Taylor, BLM, *in litt*. 2000). Fencing on the boundaries of Organ Pipe Cactus NM and Cabeza Prieta NWR have also been modified to allow passage of pronghorn. Fencing on the Sentinel Allotment still consists of four-strands of barbed wire. The 1997 biological opinion required that the bottom strand of barbed wire be replaced by a smooth strand. However, this requirement carried no time limit and only stipulated that the replacement is to occur during regular fence maintenance and repair. Because the allotment was in non-use from 1995 through 2001, regular maintenance has not occurred.

Proposed Conservation Measures

The following measures have been or will be implemented as part of the proposed action to minimize adverse affects to the pygmy-owl:

Major maintenance activities (i.e., cleaning dirt tanks, or any surface disturbing activities) in suitable pygmy-owl habitat will meet the following conditions:

1. Two years of pygmy-owl surveys must be conducted before any maintenance work is performed in suitable habitat, *or*

2. Major maintenance work must be conducted outside of the pygmy-owl breeding season (January 1 - June 30).

3. Fire wood will be harvested from July 1 through December 31 in Zone 5.

4. Only dead-and-down wood will be harvested.

The following measures have been or will be implemented as part of the proposed action to minimize adverse affects to the pronghorn:

The following conservation measures are proposed by BLM to significantly reduce any effects on the Sonoran pronghorn of the BLM's proposed action on the Ajo Allotments. These conservation measures would apply as appropriate to the portions of the Cameron, Why, Coyote Flat, and Childs allotments west of State Route 85.

Reduction of Forage Competition and Degradation of Pronghorn Habitat

1. BLM will only authorize ephemeral grazing on the Cameron, Coyote Flats, Childs, and Why allotments in accordance with ephemeral use criteria in their Arizona Rangelands Standards and Guidelines and if both of the following conditions are met:

1. In years where ephemeral plant production is geographically limited, ephemeral forage on the Ajo allotments is not an important part of ephemeral forage available to pronghorn, either in terms of forage quality or acreage of greenup.

2. The U.S. pronghorn population must be above 100 and increasing.

Prior to authorizing ephemeral grazing, the BLM will work with FWS and the Arizona Game and Fish Department in evaluating the above conditions. Furthermore, BLM will reconsider the allowance of ephemeral grazing in a revision to its Resource Management Plan.

2. BLM will implement a forage enhancement project on the Cameron Allotment (in coordination with the permittee), starting in Fiscal Year (FY) 2004, although BLM will apply for any additional funding that might become available in FY 2003. BLM will apply water to a roadside area (or other accessible area) using a tank truck, sprinklers, or other methods in order to promote annual plant growth during drought years and to enhance and prolong growth during wetter years. Forage enhancement will not be conducted along the Ajo Loop Road (aka Darby Wells Road) or other roads where pronghorn could be hit by passing vehicles.

The forage enhancement plot would be located as close to Organ Pipe Cactus National Monument as practicable. If water is not available at the Bandeja Well, BLM will otherwise acquire the necessary water.

The forage plot will not be fenced, and will be situated in the southern part of the Cameron Allotment and enhanced through the growing season, even after May 1 when cattle are moved to the northern part of the allotment (May 1 to September 15), leaving the forage for the pronghorn.

3. BLM will develop a "drought policy for the 5 allotments to more consistently guide authorization of grazing use in Sonoran pronghorn range when drought situations occur. This will be both a short- and a long-term measure. In the short-term, it would determine how to assess the end of the current drought and thus determine when or under what conditions livestock would be authorized to return to the Ajo grazing allotments and to the Sentinel Allotment. In the long-term, it would establish a clearer policy on when or under what conditions BLM will require removal or reduction of livestock due to future onsets of drought, and when to allow grazing use to return to the public land following those future occurrences.

4. BLM will install ground-level drinking troughs for use by pronghorn, outside of the corrals, on 3 livestock wells in the Cameron Allotment. These troughs will not be filled in the non-summer period so that livestock would not use them or the immediate vicinity around them. Two of these wells are part of the proposed action, and the troughs could be placed only if they are approved. These 2 wells would be developed under Cooperative Agreements, which provide BLM the authority to require that wildlife water be available at specified times. The third requires the cooperation of the permittee since he owns the well. These wells **and/or** troughs that will be installed are in the southern part of the allotment where the proposed action calls for no summer grazing.

Reduction of Fences as Barriers

5. The BLM will work with Ecological Services, Cabeza Prieta National Wildlife Refuge (NWR), and Organ Pipe Cactus National Monument (NM) to install lay-down fences along 35 to 50 percent of those areas shown on Figure 2 on the southwestern boundaries of the Cameron

Allotment to allow unimpeded passage of pronghorn. These portions of the fence will be laid down, beginning on May 1 of each year, with the reinstallation process to begin no sooner than August 31 and to be completed by September 15 of each year. The BLM will ensure that all cattle have moved to the northern portion of the allotment prior to laying down the fences. BLM will prepare the site, as necessary, to allow the fence to lay down flat.

Construction of New Fence for Livestock Management

6. BLM will construct a fence to contain livestock in the northern part of the Cameron Allotment from May 1 to September 15 of each year. This fence, shown on Figure 2, will be constructed using a pronghorn-friendly design, with the bottom smooth-wire strand 20 inches above the ground. The fence will extend northeasterly from the western boundary fence in the vicinity of Valentine Well and will bluff out on the north end of Black Mountain. (Pronghorn have been observed using the area south of Black Mountain). The purpose of the fence is to: 1) reduce the overlap of livestock and Sonoran pronghorn during the summer months, and therefore reduce the potential for disease transmission; 2) prevent livestock from using the forage enhancement plots during the summer months; and 3) reduce the possibility of cattle exiting the allotment onto Cabeza Prieta NWR and Organ Pipe NM while exterior boundary fences are laid down.

Elimination of Habitat for Disease Vectors

7. Within 60 days of this BO, BLM will provide this office with full descriptions, including photographs and diagrams, of all existing livestock water sources within the allotments west of SR 85. Based on the results of the study described below, BLM will work with us to determine any necessary modifications to each water source to 1) reduce the potential of the source to provide breeding habitat for biting midges (may require restricting access to some sources through fencing or breaching dams and allowing the sources to dry); 2) provide safe access for Sonoran pronghorn; and 3) ensure that such modifications do not result in adverse effects to other listed species in the vicinity (e.g., cactus ferruginous pygmy-owls may use the more vegetated water sources). However, based on this reconnaissance, work will begin in FY 2003 on those tanks or charcos on the Cameron, Why, and Coyote Flat allotments that are no longer functioning and are not needed to support the livestock operation. These tanks or charcos will be breached or in other ways dried so that they do not create conditions conducive to biting midge propagation.

8. Within 6 months of this BO, BLM will initiate or cooperate in development of a study of the potential for disease transmission from livestock to pronghorn in the Ajo Allotments. During this same time period, BLM will seek funding to implement the study. The study will, at a minimum, determine the existence of vectors and whether or not they carry the pertinent diseases, and the potential for transmission of diseases from livestock to Sonoran pronghorn, considering shared water sources and temporal separation of livestock and Sonoran pronghorn. Based on the information resulting from this study, reevaluation of the effects of livestock grazing on Sonoran pronghorn may be necessary. If funding is not made available for this study through BLM's FY 2004 appropriation, or from other sources within that same time frame, BLM will reinitiate this consultation.

Recreation Management and Habitat Restoration

9. BLM will identify and rehabilitate, to the extent determined necessary and practicable, heavy-use recreational areas, including, but not limited to, removal of unauthorized structures or developments. BLM will continue to enforce the 2-week camping limit rule. BLM will direct

camping use to the Gunsite Wash area, and demarcate the boundaries of the Gunsite Wash area to prevent expansion of the area of use.

10. BLM will implement a seasonal (March 15 - July 15) emergency closure of roads, trails, and camping areas to the general public; such closures will be carried over as a proposed action in the upcoming land use planning process. The closure dates and seasons will be consistent with similar closures on Organ Pipe Cactus NM, Cabeza Prieta NWR, and the Barry M. Goldwater Range. The closure will be effective west of SR 85 and south of, but will not include closures of, the Darby Well/Scenic Loop Road and the road to Chico Shunie, or as otherwise determined appropriate in coordination with Cabeza Prieta NWR. The closure will not include the Gunsite Wash area, as demarcated in measure number 9 above.

11. BLM will initiate a route designation as part of the Land Use Plan amendment process with the purpose of limiting vehicle access to designated, signed routes only, and to reduce route densities in sensitive areas. This process is scheduled to be completed by the end of fiscal year 2004.

12. BLM will continue to support appropriate portions of the 51 priority recovery items addressed in the revised Recovery Plan. This support would be in the form of funding, staffing, or equipment, as appropriate and/or available.

Scheduling and Reporting

13. BLM will provide a prioritized schedule for implementation of the above conservation measures.

14. BLM will provide annual reports to us regarding the status and efficacy of the measures outlined above. Reports will be sent to this office by February 1 of each year, beginning in 2003.

SONORAN PRONGHORN (*Antilocapra americana sonoriensis*)

STATUS OF THE SPECIES

A. Description, Legal Status, and Recovery Planning

The Sonoran subspecies of pronghorn (*Antilocapra americana sonoriensis*) was first described by Goldman (1945) from a type specimen taken near the Costa Rica Ranch, Sonora, Mexico by Vernon Bailey and Frederic Winthrop on December 11, 1932, and is currently recognized as one of five subspecies of pronghorn (Nowak and Paradiso 1983). The Sonoran pronghorn is the smallest subspecies of *Antilocapra americana*. The subspecies was listed throughout its range as endangered on March 11, 1967 (32 FR 4001) under the Endangered Species Preservation Act of October 15, 1966. Three sub-populations of the Sonoran pronghorn are extant (1) U.S. sub-population in southwestern Arizona, (2) a sub-population in the Pinacate Region of northwestern Sonora, and (3) a sub-population on the Gulf of California west and south of Caborca, Sonora. The three sub- populations are geographically isolated due to barriers such as roads and fences, and in the case of the two Sonora sub-populations, by distance. Critical habitat has not been designated for the pronghorn.

The 1982 Sonoran Pronghorn Recovery Plan (FWS 1982) was revised in 1998 (FWS 1998a). The recovery criteria presented in the revised plan entailed the establishment of a population of 300 adult pronghorn in one self-sustaining population for a minimum of five years, as well as the

establishment of at least one other self-sustaining population in the U.S. to reclassify the subspecies to threatened.

Actions identified as necessary to achieve these goals include the following: (1) enhance present sub-populations of pronghorn by providing supplemental forage and/or water; (2) determine habitat needs and protect present range; (3) investigate and address potential barriers to expansion of presently used range and investigate, evaluate, and prioritize present and potential future reintroduction sites within historic range; (4) establish and monitor a new, separate herd(s) to guard against catastrophes decimating the core population, and investigate captive breeding; (5) continue monitoring sub-populations and maintain a protocol for a repeatable and comparable survey technique; and (6) examine additional specimen evidence available to assist in verification of taxonomic status.

In February 2001, the D.C. Federal District Court ordered FWS to reassess Sonoran pronghorn recovery criteria and to provide estimates of time required to perform recovery actions detailed in the 1998 plan. In response, a supplement and amendment to the 1998 Final Revised Sonoran Pronghorn Recovery Plan was prepared (FWS 2001). We concluded that given the nature of the current threats, unknown elements of pronghorn life history and habitat requirements, uncertainty of availability of suitable reintroduction sites and animals for transplants, internal and external resistance to pro-active management actions on wilderness and other areas of public lands, and continuing uncertainty regarding the long-term stability and status of sub-populations in Mexico, the data do not yet exist to support establishing delisting criteria. Tasks necessary to accomplish reclassification to threatened status (as outlined in the 1998 plan) should provide the information necessary to determine if and when delisting will be possible and what the criteria should be.

B. Life History

Sonoran pronghorn inhabit one of the hottest and driest portions of the Sonoran Desert. They forage on a large variety of perennial and annual plant species (Hughes and Smith 1990, Hervert *et al.* 1997b, FWS 1998a), and will move in response to forage availability (Hervert *et al.* 1997a). Although it is theoretically possible for pronghorn to meet water requirements through forage consumption (Fox *et al.* 1997), after subtracting water required for excretion, respiration, and evaporation (approximately 50 percent), predicted water intake from forage was not adequate to meet minimum water requirements for 14 of 20 simulated diets (Fox *et al.* 2000). Sonoran pronghorn will use water if it is available (FWS 1998a).

Fecal analysis indicated Sonoran pronghorn consume 69 percent forbs, 22 percent shrubs, 7 percent cacti, and 0.4 percent grasses (FWS 1998a). However, Hughes and Smith (1990) reported that cacti are the major diet component (44 percent). Consumption of cacti, especially chain fruit cholla (*Cylindropuntia fulgida) (*Pinkava 1999), provides a source of water during hot, dry conditions (Hervert *et al.* 1997b). Other important plant species in the diet of the pronghorn include pigweed (*Amaranthus palmeri*), ragweed (*Ambrosia* sp.), locoweed (*Astragalus* sp.), brome (*Bromus* sp.), and snakeweed (*Gutierrezia sarothrae*) (FWS 1998a).

Sonoran pronghorn rut during July-September, and does have been observed with newborn fawns from February through May. Parturition corresponds with annual spring forage abundance. Fawning areas have been documented in the Mohawk Dunes and the bajadas of the Sierra Pinta, Mohawk, Bates, Growler, and Puerto Blanco mountains. Does usually have twins, and fawns suckle for about 2 months. Does gather with fawns, and fawns sometimes form nursery groups (FWS 1998a). Hughes and Smith (1990) recorded an average group size of 2.5 animals; however, group size observed by Wright and deVos (1986) averaged 5.1, with the largest group containing 21 animals.

The results of telemetry studies in 1983-1991 indicated that Sonoran pronghorns nonrandomly use their habitats (deVos 1998). Pronghorn move from north to south or northwest to southeast, and upslope as summer progresses. Movements are most likely motivated by the need for thermal cover provided by leguminous trees and water available in succulent cacti such as chain fruit cholla (Hervert *et al.* 1997b), that are more abundant on bajadas and in the southern portion of the pronghom's range. Home range size of Sonoran pronghorn ranged from 24.9 to 468 mi^2 for males and from 15.7 to 441 mi^2 for females (Wright and deVos 1986).

Causes of pronghorn mortality are often difficult to determine; however, some telemetered Sonoran pronghorn have been killed by coyotes, mountain lions, and bobcats. Some of these mortalities may have been influenced by dry periods, which predisposed pronghorn to predation (FWS 1998a). Of 580 coyote scat examined on the Cabeza Prieta NWR, 5 contained pronghorn remains (Simmons 1969), but some or all of these remains may have resulted from scavenging carcasses. Hervert *et al.* (2000) found that the number of fawns surviving until the first summer rains was significantly correlated to the amount of preceding winter rainfall, and negatively correlated to the number of days without rain between the last winter rain and the first summer rain. Two telemetered pronghorn died in July of 2002 with no obvious cause of death; given that pre-monsoon summer conditions were some of the driest on record, these mortalities were likely due to water loss/heat stress or starvation (J. Hervert, AGFD, pers. comm. 2002).

C. Habitat

Turner and Brown (1982) discussed seven subdivisions of Sonoran Desert scrub, two of which encompass the habitat of Sonoran pronghorn in the U.S. and the Pinacate Region of Sonora (Felger 2000). These are the Lower Colorado River Valley and the Arizona Upland subdivisions. Creosote (*Larrea tridentata*) and white bursage (*Ambrosia dumosa*) are dominant perennials of the Lower Colorado River Valley subdivision. Plant species along major water courses include ironwood (*Olneya tesota*), blue palo verde (*Parkinsonia floridum*), and mesquite (*Prosopis velutina* and *P. glandulosa*). Species in the Arizona Upland include foothill palo verde (*Parkinsonia microphyllum*), catclaw acacia (*Acacia greggii*), chain fruit cholla, teddy bear cholla (*Cylindropuntia bigelovii*), buckhorn cholla (*C. acanthocarpa*), and staghorn cholla (*C. versicolor*).

The habitat of the pronghorn in the U.S. consists of broad alluvial valleys separated by block-faulted mountain and surface volcanics. In December 1984, 40 percent of the pronghorn observed during a telemetry flight were in the Growler Valley, from the Aguila Mountains to the International Border. AGFD (1985) reported that pronghorn use flat valleys and isolated hills to a greater degree than other topographic features.

Drainages and bajadas are used by pronghorn during spring and summer. Washes flow briefly after rains during the monsoon season and after sustained winter rains. The network created by these washes provides important thermal cover (shade) for pronghorn during the hot summer season. Bajadas are used as fawning areas in the spring. Pronghorn were observed using palo verde, ironwood, and mesquite for cover during weekly AGFD telemetry flights, which began in 1994 (Hervert *et al.* 1997b). Pronghorn were observed in playas in April and May of 1988 and 1989 when forbs were abundant, later vacating these areas when desiccation of annuals occurred (Hughes and Smith 1990). In years with sufficient winter and spring precipitation, some playas produce abundant annual plant growth.

Some of the sandy areas within pronghorn habitat such as Pinta Sands, the Mohawk Dunes west of the Mohawk Mountains, and the west side of the Aguila Mountains, provide a greater variety of seasonal vegetation when precipitation events occur. The openness of these areas appears to

be attractive for pronghorn as the annuals, grasses, and shrubs provide good forage, particularly in the spring. These areas have long been considered significant pronghorn habitat in the U.S. Carr (1974) reported seeing pronghorn frequently in the Pinta Sands area. Due to the more arid nature of valley and dune habitats, annuals dry and cure, with decreased palatability for pronghorns as summer approaches. Also, these habitats lack sufficient woody vegetation to satisfy pronghorn requirements for nutrition and thermal protection. These factors limit the temporal suitability of these areas and most pronghorn move to bajadas and washes in the southeastern portion of the range by early summer.

D. Distribution and Abundance

United States

Prior to the identification of the subspecies known as the Sonoran pronghorn (Goldman 1945), specimens of pronghorn taken within its range were identified as other subspecies (AGFD 1981). Historically, the Sonoran pronghorn ranged in the U.S. from Arizona's Highway 15 to the east; the Altar Valley and the Tohono O'odham Nation (formerly known as the Papago Indian Reservation) to the north; and Imperial Valley, California, to the west (Nelson 1925, Monson 1968, Wright and deVos 1986, Paradiso and Nowak 1971) (Figure 3).

During an international boundary survey conducted from 1892 through 1894, pronghorn were found in every open valley along the international boundary from Nogales, Mexico to Yuma, Arizona (Carr 1971). In 1893, Mearns (1907) reported seeing a herd of 12 pronghorn near border monument 143 in the Baboquivari Valley and small numbers in the Santa Rosa Valley near monument 161 on what is now the Tohono O'odham Nation. Nelson (1925) stated that in 1923, local people reported that a few pronghorn were still ranging in the Santa Rosa Valley. Carr (1970) noted the "sighting of eight antelope near Pisinimo on the Papago Indian Reservation which most likely drifted north from Mexico, and that "there have been numerous rumors of antelope in the Papago country ; however, no recent reliable observations are known. Carr (1970) also stated that there "is a considerable amount of good Sonoran antelope habitat on the Papago Indian Reservation and particularly in the Great Plains area. However, Indian hunting and grazing practices prohibit a lasting resident antelope population. In 1894, pronghorn were abundant near monuments 178 and 179, and westward to Tule Well (Mearns 1907). In February 1894, Mearns observed them in the Lechuguilla Desert, as well. In the Colorado Desert (presumably west of the Gila and Tinajas Altas mountains), Mearns (1907) reported that pronghorn were not abundant. He observed pronghorn tracks in California at Gardner's Laguna, 6 miles south of monument 216, and 37 miles west of the Colorado River; and then again at Laguna Station, 7 miles north of monument 224 and 65 miles west of the Colorado River.

While Mearns (1907) suggested that pronghorn may have been common in some areas in the late 1800s, evidence suggests that the sub-population declined dramatically in the early 20th century. Sub-population estimates for Arizona, which began in 1925, have never shown the pronghorn to be abundant (Table 2).

Repeatable, systematic surveys were not conducted in Arizona until 1992. Since 1992, Sonoran pronghorn in the United States have been surveyed biennially (Bright *et al.* 1999, 2001) using aerial line transects (Johnson *et al.* 1991). Sub-population estimates from these transects have been derived using three different estimators (Table 3); currently the sightability model (Samuel and Pollock 1981) is considered the most reliable estimator (Bright *et al.* 1999, 2001). Table 3 presents observation data from transects and compares estimates derived from the three population models from 1992 through 2000.

Occasional sightings of pronghorn are recorded outside of the range defined by telemetry locations in Figure 4. For instance, a possible pronghorn sighting occurred east of Aztec and north of Interstate 8 in 1990 (FWS 1998a). Two adult pronghorn were observed in 1990 (FWS 1998a) in the northern San Cristobal Valley approximately 5 miles southeast of Mohawk Pass in the Mohawk Mountains. In 1987, a Border Patrol agent reported a pronghorn on the Tohono O'odham Nation; this sighting was not confirmed.

Bright *et al.* (2001) defined the present U.S. range of the Sonoran pronghorn as bordered by Interstate 8 to the north, the International Border to the south, the Copper and Cabeza Mountains to the west, and SR 85 to the east. This area encompasses 2,508 mi^2 (Bright *et al.* 2001). Based on pronghorn location records from 1994-2001 (Figure 4), locations of pronghorn from 1983-1995, and observations by Carr (1972) and Hall (1981), pronghorn are believed to occur most frequently in the following areas: Pinta Sands, Growler Valley, Mohawk Valley, San Cristobal Valley, and between the Growler and Little Ajo Mountains (Daniel's Arroyo area). Wright and deVos (1986) stated that observations in the Growler Valley were frequent and that the Mohawk Valley, San Cristobal Valley, and BMGR support herds of 10 to 20 animals during most of the year. Also mentioned was a regularly observed herd of 7 to10 pronghorn in the Cameron tank area on BLM lands near Ajo.

Although observations of pronghorn were common along and east of SR 85 many years ago, observations east of SR 85 in recent years have been essentially nonexistent. The paucity of recent observations east of the highway indicates that this heavily-used road currently poses a barrier to eastward movement. On June 12, 1996, however, an adult doe pronghorn was observed running west off the right-of-way at the approach of a vehicle on the north end of the Crater Range (R. Barry, Luke AFB, pers. comm. 1996). There also exists an unconfirmed report of four Sonoran pronghorn attempting to cross SR 85 in August 1993 approximately 1 mile north of the Organ Pipe Cactus NM visitor center. A juvenile crossed the highway (two lanes) to the east, but with the approach of a vehicle, ran back across the road to rejoin a group of three pronghorn (T. Ramon, Organ Pipe Cactus NM, pers. comm. 1993). In July 2002, a radio-collared pronghorn crossed SR 85 and continued on to the base of the Ajo Mountains where it resided until its death in August 2002. This aberrant movement pattern may be the result of nutritional stress brought on by the current drought.

In recent years, the Tohono O'odham Nation has not been accessible to state and Federal biologists to survey for Sonoran pronghorn. A Border Patrol agent reported a pronghorn on the Nation lands in 1987 (FWS 1998a), and although unconfirmed, this is the last report of Sonoran pronghorn on the Nation. There are no recent records of pronghorn south of the Nation in Sonora. Carr (1970) reported that hunting and grazing on the Nation was not compatible with maintaining a viable population of pronghorn. Phelps (1981) reported that pronghorn had not been observed on the Nation for 10 years. These observations suggest that pronghorn are likely extirpated from the Nation and adjacent areas.

The sightability model population estimates from 1992 to 2000 showed a 45 percent decrease in sub-population size (Table 3). The estimates indicate a steady decline in sub-population size, with the exception of the 1994 survey. The 1994 estimate may be somewhat inflated due to inconsistencies in survey timing (FWS 1998a, Bright *et al.* 2001). The 1994 survey occurred in March (whereas those of other years occurred in December) and therefore the number may be slightly inflated because of the sightability of pronghorn at this time of year (J. Morgart, FWS, pers. comm. 2001). Different population models may result in divergent estimates. Therefore, the inclusion of estimates obtained prior to 1992 in the analysis of population trends is not reasonable.

Some researchers believe that the number of pronghorn observed on transects is more statistically valid for the evaluation of population trends than estimates generated by population models (Johnson *et al.* 1991, Hervert *et al.* 1997a). The number of pronghorn observed on transects decreased by 32 percent from 1992 to 2000 (Table 3). Contrary to the sightability model estimate, the number of pronghorn observed on transects showed only a minor increase, while the total number of pronghorn sighted actually decreased in 1994 compared to the 1992 survey. High fawn mortality in 1995 and 1996 and the death of half (8 of 16) of the adult, radio-collared pronghorn during the 13 months preceding the December 1996 survey suggests that the decline was real. Five consecutive six-month seasons of below normal precipitation (summer 1994 through summer 1996) throughout most of the Sonoran pronghorn range, likely contributed, in part, to observed mortality (Bright *et al.* 2001, Hervert *et al.* 1997b).

The winter of 2001-2002 brought little or no rain to southwestern Arizona, and virtually no green up occurred (a slight green up occurred in the northern Mohawk Valley). This year's drought has profoundly affected adult pronghorn, resulting in the highest adult mortality rate documented thus far. Since 1995 adult mortality has averaged 22 percent a year. Yearly mortality rates have fluctuated around this mean in direct relationship with precipitation. In 1997 and 1999, years with relatively good rainfall, there was only 12 and 10 percent adult mortality, respectively. In contrast, during 1996, a relatively severe drought year, a 38 percent adult mortality was documented. This year (2002), 5 of 7 collared pronghorn have been lost. Extrapolating to the U.S. population as a whole, the adult population is likely 25-50 animals. Also, very few fawns survived in 2002 (J. Morgart, pers. comm. 2002). Compounding the problem, the 2002 summer monsoon season in the pronghorn range was spotty and late in coming, although rains in September resulted in a significant green up.

In 1996, a workshop was held in which a population viability analysis (PVA) was conducted for the U.S. sub-population of Sonoran pronghorn (Defenders of Wildlife 1998). A PVA is a structured, systematic, and comprehensive examination of the interacting factors that place a population or species at risk (Gilpin and Soulé 1986). For the Sonoran pronghorn PVA, these factors included impacts of inbreeding, fecundity, fawn survival, adult survival, impacts of catastrophes, harvest, carrying capacity, and numbers and sex/age composition of the present population. Based on the best estimates of demographic parameters at the time, the likelihood of extinction of Sonoran pronghorn was calculated as 1 percent in the next 25 years, 9 percent in the next 50 years, and 23 percent in the next 100 years. More severe threats include population fluctuation, periodic decimation during drought (especially of fawns), small present population size, limited habitat preventing expansion to a more secure population size, and expected future inbreeding depression.

Furthermore the PVA suggested that the current pronghorn population is extremely sensitive to fawn mortality, with the likelihood of extinction increasing markedly when fawn mortality exceeds 70 percent. Thus, a 30 percent fawn crop (30 fawns/100 does) each year is necessary to ensure the continuance of the population. This level of reproductive success has only been achieved in two of the last nine years. Fawn survival is correlated with precipitation (Hervert *et al.* 1997). With above average precipitation in 1998, 33 fawns per 100 does were produced (Bright *et al.* 2001). In 2001, precipitation levels in the pronghorn range were the highest seen in many years. Pronghorn numbers increased from 99 in December 2000 to approximately 140 individuals in December 2001 (based on an estimated increase of 50 individuals by recruitment, minus an estimated adult mortality rate of 11 percent). However, with the severe drought in 2002, all the gains from the previous year have likely been lost, and the biologists working on the species for FWS and AGFD are concerned that the December 2002 aerial counts will show a dramatic decline. Although an estimated 50 fawns were recruited into the population in 2001, it is unknown how well these young and still-maturing animals have handled the severe drought

conditions. This year's (2002) fawn crop, based on surveys, is estimated to be a maximum of 5 individuals and may be as few as one (J. Morgart, pers. comm. 2002).

The Sonoran pronghorn's previously poor status, coupled with the impacts from this year's drought on both recruitment and adult survival, have resulted in the serious imperilment of the U.S. sub-population. Actions taken by Federal and state agencies in the immediate future will determine whether the Sonoran pronghorn will continue to survive in the United States.

Mexico

Historically, Sonoran pronghorn ranged in Sonora from the Arizona border south to Hermosillo and Kino Bay, west to at least the Sierra del Rosario, and east to the area south of the Baboquivari Valley on the Tohono O'odham Nation (Nelson 1925, Carr 1974, Monson 1968). The distribution in Baja California Norte is less clear, but observations by Mearns (1907) indicate they occurred in the Colorado Desert west of the Colorado River, as well. Sonoran pronghorn are currently extant in two sub-populations in Mexico, including 1) west of Highway 8 near the Pinacate Lava flow, and 2) south and west of Caborca. In 2001, a park ranger at Pozo Nuevo, El Pinacate y Gran Desierto de Altar Biosphere Reserve (El Pinacate), reported that pronghorn have been seen in recent years west of Volcan Pinacate to the Pozo Nuevo area, and reportedly use a cement cattle trough north of Pozo Nuevo (J. Rorabaugh, pers. comm. 2001).

Sub-populations of Sonoran pronghorn in Mexico had not been exhaustively surveyed until all suitable habitat within the current known range of the Sonoran pronghorn in Mexico was surveyed in December 2000 (Bright *et al.* 2001). Although the 1993 estimate was approximate, survey results suggested a decline in the sub-populations of 16 percent from 1993 to 2000 (Table 4). The December 2000 estimate was 346 individuals. This estimate, together with the 2001 U.S. estimate, provides a total estimated size of the U.S. and Mexico Sonoran pronghorn populations in 2000-2001 of approximately 445 individuals (J.L. Bright *et al.*, AGFD, unpubl. data). Although the extent to which the Mexico sub-populations have declined in response to the current year's drought is unknown, the total number of pronghorn in all three sub-populations is now undoubtedly smaller than the 2000 estimate.

Although the Sonoran pronghorn sub-population in Mexico declined approximately 16 percent from 1993 to 2000, the decrease was not experienced equally across pronghorn range. Sonoran pronghorn habitat in Mexico is bisected by Highway 8. The sub-population southeast of Highway 8 remained stable or even increased slightly between 1993 and 2000 (Table 5). Forage conditions in 2000 were notably better in this area than the rest of Sonoran pronghorn range in Mexico and the U.S. (J. L. Bright *et al.*, AGFD, unpubl. data). The sub-population west of Highway 8 ranges throughout suitable habitat on and surrounding Volcan Pinacate, and is adjacent to the U.S. sub-population. Mexico Highway 2 (and to a lesser extent the international boundary fence) acts as a barrier to movement between El Pinacate and U.S. sub-populations. The El Pinacate sub-population declined by approximately 73 percent between 1993 and 2000 (Table 5). Dry periods and associated poor forage conditions, likely exacerbated by extensive livestock grazing, may have figured prominently in the significant decline observed in the El Pinacate sub-population. If loss of pronghorn during the recent drought has occurred at a similar magnitude to that observed in the U.S. population, the El Pinacate population may be at less than 20 and is probably no longer viable (see *"Small Population Size and Aging Demographics* , page 19). Loss of the El Pinacate sub-population would result in further fragmentation and isolation of the remaining pronghorn sub-populations in the U.S. and Mexico. Portions of Highway 8 are not fenced. Pronghorn moving across Highway 8 to the southeast may also be an explanation for the changes in these sub-populations' sizes. Between 1993 and 2001, Highway 8 was widened

and improved, increasing traffic and probably increasing its effectiveness as a barrier to pronghorn movement.

E. Threats

Barriers that Limit Distribution and Movement

Sonoran pronghorn require vast areas of unencumbered open range to meet their annual needs for survival and reproduction. This includes the ability to freely travel long distances between localized, seasonally sporadic rainfall events in search of forage. Highways, fences, railroads, developed areas, and irrigation canals can block these essential movements. Highway 2 in Mexico runs parallel to the southern boundary of Cabeza Prieta NWR and divides the range of the pronghorn between the U.S. and El Pinacate sub-populations. This highway supports a considerable amount of fast-moving vehicular traffic, and is fenced along its length, so is likely a substantial barrier to Sonoran pronghorn. In 1999, Dr. Rodrigo Medellin of Instituto de Ecologia reported that Sonora, Mexico is planning to widen and improve Highway 2 to four lanes, which would further reduce the likelihood of pronghorn crossing the highway.

Both Cabeza Prieta NWR and Organ Pipe Cactus NM maintain boundary fences along the border. At the southern boundary of Cabeza Prieta NWR, a seven-strand livestock fence continues to be a substantial barrier to pronghorn. Modifying the fences along the U.S./Mexico border to allow pronghorn passage could aid in maintaining genetic diversity if sufficient pronghorn movement occurred. It may, however, also lead to increased pronghorn fatalities from motorized traffic on Highway 2. Mexico has been involved in discussions regarding the fences, as any modifications could potentially affect pronghorn sub-populations in both countries. Sonoran pronghorn habitat in Mexico is also bisected by Highway 8 between Sonoyta and Puerto Peñasco. This highway is bordered by a livestock fence and receives considerable tourist traffic. A less-traveled highway runs from Puerto Peñasco to Caborca.

Between Gila Bend and Lukeville, Arizona, SR 85 appears to be a significant barrier to pronghorn dispersal eastward from their current range. Traffic volume and average speeds have increased substantially over the last 30 years as international trade and tourism have increased. The Arizona Department of Transportation increased the posted speed limit on SR 85 from 55 to 65 miles per hour (mph) in 1997, and 85th percentile traffic speed has increased from 68-71 mph in the same period (Organ Pipe Cactus NM 2001). This highway corridor is unfenced in Organ Pipe Cactus NM, allowing potential free movement of pronghorn and other wildlife, but has livestock fencing on both sides for most of the remaining mileage on BLM, Department of Defense (DoD), and private lands between Interstate 8 and Organ Pipe Cactus NM. Interstate 8, the Wellton-Mohawk Canal, agriculture, a railroad, and associated fences and human disturbance near the Gila River act as barriers for northward movement of pronghorn. De-watering of much of the Sonoyta River and barriers to pronghorn accessing the Gila River, such as Interstate 8 and the Wellton-Mohawk Canal, have caused significant loss of habitat and loss of access to water (Wright and deVos 1986). Agricultural, urban, and commercial development at Sonoyta, Puerto Penasco, and San Luis, Sonora, in the Mexicali Valley, Baja California Norte, and at Ajo, Yuma, and along the Gila River, Arizona, have removed habitat and created barriers to movement. BLM grazing allotment fences in the Ajo area may have been a barrier to movement, but were modified after 1997 to allow safe passage of pronghorn (BLM, *in litt.* 2000). Fences between BLM lands and Organ Pipe Cactus NM and Cabeza Prieta NWR are also designed to allow passage of pronghorn. Although fences can be designed to encourage safe passage, pronghorn are less likely to move across a fence line of any design than through an area without fences (J. Morgart, pers. comm. 2002).

Historically, pronghorn occurred in the Lechuguilla Desert and in low numbers in the Colorado Desert to the west of the Gila and Tinajas Altas mountains (Mearns 1907). No apparent barrier to movement from their current range to the Lechuguilla Desert exists. Interstate 8, Mexico Highway 2, and the Gila and Tinajas Altas mountains form a substantial barrier to movement between the Lechuguilla Desert and the Yuma Desert; however, pronghorn could potentially use Tinajas Altas pass as a corridor through the mountains.

Human-caused Disturbance

A variety of human activities occur throughout the range of the pronghorn that have the potential to disturb pronghorn or its habitat, including livestock grazing in the U.S. and Mexico; military activities; recreation; poaching and hunting; clearing of desert scrub and planting of bufflegrass in Sonora; dewatering and development along the Gila River and Rio Sonoyta; increasing undocumented immigration and drug trafficking along the international border and associated law enforcement response; and roads, fences, canals, and other artificial barriers.

Studies of captive pronghorn, other than the Sonoran subspecies, have shown that they are sensitive to disturbance such as human presence and vehicular noise. Human traffic, such as a person walking or running past pronghorn in an enclosed pen, a motorcycle driving past, a truck driving past, a truck blowing its horn while driving past, or a person entering a holding pen, caused an increased heart-rate response in American pronghorn in half-acre holding pens (Workman *et al.* 1992). The highest heart rates occurred in female pronghorn in response to a person entering a holding pen, or a truck driving past while sounding the horn. The lowest heart rates occurred when a motorcycle or truck was driven past their pen. Other investigators have shown that heart rate increases in response to auditory or visual disturbance in the absence of overt behavioral changes (Thompson *et al.* 1968, Cherkovich and Tatoyan 1973, Moen *et al.* 1978).

A pronghorn can canter effortlessly at 25 mph, gallop without straining at 44 mph, and run flat out at speeds of 55-62 mph (Byers 1997). During an aerial reconnaissance, one herd of Sonoran pronghorn was observed 12 miles away from the initial observation location 1.5 hours later (Wright and deVos 1986). Hughes and Smith (1990) found that pronghorn immediately ran 1,310-1,650 feet from a vehicle and that military low-level flights (<500 feet AGL) over three pronghorn caused them to move about 330 feet from their original location. Krausman *et al.* (2001) examined effects of ground-based and aircraft military activities on Sonoran pronghorn at the North and South tactical ranges (TACs) at the BMGR and concluded that behavioral patterns were similar with and without presence of military stimuli. Military activities, both ground-based and aerial, were associated with some changes in behavior (e.g., from standing to trotting or running, or bedded to standing) but the authors concluded that these changes were not likely to be detrimental to the animals. Eighty-seven (4.1 percent) of the 2,128 events with ground-based stimuli resulted in pronghorn changing their behavior to trotting or running; a total of 866 (41 percent) resulted in some change in behavior. Krausman *et al*. (2001) documented 149 direct overflights and 263 other overflights (in which the aircraft passed ≥328 feet to the side of the animal). Pronghorn changed their behavior 39 and 35 percent of the time during direct and other overflights, respectively. Unfortunately, we can not discern from Krausman *et al*. (2001) how pronghorn responded to low-level helicopter flights. A study is being developed to quantify effects of helicopter flights by the Border Patrol on Sonoran pronghorn. No conclusions could be drawn about effects to fawns due to poor fawn productivity during the Krauseman *et al.* study. During times of drought, disturbances that cause pronghorns to startle and run would energetically have a more significant effect. Such energetic expenditures, particularly during times of stress, may lead to lower reproductive output and/or survival of individual animals (Geist 1971).

Habitat Disturbance

Livestock grazing has the potential to significantly alter pronghorn habitat and behavior (Leftwich and Simpson 1978, Kindschy *et al.* 1982, Yoakum *et al.* 1996). This is especially true in the arid Sonoran Desert. Cattle and other domestic livestock were first brought to northwestern Sonora, Mexico, in 1694 (Wildeman and Brock 2000). Overgrazing well into the 19th century by Spaniards and their descendants caused widespread habitat changes throughout much of the Sonoran Desert, particularly in more settled areas such as central Sonora, Mexico (Sheridan 2000).

American ranchers were running livestock by the early 1900s in much of the area that would later become Organ Pipe Cactus NM (Rutman 1997) and Cabeza Prieta NWR (Cabeza Prieta NWR files). Because there was no international boundary fence until 1947, livestock from both the U.S. and Mexico ranged freely across the border (Rutman 1997). Rutman (1997) estimates 1,000 head of burros and horses were present in 1942 on the southern half of Organ Pipe Cactus NM, and as many as 3,000 cattle on Organ Pipe Cactus NM at one time. Cattle were removed from Organ Pipe Cactus NM, Cabeza Prieta NWR, and the BMGR in 1979, 1983, and 1986, respectively (FWS 1998a, Rutman 1997). Grazing continues to be an important use of former pronghorn habitat on the Tohono O'odham Nation. Wright and deVos (1986) stated that poor habitat conditions (caused in part by livestock grazing) still appeared to be the leading cause in the decline in Sonoran pronghorn numbers. In Sonora, livestock grazing occurs in ejidos (community ranches or farms) and other ranch lands throughout much of the range of the pronghorn. Cattle range farther in years with abundant annual growth, and are more limited to areas near water during hot and dry periods and seasons.

Mining occurred historically throughout much of the U.S. range of the pronghorn. Miners probably hunted pronghorn and disturbed habitat locally. Mining is currently not a significant threat to Sonoran pronghorn. No mining occurs now on the BMGR, Cabeza Prieta NWR, or Organ Pipe Cactus NM. The open pit and associated tailings piles at the Phelps Dodge copper mine at Ajo eliminated habitat in that area (MCAS-Yuma 2001, Organ Pipe Cactus NM 2001), but is no longer in operation.

Illegal crossings by undocumented immigrants and drug smugglers in the U.S. range of the pronghorn has increased dramatically in recent years. Deportable migrant apprehensions by Border Patrol agents in the Ajo Station increased steadily from 9,150 in 1996 to 20,340 in 2000 (U.S. Immigration and Naturalization Service 2001). In 2001, estimates of undocumented migrants traffic reached 1,000 per night in Organ Pipe Cactus NM alone (Organ Pipe Cactus NM 2001) and an estimated 150,000 people entered the monument illegally from Mexico (Milstead 2002). Illegal border-related activities and Border Patrol response have resulted in widespread habitat degradation and increased human presence in remote areas. Increased presence of Border Patrol in the Douglas, Arizona area, and in San Diego (Operation Gatekeeper) and southeastern California, have pushed undocumented migrant traffic into remote desert areas, such as Cabeza Prieta NWR, Organ Pipe Cactus NM, and the BMGR (Klein 2000).

Small Population Size and Aging Demographics

A possible minimum viable population for pronghorn is 50 animals (Reed *et al.* 1986, Scott 1990). At populations of less than 100, population viability declines at an increasingly steep rate. To maintain genetic diversity, a population of at least 500 is desirable (Defenders of Wildlife 1998). The U.S. sub-population is likely below 50 after this year's drought. At an estimated 34 in 2000, combined with likely recent declines, the El Pinacate sub-population is probably well below the possible minimum viable population. Thus, 2 of the 3 pronghorn populations are

seriously endangered. Loss of the U.S. population would dramatically reduce our ability to manage or recover this subspecies. Populations at low levels may experience random variations in sex ratios, age distributions, and birth and death rates among individuals, which can cause fluctuations in population size and possibly extinction (Richter-Dyn and Goel 1972). The sex ratio as of December 2000 was skewed in favor of females (male:female ratio of 63:100 [Bright *et al.* 2001]), which is advantageous in regard to reproductive potential. However, a scenario in which males outnumber females by a similar margin is just as likely. In very sparse populations, males may have trouble finding females, reducing productivity (Ehrlich and Roughgarden 1987). Small populations are also sensitive to variations in natural processes, such as drought and predation (Hecht and Nickerson 1999).

Of additional concern is the age of individual pronghorns in the U.S. sub-population. Because of limited recruitment over the last seven years, in 2000 an estimated 56 percent of the sub-population was more than six years of age. We do not know the current age distribution of the population, but if similar to that of 2000, we can expect the majority of the current adult population to die in the next year or two because pronghorn rarely live more than nine years (Bright *et al.* 2001).

Disease

Sonoran pronghorn can potentially be infected by at least one bacterial (leptospirosis) and two viral (bluetongue and epizootic hemorrhagic disease) diseases. Bluetongue virus and epizootic hemorrhagic disease virus together produce a hemorrhagic disease syndrome. Pronghorn are susceptible to an additional two bacterial (Arcanobacterium and Fusobacterium) and four viral (parainfluenza, St. Louis encephalitis, vesicular stomatitis, and malignant catarrhal fever) diseases; blood testing has shown pronghorn exposure to these diseases by increases in antibody titers over time. A number of other viral diseases, in particular, are known to affect North American ungulates and antelope and gazelle worldwide, including but not limited to, infectious bovine rhinotracheitis, bovine viral diarrhea and bovine syncytial virus (Williams and Barker 2001, Howerth and Stallknecht, 2002). The specific names, etiologies, signs, symptoms, reservoirs/hosts/transmission modes, controls, and applicable literature for those diseases specific to pronghorn are noted in Table 7.

Animals in general are subject to increased disease susceptibility when either very young, very old and debilitated and/or stressed. The manner in which a particular disease is spread can also be a factor in disease risk. Noting Table 7, the diseases relevant to pronghorn can be transmitted indirectly through vectors, such as infected midges or ticks, or directly via aerosolized or direct contact of infected fluids or tissues. All the diseases in Table 7 are serious diseases of cattle, as well, and often lead to mortality. Cattle in the Ajo allotments have not been tested for the disease listed in Table 7.

The most serious of the diseases listed in Table 7 are the two viruses, bluetongue virus (BTV) and epizootic hemorrhagic disease virus (EHDV) which together produce hemorrhagic disease (HD) syndrome. Infected cattle can spread particularly HD via fecal contamination. Bovine feces are moist and voluminous, and at watering sources where animals congregate in large numbers, this fecal material is trampled into the soil, causing a substrate and odor that attract insects that are vectors capable of spreading the ED viruses from one animal to another nearby. Pronghorn, deer, and other wild ungulates produce drier, less voluminous, pelleted feces, which are less likely to produce moisture or odors that attract vectors, such as flies or midges.

Overcrowding at essential congregating areas, such as watering sources, particularly in times of drought is another factor that sets up an optimal situation for such disease transmission. Animals

are competing for scarce resources and, particularly in times of severe drought, are stressed and debilitated.

Control of the diseases in general can be managed in many cases by following often-used animal husbandry practices, including: 1) keeping hosts prone to infection (such as pronghorn and cattle) separated; 2) keeping vectors under control by ensuring that moist fecal material build-up at crucial areas (such as watering sources), does not occur; and, 3) keeping overcrowding, overconcentration, stressful competition and direct contact among animals to a minimum.

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all Federal, state, or private actions in the action area; the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation; and the impact of state and private actions which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform from which to assess the effects of the action now under consultation.

A. Action Area

The "action area means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. Within the U.S. portion of the Sonoran pronghorn's range, pronghorn interact to form one sub-population in which interbreeding may occur. The U.S. sub-population is effectively separated from sub-populations in the El Pinacate Region and on the Gulf Coast of Sonora by Mexico Highways 2 and 8, and the U.S.-Mexico boundary fence. Activities that may affect animals in any portion of the U.S. range of the pronghorn may affect the size or structure of the U.S. sub-population, or habitat use within the U.S. range. The action area for this biological opinion is defined as the range of the pronghorn within the U.S. (Figure 4), plus the five grazing allotments. Although this entire area is affected, at least indirectly, by the proposed action, effects of the proposed action are most evident where BLM activities occur within the five allotments. Particularly important are activities that occur within the Cameron, Why, Coyote Flat, and Childs allotments west of SR 85. It is within this area that our analysis focuses.

Management of the action area is almost entirely by Federal agencies. The largest area, the BMGR (roughly 1.6 million acres) is managed by Luke AFB and MCAS-Yuma primarily for military training. Legislation removed the BLM from natural resources management on the BMGR in November 2001; these resources are now managed by MCAS-Yuma (western portion) and Luke AFB (eastern portion) in accordance with the Sikes Act. Organ Pipe Cactus NM manages 329,000 acres in the southeastern corner of the action area for scenic, ecological, natural, and cultural values. Cabeza Prieta NWR lies along the border west of Organ Pipe Cactus NM and encompasses 860,000 acres. Cabeza Prieta NWR is managed to protect, maintain, and restore the diversity of the Sonoran Desert. The BLM manages lands near Ajo (four allotments totaling 191,740 acres) and Sentinel (one allotment totaling 21,876 acres) for multiple use in accordance with the Lower Gila Resource Management Plan.

B. Terrain, Vegetation Communities, and Climate in the Action Area

The action area is characterized by broad alluvial valleys separated by block-faulted mountains and surface volcanics. The Yuma Desert on the western edge of the BMGR is part of a broad valley that includes the Colorado River. It is bordered on the east by the Gila and Tinajas Altas

mountains. To the east of these mountains are a series of basins and ranges; from west to east these include the Lechuguilla Desert; the Cabeza Prieta and Copper Mountains; the Tule Desert and Mohawk Valley, including the Mohawk Dunes and Pinta Sand Dunes; the Sierra Pinta, Mohawk, and Bryan mountains; the San Cristobal Valley; the Aguila and Granite mountains; the Growler Valley; the Crater Range, Growler, Bates, and Agua Dulce mountains; and the La Abra Plain and Puerto Blanco Mountains west of SR 85, eastward to the base of the Ajo Mountains. Elevations range from 180 feet in the southwestern corner of the BMGR to 3,294 feet in the Growler Mountains. Major drainages and mountain ranges run northwest to southeast. The mountains are of two major types: a sierra type, composed of metamorphic and granitic rock, and a mesa type, typically of basaltic composition. Major drainages flow mostly northward to the Gila River, although southern portions of Organ Pipe Cactus NM and the southern slope of the Agua Dulce Mountains drain south to the Rio Sonoyta, Sonora.

Climate is characterized by extreme aridity, mild winters, and hot summers. Approximately 2.7 inches of precipitation fall annually at Yuma, with slightly more than half of this occurring in the winter months (Turner and Brown 1982). Annual precipitation increases from west to east across the BMGR; at Aguajita/Quitobaquito, precipitation is 10.5 inches annually. Infrequent chubascos (tropical storms) bring heavy rains in September or October that can produce spectacular growth on warm-season perennial plants (Felger 2000).

The vegetation community of the western portion of the BMGR has been classified as the lower Colorado River Valley subdivision of Sonoran Desert scrub (Turner and Brown 1982). It is the largest and most arid subdivision of Sonoran Desert scrub. Vegetation in the valleys, particularly in the Yuma Desert, is dominated by the creosote-white bursage series of Sonoran Desert scrub (Turner and Brown 1982). This series occupies approximately three-fourths of the lowland or valley areas in the BMGR (Reichenbacher and Duncan 1989). In this series, creosote and white bursage are often co-dominants, with galleta grass (*Hilaria rigida*), dalea (*Psorathamnus emoryi*), coldenia (*Tequilia plicata*) and other locally abundant species. Distinctive floras are also found in dunes in the area, particularly in the Yuma Dunes west of the Tinajas Altas Mountains, at Pinta Sands, and at the Mohawk Dunes. Species such as dune buckwheat (*Eriogonum deserticola*), mormon tea (*Ephedra trifurca*), bugseed (*Dicoria canescens*), dune spurge (*Euphorbia platysperma*), the threatened Peirson's milkvetch (*Astragalus magdalenae peirsonii*), and wire lettuce (*Stephanomeria schotti*) are found in one or more of these dune habitats. These species are dune specialists typical of the Gran Desierto dunes in northwestern Sonora (Felger 2000).

In drainages, bajadas, and montane habitats (including the Mohawk, Cabeza Prieta, Granite, and the Sierra Pinta mountains), the mixed scrub series of the lower Colorado River subdivision (Turner and Brown 1982) is found. This community is more diverse than the creosote-bursage series and includes species more representative of the Arizona Upland subdivision of Sonoran Desert scrub, such as palo verde, saguaro (*Carnegia gigantea*), ironwood, and desert lavender (*Hyptis emoryi*), among others. Frost-sensitive species such as elephant tree, limber bush, and Mexican jumping bean (*Sebastiania biloculare*) are also found in this community, but are more representative of species and genera of the Central Gulf Coast subdivision of Sonoran Desert scrub found to the south in Sonora (Dames and Moore 1995, Turner and Brown 1982).

The Arizona Upland subdivision of Sonoran Desert scrub is found in the Growler, Puerto Blanco, and Bates mountains, and surrounding bajadas. Vegetation in this community takes on the appearance of a scrubland or low woodland of leguminous trees, shrubs, and cacti. The woodland component is most developed and species richness is greatest in drainages. In the action area, common trees of the Arizona Upland include palo verdes, ironwood, catclaw acacia,

and velvet mesquite (*Prosopis velutina*). Dominant cacti include saguaro, chain fruit cholla, teddy bear cholla, and organ pipe cactus. Senita cactus (*Lophocereus schottii*), more common to the south in Mexico, is found in the southern portion of Organ Pipe Cactus NM and the Agua Dulce Mountains, Cabeza Prieta NWR. Vegetation on Cabeza Prieta NWR, Organ Pipe Cactus NM, and most of the BMGR is relatively undisturbed by human activities.

Rutman's (1996) assessment of accelerated erosion at Organ Pipe Cactus NM implicates several historical and on-going sources of erosion. Rutman (1996) suggests the condition of the area near Rasmussen Tank has resulted in "large flows of water being delivered to Cuerda de Lena and Kuakatch Wash. In addition to the increase in runoff resulting from the condition of the Rasmussen Tank area, Rutman (1996) describes the effects of grazing on the Cuerda de Lena and Organ Pipe Cactus NM's concerns for continued grazing: "Grazing along Cuerda de Lena on BLM land has caused the development of vertical cutbanks just north of the monument. In 1995, these banks were chiselled by cattle hooves. Trees in the riparian zone were hedged by shade- and forage-seeking cattle and understory vegetation was lacking or sparse. These conditions signal resource overuse, a situation that could significantly affect the monument if the current permitted stocking rate and grazing system are maintained. (See photographs, Appendix 2). Note that the photographs in Appendix 2 are not meant to represent the allotments in general; rather they show effects of grazing in a specific location (Cuerda de Lena) and time (March 1995).

BLM has collected utilization data on four of the five allotments, and provided data for the Cameron, Why, and Coyote Flat allotments to us for the years 1992-2001 and for the Sentinel Allotment during 1989-1994 (the Sentinel Allotment was in non-use from 1995-2001). Utilization data have not been collected on the Childs Allotment. For some years and in some areas of the other allotments utilization was not monitored (e.g. 1994-1997 on Cameron). Utilization data are collected on transects and at key management areas (KMAs). KMAs are selected based on "location, grazing use, and value as a monitoring point for grazing use and, if selected properly, represent the "overall acceptability of current grazing management over the entire range (BLM unpubl. report). Data for all years monitored, except 2001, on the Cameron and Coyote Flat allotments, and 1993-1994 on the Sentinel Allotment, showed utilization rates below their 2001 target of 40 percent for the three allotments (Table 7). Utilization rates as high as 54 percent on the Sentinel Allotment in 1993-1994 are probably incorrect and attributable to inexperienced observers, according to BLM. On the Cameron Allotment, the highest utilization recorded from 1990-2000 was 10 percent on bush muhly in 2000. On the Why Allotment, utilization from 1998-2001 did not exceed 2.5 percent on any species in KMAs.

Although BLM estimated that, at full preference utilization, rates may approach 40 percent, in 2001 utilization rates exceeded 40 percent on two allotments despite the fact that actual AUMs were well below full preference. Utilization exceeded 40 percent in three of seven KMAs on the Cameron Allotment and was as high as 77 percent on chuparosa (*Justicia californica*) at one KMA. On the Coyote Flat Allotment in 2001, utilization exceeded 40 percent on one of three KMAs, and reached 43 percent on galleta grass (*Hilaria rigida*). Actual use on the Cameron Allotment in 2001 was 469 AUMs (18 percent of full preference) and on the Coyote Flat Allotment was 228 AUMs (50 percent of full preference).

The BLM conducted a Rangeland Health Evaluation (BLM 2002) on the Cameron, Childs, Why, and Coyote Flat allotments, which included analyses of range condition and trend based on the comparisons of a site's vegetation composition and frequency to what should occur there (potential natural community - PNC) based on Natural Resource Conservation Service (NRCS) data, and comparisons of soil densities, vegetation cover, cover by cryptobiotic crusts and other features among sites on the allotments and sites at Organ Pipe Cactus NM and Cabeza Prieta

NWR (BLM 2002). Sites are categorized into condition classes that correspond to community seral stages as follows (percentages are percent similarity to PNC.):

Early seral stage (0-25 percent) (equivalent to poor range condition)
Mid seral stage (26-50 percent) (equivalent to fair range condition)
Late seral stage (51-75 percent) (equivalent to good range condition)
PNC (76-100 percent) (equivalent to excellent range condition)

Rangeland survey data were collected in 1981 and 2001. At five sites evaluated on the Cameron Allotment and two nearby on Organ Pipe Cactus NM, dry weight/ground cover of grasses and forbs (both annual and perennial) were absent or lower than the estimated PNC. Current conditions on the Cameron Allotment are generally at PNC or late seral stage. On the Childs Allotment, condition is primarily late seral. Similar to the Cameron Allotment, dry weight/ground cover of forbs is lower than estimated for PNC. Grasses, particularly in 2001, were better represented than on the Cameron Allotment. On the Coyote Flat Allotment in 2001, two of the monitored sites rated as mid-seral, the third was rated at PNC. Grasses and forbs were under-represented in comparison to predicted vegetation composition at PNC. A site nearby in Organ Pipe Cactus NM rated at PNC, but grasses and forbs were also under-represented. Of two sites monitored on the Why Allotment; one site rated at PNC, the other was late seral. A site nearby at Organ Pipe Cactus NM was rated at PNC. Similar to other sites and allotments, grasses and forbs were under-represented. The BLM reported that range condition trend is mostly static on the five allotments, however; trend assessments were based on only two points in time. Discerning trends based on two points is problematic and determinations made with such few data points may be not be reliable. Holecheck *et al.* (2001) finds that "to accurately identify trend, consecutive years of information are needed to smooth out variation from annual climatic fluctuations. Collection of range condition data at intervals of no more than 5 years is necessary to effectively monitor trend, in our opinion.

In the Rangeland Health Evaluation, BLM found that grass species make up a small percentage of the PNC. Grass could be missing from an ecological site, and the site could still receive a high rating. At most of the KMA's, perennial grasses were observed, but the amount of perennial grasses is lower than the BLM resource specialists would expect (BLM 2002). Although BLM's preliminary analysis reports that "the dry wash communities do not rate very high, it is stated that "the ecological site guides do not appear to describe these sites accurately (BLM 2002).

Vegetation transects and plots to monitor trends in density and cover of perennial plant species were established near the western boundary of the Cameron Allotment on Cabeza Prieta NWR in 1983. Similar transects were established on the Cameron Allotment in 1984. The plots and transects have been monitored several times through the 1980s and 1990s, and were monitored in 2001. In regard to the Rangeland Health Evaluation of the Cabeza Prieta NWR and Cameron Allotment data, BLM, their biological evaluation, describes problems interpreting the results of transects and plots due to errors, such as not consistently applying the protocols. Despite these problems, BLM believes some general trends emerge from the data: (1) total perennial cover "may have increased in some periods but in both BLM and Cabeza Prieta NWR study areas, total perennial cover is "about the same or slightly less than the 1983-1985 period when initial readings were made, and (2) "some plant densities have varied greatly over the period with perennial grasses increasing slightly on some BLM study areas and decreasing in others, while sites on Cabeza Prieta NWR generally "lost both grass cover and density from the beginning to the end of the period (from BLM's biological evaluation). BLM further states that the decrease in grass cover and density in the Cabeza Prieta NWR study areas "may be due, in part, to many of the refuge sites occurring in heavily impacted sites near old wells and corrals . To date, BLM

has identified no discernible difference in trend between the study areas on Cabeza Prieta NWR and the Ajo allotments study areas.

Selection of monitoring sites for the Rangeland Health Evaluation (BLM 2002) did not occur in a manner that allows for extension or extrapolation of the results beyond the sites selected. Monitored sites were not selected in a stratified random or completely randomized design, which questions whether they constitute an unbiased sample of the allotments. Some of the sites were key management areas on the allotments and were established "using an interdisciplinary team to identify areas that represent a variety of plant communities , most of which were within one mile of cattle waters. Thus, these sites were selected based on specific qualifying criteria and cannot be considered a random sample or representative of the allotments as a whole. Other sites were established on Organ Pipe Cactus NM and Cabeza Prieta NWR, which BLM considered as "ungrazed reference sites. We find no reference to how the sites at Organ Pipe Cactus NM were selected; however, the monitoring sites at Cabeza Prieta NWR were established in 1983 to document recovery from livestock grazing and were located in areas that received heavy grazing use, such as near corrals and waters. Sites monitored at Organ Pipe Cactus NM are near the historic Armenta Ranch where Rutman (1997) documented continuing erosion likely attributable to past grazing, and are also located between Armenta Ranch and Bates Well in an area of the Monument that received heavy livestock use more than 20 years ago. Thus, the "ungrazed sites have a long history of grazing, although cattle were excluded from Organ Pipe Cactus NM in 1979 and Cabeza Prieta NWR in 1986. To summarize, because of problems with site selection and the history of grazing in "ungrazed reference sites, any conclusions about the effects of grazing on the BLM lands based on comparisons with "ungrazed areas of Organ Pipe Cactus NM and Cabeza Prieta NWR may not be very meaningful because such conclusions can not be extrapolated beyond the sites sampled. In their September 27, 2002, memo to us, the BLM admits that the study sites were "subjectively selected and therefore "no valid statistical projections to an entire allotment are possible. They continue that "Therefore, careful consideration and good professional judgement must be used in selecting key areas to ensure validity of any conclusions reached. Yet, from the discussion above, the selected monitored sites are apparently neither random or representative of the areas sampled.

In regard to analysis of the data collected at the monitored sites, most of the conclusions drawn are qualitative - few conclusions are based on results of statistical tests, thus the data could potentially be interpreted differently by different analysts. For instance, on page 24 of BLM (2002), the text reads "Total vegetative cover at the Limy Fan study sites (R-DW-1, R-DW-2) was significantly higher than ungrazed areas on CPNWR and OPCNM. The measured values were higher, but no statistical tests were conducted to determine the level of variance in these statistics or if in fact the apparent differences are statistically significant. Also, no rationale is presented for only comparing the Limy Fan sites (versus the entire data set) with ungrazed sites (the Limy Fan sites had the highest foliar vegetation cover of sites sampled on the Cameron allotment). Furthermore, an analysis of current vegetation cover among sites is not a good measure of the impact of livestock grazing because any differences (if significant) may be caused by factors other than grazing (such as other land uses, soils, patterns of precipitation runoff, etc.). A more appropriate way to evaluate the effects of livestock removal at Organ Pipe Cactus NM and Cabeza Prieta NWR versus continued grazing on the BLM lands would be to compare *changes* in vegetation cover and other variables among sites over time since cattle were removed. Various statistical tests are available to conduct these analyses. Sites selected for such analysis should be a random sample of sites that are similar in terms of land uses other than grazing, otherwise the results may not accurately characterize the effects of grazing removal. Enough sites need to be monitored to provide precise estimates of the distribution of the data in grazed and ungrazed sites.

The Rangeland Health Evaluation finds that "there was no indication that livestock was affecting recruitment of saguaros on the Cameron allotment. However, sites selected to test this hypothesis were not selected randomly, and no statistical tests were conducted on the data collected. A qualitative look at the data, which is the only analysis presented, could come to a different conclusion. No saguaros in the smallest size class (<1 meter) were found on the Cameron allotment (Figure 37 of the Evaluation), suggesting no recent recruitment. On the other hand, 3 saguaros in this size class were found on currently ungrazed sites at Cabeza Prieta NWR (Figure 40 of the Evaluation). However, this contradicts information presented in Table 4 of the biological evaluation, which shows that 7 saguaros of less than one foot in height were found on the Cameron allotment plots. In other comparisons conducted, only single data points are presented for the Coyote Flats and Why allotments. When only one data point is collected, no analysis of the variance in the data can be conducted, which precludes statistical analyses and testing. Soil surface density, as a surrogate for infiltration, was measured at some sites, but not others. "The mean, standard deviation, and 95% confidence intervals were calculated for each study site . These statistics are presented in Appendix E of the report, but the analysis or interpretation of these data in the body of the report only discusses highest and lowest densities and qualitatively discusses similarities among sites. Drawing on this qualitative analysis, the report concludes "Based on density measurements alone, it is difficult to discern a difference between grazed and ungrazed areas ; although the data appear appropriate for statistical tests that could quantify differences or lack thereof (at least for the non-random sample of sites where this variable was measured). In their September 27, 2002, memo to us, BLM states that "...as with most biological sampling, the true population will never be known. The best way to judge how well a sample estimates the true population is by calculating a confidence interval. A confidence intervals does not estimate the accuracy of a population estimate, but rather is a range of values over which we can say with a measured level of certainty a population parameter lies. Yet, confidence intervals are not meaningful if the samples upon which the interval is based are biased. In another example, to evaluate soil loss, the BLM used the "Hillside Model , but concluded "the model proved unreliable in determining differences between grazed and ungrazed sites. However, the results of the model run are not presented, and the reasons why the model was unreliable are not revealed or discussed.

Apparently the only comparison for which a statistical test was conducted was comparison of mean cover by cryptobiotic crusts between grazed and ungrazed areas. The authors of the Rangeland Health Evaluation state that a t-test failed to reveal any significant differences; however, the t value, sample sizes or degrees of freedom, means, and variance or standard deviations were not presented, and the level of significance was not defined. Neither was the distribution of the data discussed, which would determine if a t-test or a non-parametric test would be an appropriate statistical tool for analyzing these data. Without this information we cannot fully evaluate the conclusions. In addition, cryptobiotic crust data were collected in May, June, and August, and the August cover figures were higher than the previous months, apparently due to dry conditions in the earlier period when cryptobiotic crusts were not as visible. The report does not state if the t-test was conducted on the May-June data set, the August data set, or if all data were pooled.

Interpretation of these utilization, rangeland survey, and perennial vegetation transect and plot data in regard to effects of grazing is unclear for a number of other reasons. Desert scrub communities take a long time to recover from grazing, and deterioration of soils and vegetation communities can continue after cessation of grazing (Lovich and Brainbridge 1999). In Great Basin Desert scrub, plots protected from grazing for ten years showed no differences from heavily grazed areas, indicating slow recovery (Jeffries and Klopatek 1987). Exclusion of grazing for 14-19 years did not allow recovery of perennial grasses in southeastern Arizona (Roundy and Jordan 1988). Rutman (1996, 1997) describes ongoing head cuts and erosion at

Organ Pipe Cactus NM that are likely attributable to grazing that occurred before 1979. Continuation of land degradation following cessation of grazing has also been noted in the deserts of Kuwait (Omar 1991). As a result, we do not expect differences among grazed and ungrazed plots in the action area to be very great because grazing was removed from Organ Pipe Cactus NM and Cabeza Prieta NWR relatively recently (23 and 16 years ago, respectively). On the other hand, there is some evidence that areas of Organ Pipe Cactus NM and Cabeza Prieta NWR have recovered to some degree from past grazing and/or other land uses, causing visible differences among the lands of these three jurisdictions (Rutman 1996; see Figure 5, Appendix 2, and discussions thereof in the Effects of the Action - pages 47 and 48). Finally, because of a lack of reference sites in this area of southern Arizona that have never been grazed or have not been grazed for a long time, deriving the composition of a PNC for this area is difficult, at best. In conclusion, because of design and analysis problems, the conclusions of the Rangeland Health Evaluation, particularly in regard to comparisons between grazed and recently ungrazed sites, are questionable.

C. Status of the Sonoran Pronghorn in the Action Area

Distribution

Figure 4 illustrates records of Sonoran pronghorn in Arizona from 1994-2001. Based on these locations and observed locations of pronghorn from 1983-1993, pronghorn are believed to occur most frequently in the following areas: Pinta Sands, Growler Valley, Mohawk Valley, San Cristobal Valley, and between the Growler and Little Ajo mountains (Daniel's Arroyo area). All localities from 1994-2001 are south of Interstate 8, east of the Copper and Cabeza Prieta mountains, and west of SR 85 (Bright *et al.* 2001). Habitat north of Interstate 8 has not been surveyed to any extent for pronghorn, but habitat in this area is highly fragmented. Interstate 8 and the Wellton-Mohawk Canal are probably barriers to movement of pronghorn.

On Cabeza Prieta NWR, pronghorn groups were most often observed on the southwestern edge of the Sierra Pinta Mountains and in the Pinta Sands, in the valley between the Sierra Pinta and Bryan mountains, in the San Cristobal and Growler valleys, and near Daniel's Arroyo. At Organ Pipe Cactus NM, pronghorn were most often observed near Acuna and Bates wells, and west of the Bates Mountains and Cipriano Hills. On the BMGR, concentrations of animals were observed near HE Hill on South TAC, with scattered sightings through the San Cristobal Valley and into the Mohawk Valley. John Hervert (AGFD, pers. comm. 1996) also believes that pronghorn frequent the northern portion of the Agua Dulce Mountains. Pronghorn may have used the Pinta Sands area to a greater degree in the early 1970s (AGFD 1981).

Pronghorn often seek the thermal cover found in the Arizona Upland subdivision of Sonoran Desert scrub during the hot, dry summer months. This cover is best developed in the southeastern portion of their range in Arizona. With the onset of summer rains or cooler temperatures, pronghorn may move to the more open valleys and flats, such as the Growler Valley and Pinta Sands. Rocky, mountainous terrain, such as the slopes of the Growler or Mohawk mountains, is not considered habitat for the Sonoran pronghorn (deVos 1990); however, pronghorn may be found on lower slopes and in associated washes (L. Thompson-Olais, FWS, pers. comm.1996).

Telemetry data collected by the AGFD between 1994 and 2001 reports observation of radio-collared Sonoran pronghorn on the Cameron Allotment in 1995, 1996, and 1998. Locations of these data points occur in the approximate center of the allotment (1995), near the Cabeza Prieta NWR boundary fenceline (1996 and 1998), and in the vicinity of Little Ajo Mountain (1998). In 1996 an observation was reported in the northeastern portion of the Sentinel Allotment.

The following table provides a summary of the Sonoran pronghorn observations on the Ajo allotments as of September 19, 2002 (Jill Bright, AGFD), based on weekly telemetry flights 1995-2002:

Month	Day	Year	Number	Utmx	Utmy	Bucks	Does	Fawns	Group Size
Jul	30	1995	22	324031	3580912				
Aug	6	1995	22	324113	3574811				
Aug	13	1995	22	323656	3575595		1		1
Aug	18	1995	22	322991	3575274		1		1
Jun	3	1996	9	319062	3566250		1		1
Jun	21	1998	31	320326	3584305				
Jun	28	1998	31	320598	3583746				
Jul	3	1998	31	320512	3584191				3
Jul	12	1998	31	320791	3583964				
Aug	1	1998	31	318348	3579017	1	2	1	4
Aug	1	1998	27	318348	3579017	1	2	1	4
Jun	23	2002	33	319380	3568240				

Additional incidental observations on BLM Ajo Allotments include the following: Approximately 20 years ago, Roger DiRosa, Refuge Manager, used to run a 10-mile loop on BLM lands just west of Ajo. During one 2-week period, he was paced by 4 Sonoran pronghorn on 4-5 occasions. During the summer of 1998, John Hervert and Jill Bright (both AGFD) observed 1 male Sonoran pronghorn standing in the shade of an old house, approximately 1.5 miles NW of Ajo at Dunn's Well. On August 11, 2000, Kate Garmise reported two male Sonoran pronghorn on the dirt road in front of her house just west of Ajo on the backside of "A Mountain. On August 13, 2002 , two Border Patrol agents reported seeing two Sonoran pronghorn on Bates Well Road, approximately 3 miles south of Ajo and just west of Black Mountain. On September 19, 2002, Lee Price, an older, local rancher (with a self-admitted memory problem) reported seeing a Sonoran pronghorn 1-2 weeks prior at the water on his ranch, approximately 2 miles NW of Ajo.

Population Size and Dynamics

Data on the size of the U.S. population of Sonoran pronghorn are presented in Tables 2 and 3. Before 1992, population estimates were not repeatable or accurate enough to be comparable or to discern trends in population size. However, anecdotal information in historical observations suggests a real decline. Observations of Mearns (1907) in the early 1890s suggested that pronghorn were locally common in what is now Cabeza Prieta NWR. From 1925-1968, however, population estimates ranged from only 50-105 individuals. Mearns (1907) observed pronghorn in the Lechuguilla Desert, in the Colorado Desert, and on what is now the Tohono

O'odham Nation, as well. The pronghorn is not known to occur in these areas today; thus populations declined and the range contracted substantially during the early 20th century.

Quantitative, repeatable estimates of population size were calculated from survey data collected in 1992, 1994, 1996, 1998, and 2000. As late as 1994, the estimated U.S. sub-population of Sonoran pronghorn using distance sampling methods was 282 individuals. The results of an aerial survey, conducted in December 1996, suggested that the most reliable estimate (based on capture-recapture estimates using collared individuals) was 130 individuals at that time (Bright *et al.* 2001). The decrease in the population may be attributable, in part, to dry periods in 1994 (November), 1995 (summer), and 1996 (winter). Because available food was not as abundant during this period, pronghorn may have been forced to use habitat where they are more vulnerable to predation. Lack of water may also be a factor affecting the pronghorn.

In 1995, there was abundant rainfall in the spring. Productivity of Sonoran pronghorn was between 1 and 1.4 fawns per doe. In July, as many as 50 percent of the does were accompanied by fawns. However, as dry conditions set in from July to December, most fawns died. Recruitment for the year was only 12 fawns per 100 does (12 percent). Dry conditions continued in 1996 and 1997, during which no fawns were known to have been recruited into the population. The heavy and steady precipitation during winter of 1997-98 produced perhaps the best annual plant production since 1978, and good fawn recruitment occurred that year (33 fawns per 100 does). The spring of 1999 was drier than normal, and no fawns were known to have survived by December. Fawn production was 14 fawns per 100 does in 2000 (Bright *et al.* 2001). An exceptional fawn crop in 2001 of approximately 50 fawns may reflect good precipitation in spring and summer of 2001 (J. Hervert, pers. comm. 2001). However, with the severe drought in 2002, it is likely that all gains from the previous year's recruitment have been lost. Further, it appears that few if any of the fawns born in 2002 have survived.

At a population viability analysis workshop conducted for the Sonoran pronghorn, recruitment at a level of 30 fawns per 100 does was deemed to be necessary for the subspecies to persist (Hervert 1996, Defenders of Wildlife 1998). Although there is a close relationship between fawn survival and precipitation, in the context of the last 100 years, the 1990s were not characterized by drought (Rowlands 2000); thus factors, in addition to precipitation, may have contributed to the population decline (see "Drought section on following page). However, the seasonal timing and intervals between rainfall events may be more significant than annual totals (J. Hervert, pers. comm. 2001).

Adult mortality has been high in recent years, with predator-related mortality being the most frequently identifiable proximate cause of death (one of the recovery actions identified by the recovery team is development of a narrowly-defined and rigidly controlled coyote removal plan). Thirty-five adult pronghorn have been radio collared by AGFD since 1994. Of these, 26 (74 percent) have since died. A total of 12 of these mortalities were attributed to predation, while the remaining were from unknown causes. Some of the 14 mortalities attributed to unknown causes were likely caused by predation (J. Hervert, pers. comm. 1999); however, unavoidable lag times between time of death and scene investigation caused evidence to be obscured. No evidence of predation of pronghorn was documented near water sources (Hervert *et al.* 2000). Capture myopathy (physiological condition of an animal, caused by fear, stress, and/or overexertion that sometimes manifests itself during or up to 14 days after capture and left untreated the effects can range from temporary debilitation to death) may have played a role in up to five of the mortalities in 1994 (Hervert *et al.* 2000). In the majority of documented mortalities, bone marrow condition was assessed. Only one specimen was determined to be in poor to fair condition, while all others were determined to be in good condition.

Mortality of radio-collared adults in 2002 has been exceptionally high. At the start of the year, a total of 7 radio-collared Sonoran pronghorn were at large in the U.S. sub-population. By August 2002, only one radio-collared pronghorn is known to have survived (an additional pronghorn's radio collar malfunctioned and the animal's fate is unknown). Of the five mortalities, one was due to mountain lion predation, one was an old female which probably died of natural causes, and three were females of prime breeding age (5-7 years old) with no identifiable cause of death. The later three deaths are source of great concern, given their relatively young age, lack of any signs of disease or predation, and the timing of their deaths during one of the most severe drought years ever recorded. These animals may have died of heat stress and/or malnutrition resulting from inadequate forage conditions due to drought. The deaths of these prime-age individuals is perhaps indicative of how severe conditions have become in 2002. Three recent sightings of pronghorn in various parts of their range verify their declining condition. In July 2002, adult pronghorn were observed on Organ Pipe Cactus NM, Cabeza Prieta NWR, and the North TAC of BMGR. In all three cases, observers described the pronghorn as emaciated, with ribs visible, and rough-coated (M. Coffeen, FWS, pers. com. 2002). In August 2000, two pronghorn were spotted on the Cameron allotment about 2-3 miles south of Ajo by a Border Patrol agent. The agent reported the animals appeared "skinny but were not emaciated or staggering.

Although 7 radio-collared animals is a small sample size, the death of 5 of these in 2002 is disturbing. Assuming an estimated population size of 140 animals at the start of 2002, and extrapolating to the adult population as a whole, and estimated 25-50 adult pronghorn remain in the U.S. population (J. Morgart, pers. comm. 2002). More accurate estimates of population size will not be available until aerial survey flights are completed in December 2002.

Drought

Precipitation, particularly winter rainfall, is closely associated with production of annual forage, although other factors, such as timing of precipitation, temperature, and soils are important, as well (Felger 2000, Inouye 1991). Hervert *et al.* (2000) found that the number of fawns surviving until the first summer rains was significantly correlated to the amount of preceding winter rainfall, and negatively correlated to the number of days without rain between the last winter rain and the first summer rain. Bright *et al.* (2001) concluded that low rainfall and poor forage conditions from 1994-2000 have negatively affected Sonoran pronghorn. Annual precipitation increases from west to east across the range of the pronghorn. At Yuma, annual precipitation is about 68 mm. Moving west to east, annual precipitation is 112.4 mm at Mohawk, and 227.4 at Ajo and 232.9 mm at Organ Pipe Cactus National Monument (Turner and Brown 1982).

Rowlands (2000) examined trends in precipitation for southwestern Arizona and Organ Pipe Cactus NM from 1895-1999. For southwestern Arizona, no trend in precipitation was found for the period, but low precipitation occurred around 1895 and during the 1950s. Periods of high precipitation occurred in 1915-1920 and in the 1980s. For Organ Pipe Cactus NM, there was a slightly increasing trend in monthly and annual precipitation over the period 1895-1999, a strong drought occurred in the 1950s, and a lesser drought occurred in the 1970s (Felger 1980 notes a 34-month period, from September 1969-August 1972, without precipitation in the Sierra del Rosario). No discernable trend in precipitation in southwestern Arizona or Organ Pipe Cactus NM was found in the 1990s, which is when the current decline in the U.S. pronghorn population began. At four stations in southwestern Arizona, Hervert *et al.* (2000) note below normal precipitation in the winters of 1995/1996 (-2.78 inches) and 1996/1997 (-2.87 inches), and wet winters in 1994/1995 (+1.97 inches) and 1997/1998 (+4.29 inches). Annual plant production was exceptional in the winter of 1997/1998 and spring of 1998. Winter of 1992/1993 and spring of 1993 also saw a very good crop of annual plants. Because of increased precipitation, the

eastern portions of the pronghorn's current range, including the allotments in this consultation, are most likely to support annual plant production, and thus are disproportionally important to the pronghorn.

Organ Pipe Cactus NM (2001) examined available data on precipitation and concluded that "although substantial year-to-year variations exist, the general trend in the later 20th century has been one of slightly increasing rainfall at Organ Pipe Cactus NM. Given that pronghorn populations survived the droughts of the 1890s, 1950s, and 1970s, it is unreasonable to solely attribute the current decline in the U.S. pronghorn population to drought. Organ Pipe Cactus NM (2001) concluded, "If (individual) recent dry years have had an impact on Sonoran pronghorn, it is most likely because in recent decades Sonoran pronghorn have much more limited options for coping with even brief moderate drought. Because of restrictions on their movements and range, and increasing human presence within their range, pronghorn are less able to employ their nomadic strategy in search of relief. It is not that drought itself is an impact, but possibly that drought has *become* an impact, due to other factors confounding the species' normal ecological strategy.

Disease

Blood samples from U.S. Sonoran pronghorns were collected between 1994 and 2000 for serologic, hematologic, and serum chemistry testing. Samples collected in 1994 provided evidence of pronghorn exposure to *Leptospira interrogans* serovar *hardjo* (a strain of the leptospirosis-causing bacteria carried by cattle and sheep) and a high seroprevalence (the rate at which a specific population tests positive for particular antibodies) to BTV and EHD, in both the 1994 and 1997 samples (National Wildlife Health Center, *in litt.* 1999). Results from the AGFD's winter 1997-1998 serology study also showed a high seroprevalence for BTV and EHD. Of the nine serum samples, seven animals tested positive for BTV and all nine were positive for EHD; all were negative for leptospirosis (AGFD, *in litt.* 1998; University of Arizona, Arizona Veterinary Diagnostic Lab, *in litt.* 1998). Five additional samples were collected in December 2000 and evaluated at the Arizona Veterinary Diagnostic Lab at the University of Arizona. All five samples tested positive for both BTV and EHD (one sample was considered a "weak positive) (FWS 2001). Leptospirosis, BTV, and EHD may adversely affect reproduction and recruitment and are all potentially fatal diseases. Leptospirosis may have an effect on pronghorn reproduction and fawn survival by causing abortion or birth of fawns that are weakened by infection (National Wildlife Health Center, *in litt.* 1999). These diseases and their relationship to the proposed action are discussed further in the Status of the Species and the Effects of the Proposed Action, herein.

D. Past and Ongoing Non-Federal Actions in the Action Area

The Status of the Species section describes a variety of human activities that have affected the Sonoran pronghorn since initiation of livestock grazing in the early 1700s (Officer 1993). Most non-Federal activities that have affected the pronghorn are historical in nature, and pronghorn have been all but extirpated from private, state, and Tribal lands.

Before the Taylor Grazing Act of 1934, and land use designations such as Organ Pipe Cactus NM, the BMGR, and Cabeza Prieta NWR, unregulated cattle grazing was widespread in the current range of the pronghorn. Forage and precipitation is greater in the eastern portion of the current range, thus it is likely that grazing was more prevalent in BMGR-East, Cabeza Prieta NWR and Organ Pipe Cactus NM, than in BMGR-West (MCAS-Yuma 2001). However, cattle grazing presently occurs west of Volcan Pinacate and near the Sierra del Rosario in northwestern Sonora, which are as dry as much of BMGR-West; thus we suspect cattle grazing historically

occurred throughout the current U.S. range. The degree to which cattle grazing may have affected soils and vegetation communities in this area is impossible to quantify. Humphrey (1987) compared vegetation in historic photos taken at boundary monuments in the early 1890s with photos taken in the 1980s and could not discern any temporal differences in vegetation in what is now Organ Pipe Cactus NM, Cabeza Prieta NWR, and BMGR. However, the changes may have occurred before 1890. In reference to monument 172 at the southern end of the Quitobaquito Hills, Humphrey notes "the entire region near the spring has probably been grazed by domestic livestock since their introduction by the Spaniards in the early eighteenth century. Any grasses that might have grown there prior to that time had probably been grazed out long before the monument was erected. Organ Pipe Cactus NM (2001) discusses possible effects of long-term grazing in pronghorn habitat, and apparent evidence and impacts of grazing still visible at Organ Pipe Cactus NM 25 years after cattle were removed.

Before the establishment of Organ Pipe Cactus NM, BMGR, and Cabeza Prieta NWR, mining occurred in many of the mountain ranges of the area. The copper mine at Ajo was operated by Phelps Dodge Corporation and others from 1911 to 1985. The open pit mine and its tailings eliminated pronghorn habitat east and southeast of Ajo. Smaller mining operations caused habitat disturbance locally, but most mines were in mountainous terrain outside of pronghorn habitat.

Hunting and poaching may have been an important factor historically in the decline of pronghorn populations early in the 20th century; however, the Sonoran pronghorn has been protected from hunting in the U.S. for more than 50 years, and we are not aware of any recent poaching events (FWS 1998a). Recreational hunting for other species occurs within the U.S. range of the pronghorn. Of particular importance is the bighorn sheep season, which occurs in December of each year, when a small number of hunters access remote portions of Cabeza Prieta NWR and BMGR to hunt a limited number of sheep. Presence of hunters in pronghorn habitat and discharge of firearms has the potential to disturb pronghorn; however, sheep hunting occurs at a time of year when temperatures are moderate, and hunters focus their activities in the mountains whereas pronghorn are in the valleys and bajadas.

Development of agriculture, including construction of canals, roads, towns, a railroad, and other activities along the Gila River excluded pronghorn from the riparian habitats and water available along the river. Similarly, construction of Sonora Highway 2, the U.S./Mexico boundary fence, and towns and agriculture along the Rio Sonoyta, excluded pronghorn from these riparian habitats, as well. Flow in the Gila and Sonoyta rivers are now much reduced or restricted to return agricultural flows or periodic flood flows. These greenbelts may have been a source of water and forage, and probably acted as buffers, to enhance survival of pronghorn during drought periods (FWS 1998a).

Numbers of undocumented immigrants and smugglers have increased dramatically in the action area. Deportable migrant apprehensions by Border Patrol agents in the Ajo Station increased steadily from 9,150 in 1996 to 20,340 in 2000 (U.S. Immigration and Naturalization Service 2001). In 2001, estimates of undocumented migrant traffic reached 1,000 per night in Organ Pipe Cactus NM alone (Organ Pipe Cactus NM 2001), and 150,000 for the year (Milstead 2002).. These activities have resulted in route proliferation, off-highway vehicle (OHV) activity, increased human presence in backcountry areas, discarded trash, and abandoned vehicles. Habitat degradation and disturbance of pronghorn almost certainly results from these illegal activities. Increased illegal activities have precipitated increased law enforcement presence, particularly Border Patrol, with additional associated adverse effects. However, without Border Patrol efforts the impacts from undocumented immigrants would be even greater.

E. Past and Ongoing Federal Actions in the Action Area

Because of the extent of Federal lands in the action area, most activities that currently, or have recently, affected pronghorn or their habitat are Federal actions. The primary Federal agencies involved in activities in the action area include the Marine Corps, USAF, FWS, BLM, NPS, and Border Patrol.

Resource management on and near the BMGR is coordinated through the Barry M. Goldwater Executive Council (BEC), a group of Federal and state agency representatives with statutory authority and management responsibility for the BMGR, its resources, and adjacent Federal lands. Formalized in March 1998, the BEC provides a conduit for communication regarding resource management issues, conflicts, and planning on the BMGR. Membership on the council includes representatives from Luke AFB, MCAS-Yuma, the Phoenix and Yuma field offices of BLM, Cabeza Prieta NWR and Arizona ESO, Organ Pipe Cactus NM, AGFD, and Tucson and Yuma sectors of the Border Patrol. No single agency serves as the council lead and the organization operates on a consensus basis. One subcommittee of the BEC is dedicated to Sonoran pronghorn.

AGFD, working in cooperation with a number of Federal agencies, has captured and radio-collared a total of 35 adult Sonoran pronghorn since 1994; 22 in 1994, nine in 1997/98, and four in 2000. Five pronghorn captured in 1994 died within 1-33 days post-capture. Three of these mortalities were from unknown causes, while two appeared predator-related (mountain lion and coyote). Since it is unusual to have this many animals die within 40 days post-capture, the direct or indirect effects of capture myopathy, was a suspected factor in their deaths. Capture and handling procedures were immediately modified and no subsequent losses related to capture myopathy have occurred. A sixth animal died from a broken neck caused by capture operations in December 2000. Despite these detrimental effects, data collected through radio telemetry are ultimately of great benefit to the conservation of the subspecies. Telemetry data provide information regarding habitat use and requirements, movement patterns, and increase the validity of population estimates.

In the following discussion, we have categorized Federal actions affecting the pronghorn as: (1) those actions that have not yet undergone section 7 consultation (although in some cases consultation has been completed on components of the Federal activity), and (2) Federal actions that have undergone consultation.

Federal Actions For Which Consultation Has Not Been Completed

Management at Cabeza Prieta NWR

Over 90 percent of Cabeza Prieta NWR was designated by Congress as wilderness in the1990 Arizona Wilderness Act. To help maintain wilderness character, no vehicular traffic is allowed except on designated public use roads. Vehicles may be parked up to 50 feet from the center of the roads in areas previously used by other vehicles. All other off-road travel is prohibited. Visitors are encouraged to practice a "leave no trace" ethic. Recreational activities on the Cabeza Prieta NWR include backpacking, hunting, camping, rock climbing, mountain biking, and driving on roads. Before entering, visitors must obtain a valid Refuge Entry Permit and sign a Military Hold Harmless Agreement.

Most of the Cabeza Prieta NWR is within the air space of the BMGR. Numerous low-flying

aircraft cross the Cabeza Prieta NWR on their way to air-to-ground bombing and gunnery ranges located to the north. Low-level helicopter flights are limited to flight corridors and occur only in the spring and the fall; in FY 1995 this use represented 4.5 and 16.5 hours, respectively. However, such flights may cause pronghorn to flee (Workman *et al.* 1992). Some military training exercises over the Cabeza Prieta NWR may require limitations on travel and even short periods of closure to the public.

Four-wheel drive vehicles are required on all routes except Charlie Bell Road where 2-wheel drive high-clearance vehicles may be driven. Driving in wet areas is prohibited and visitors are encouraged to not travel during wet conditions due to possible damage to refuge roads. In addition to the prohibitions mentioned above, the following activities are prohibited: dumping of litter, sewage, or liquid waste; firearms, except as authorized in writing by the Cabeza Prieta NWR manager; prospecting, removal, or disturbance of sand, rock, gravel, or minerals; rock hounding; excavating or removing objects of antiquity, cultural artifacts, or paleontological artifacts; trapping; collecting, possessing, molesting, disturbing, injuring, destroying, removal, or transportation of any plant, or animal, or part of the natural flora and fauna on the NWR (exceptions to the above are legally taken game); wood campfires; and unleashed pets.

The management plan for the Cabeza Prieta NWR includes an endangered species management component (FWS 1998b). Activities in this component include the use of remote sensors, an increase in monitoring, and the possibility of the establishment of experimental waters for pronghorn. Specific objectives concerning management goals for the pronghorn were presented in a preliminary draft Comprehensive Conservation Plan (CCP) for the Cabeza Prieta NWR (FWS 1998b) and included coordination with AGFD to conduct aerial surveys, weekly telemetry flights, radio-collaring operations, digital vegetation mapping, food plot feasibility studies, installation of water developments with photomonitors to document pronghorn use, telemetry tracking using remote data loggers, and coordination with Mexican authorities on pronghorn populations south of the border. Work continues on the CCP; the EIS is expected to be completed in early 2003. When the CCP is completed, we will conduct section 7 consultation on that Plan if listed species or critical habitat may be affected. In the interim, we conduct section 7 consultation on individual actions when they are proposed.

Cabeza Prieta NWR provides habitat for the pronghorn and is actively working to conserve the species. However, the presence of humans within pronghorn habitat may constitute a major disturbance factor. Furthermore, human presence may restrict pronghorn access to cover and/or forage and effectively create a barrier to movement.

Tucson Sector of the Border Patrol

The Tucson Sector Border Patrol section 7 consultation is not yet complete (consultation number 2-21-99-I-138). We have received a preliminary draft BA and expect to receive a second draft in the near future. This consultation encompasses all field activities conducted by the Border Patrol-Tucson Sector, as part of the program to detect, deter, and apprehend undocumented immigrants and drug traffickers. Also included will be the newly initiated patrol operation, Operation Grip, which is being conducted on the Los Vidrios Trail area of the Agua Dulce Mountains on Cabeza Prieta NWR. As part of this operation, trailers, which serve as living quarters for Border Patrol agents, have been placed near Bates Ranch on Organ Pipe Cactus NM.

The Tucson Sector is comprised of nine stations. Activities within the Ajo Station have the greatest potential to adversely affect pronghorn. Adverse effects may result from patrol road

activities, drag road activities, off-road operations, aircraft overflights, and the use and maintenance of sensors. Further, the potential for disturbance to pronghorn due to human presence may increase in areas where agents live on site (i.e., Operation Grip).

Patrol roads used by Border Patrol agents are typically public or private ranch roads. Although the Border Patrol is not the primary user of these roads, they do have the potential to encounter Sonoran pronghorn during patrols and cause them to flee the area. The Border Patrol monitors tracks of undocumented immigrants on drag roads (dirt roads that are regularly cleared by dragging tires behind a vehicle and then monitored for human tracks). Less than 10 miles of drag roads are used by the Ajo Station. Pronghorn appear to have an affinity for drag roads as the process of preparing the roads promotes forb growth (J. Hervert, pers. comm. 1999). Additionally, these roads may be utilized by pronghorn as bedding areas due to greater predator detection resulting from increased visibility (J. Hervert, pers. comm. 1999). Pronghorn attracted to these areas may be adversely affected by the presence of patrols and road preparation activities. Sensors are placed at strategic locations along the U.S.-Mexico border on established roads or trails within known travel corridors to detect illegal activities. The Ajo Station uses and maintains approximately 85-90 sensors during daily operations. Sensor installation and/or maintenance activities could disturb pronghorn if they are in the immediate area. However, these disturbances should be infrequent and short in duration.

Off-road activities include agents on foot, the use of OHVs, including four-wheel drive vehicles, dirt bikes, and all-terrain vehicles. These activities may disturb pronghorn and disrupt normal behavioral activities. Motorized off-road activities also degrade pronghorn habitat. In addition to off-road activities, one routine helicopter patrol route is flown from Why along a southwesterly route to the Agua Dulce Mountains. Additional helicopter activities may occur throughout the range of the pronghorn and helicopters may hover and land. Areas where low-level helicopters are used have the highest potential for disturbance to pronghorn. Evidence from other subspecies of pronghorn and other ungulates suggests that pronghorn may exhibit elevated heart rates, may flee, and could alter habitat use in response to low-level helicopter flights (Workman *et al.* 1992).

Yuma Sector Border Patrol Beacon Stations

After initiating emergency consultation, the Yuma Sector Border Patrol installed six emergency beacon stations (panic buttons) on the BMGR as a means to reduce mortality of illegal immigrants. The installation of the stations resulted in little habitat disturbance, the presence of the electronic stations may increase human presence in these areas (undocumented immigrants, and maintenance and rescue crews) and therefore represents an additional disturbance factor for pronghorns. To date, however, the beacon stations have only been activated once. Yuma Sector Border Patrol is developing a package to reinitiate consultation on their ongoing activities, including the operation and maintenance of these beacons. We are currently reviewing the preliminary draft BA for these activities.

Federal Actions Addressed in Section 7 Consultations

As part of our comprehensive discussion of all past and present actions affecting pronghorn within the action area, we describe below all biological opinions issued to date that may affect the pronghorn.

Four opinions addressed projects with minor effects to the pronghorn. Two opinions (consultation numbers 2-21-83-F-26 and 2-21-88-F-6) covered capture and collaring of pronghorn for research purposes, with no take of pronghorn anticipated. Consultation number 2-

21-88-F-81 involved installation of a water source in the Mohawk Valley for pronghorn, with no take anticipated. Consultation number 2-21-89-F-8 addressed change in aircraft use by Luke AFB on the BMGR, including change in aircraft type from the F-15A/B to the F-15E, and an increase in nocturnal flights (F-15E Beddown Project). We anticipated take of pronghorn in the form of harassment as a result of aircraft overflights. Reasonable and prudent measures to minimize take included: (1) development of long-term studies to determine the effects of overflights on the pronghorn, (2) if effects of overflights are identified, Luke AFB would work with us to eliminate them, and (3) work involving pronghorn would be carried out in accordance with appropriate state and Federal permits. This project was later incorporated into the biological opinion on Luke AFB's activities on the BMGR, discussed below.

Nine biological opinions were major projects with greater effects to pronghorn:

Border Patrol Activities in the Yuma Sector, Wellton Station, Yuma, Arizona

This biological opinion (consultation number 2-21-96-F-334), issued September 5, 2000, addressed all Border Patrol activities along the United States/Mexico border in Yuma County from the Colorado River to about the area of Pinta Sands at the south end of the Sierra Pinta Mountains. Border Patrol activities within the Yuma Sector/Wellton Station included helicopter and ground patrols; drag road preparation and assessment of road maintenance; remote sensor installation and maintenance; apprehensions and rescues; and assistance to other sectors and agencies. To reduce adverse effects on pronghorn, the Border Patrol agreed to implement the following measures: (1) purchase new, quieter MD600N helicopters to replace existing OH-06As; (2) contact the AGFD weekly for an update on weekend telemetry flights to avoid areas of pronghorn concentration; (3) modify helicopter flights to avoid fawning areas during the three peak months of the fawning season (April-June); (4) make confidential monthly reports to the manager of Cabeza Prieta NWR detailing the law enforcement actions and wildlife observations made during the previous month; (5) finalize the Memorandum of Understanding between the Border Patrol and Cabeza Prieta NWR to address objectives that will minimize potential conflicts including limiting of routine patrols and off-road use in wilderness and provide a framework for cooperation; and (6) conduct an annual interagency meeting with Cabeza Prieta NWR, the Arizona ESO, and BLM to present the annual report and discuss ways to improve coordination.

Disturbance to pronghorn was anticipated as a result of on-the-ground Border Patrol operations, and direct injury or mortality of pronghorn as a result of collision with Border Patrol vehicles or by low level helicopter flights abruptly approaching and startling pronghorn which may result in injury or energetic stress, particularly during drought. Pronghorn may also be adversely affected by noise and visual impacts of aircraft overflights. The increased energy expenditure caused by sudden or loud noises may lead to lower reproductive output and/or survival. The potential for detrimental effects to pronghorn may be greatest during the fawning season (April-June). Habitat disturbance due to off-road vehicle travel would also result.

We determined that the proposed action was not likely to jeopardize the continued existence of the pronghorn. We anticipated take in the form of harassment that is likely to injure up to one pronghorn in 10 years. The following reasonable and prudent measures were provided: (1) minimize injury of pronghorn; (2) monitor and study reactions of pronghorn on BMGR to Border Patrol activities; and (3) provide a means to determine the level of incidental take that results from Border Patrol activities. The following conservation recommendations were provided: (1) assign an environmental protection specialist to coordinate the effects of their activities statewide on listed species in order to reduce these impacts where possible; (2) continue participation in ecosystem partnerships with other Federal agencies in pronghorn habitat; and (3) obliterate and

block illegal roads in pronghorn habitat created by illegal border traffic.

The Border Patrol submitted an annual report of their activities in 2001, in which they stated that they were in the process of implementing the reasonable and prudent measures, terms and conditions, and conservation recommendations that were part of the proposed action. We are not aware of any incidental take attributable to Border Patrol activities in the Yuma Sector's Wellton Station resulting from the proposed action. However, the Border Patrol is planning to reinitiate consultation on its existing biological opinion, in order to reanalyze the effects of its ongoing actions on the Sonoran pronghorn.

BLM's Lower Gila South Management Area

Three biological opinions address BLM's Lower Gila South Management Area. The Lower Gila South Resource Management Plan-Goldwater Amendment (consultation number 2-21-90-F-042), proposed specific and general management guidance for non-military activities on the BMGR. Of particular importance for pronghorn was proposed management of recreation. Use of the BMGR is by permit only. The number of BMGR recreational use permits issued by the BLM field offices increased dramatically in the late 1990s, with a total of 893, 2545, and 3528 permits issued in 1998, 1999, and 2000, respectively. Permits are also issued by the USAF, Marine Corps, and Cabeza Prieta NWR. Permits are valid for any part of the BMGR that is open to public recreation. The presence of an increasing number of humans creates a disturbance risk to pronghorns, and OHVs may constitute a mortality factor. The OHV roads and heavily used vehicle-camping areas degrade habitat and may disturb pronghorn, as well as create barriers to pronghorn movement. No incidental take was anticipated. We provided conservation recommendations to reduce interaction between pronghorn and recreationists, exclude wild horses and burros from endangered species habitat, and investigate the effects of water sources on pronghorn. The non-jeopardy biological opinion, issued April 25, 1990, was programmatic, requiring BLM to consult when site-specific projects are proposed. To date, no site-specific formal consultations have been conducted. In November 2001, BLM's management of the range ceased and will be replaced by the BMGR Integrated Natural Resources Management Plan (INRMP). An internal draft INRMP has been completed and the Plan is scheduled to be finalized, after undergoing section 7 consultation, by December 2002.

The Lower Gila South Habitat Management Plan (HMP) (consultation number 2-21-89-F-213) provided management guidance for both specific and general actions in southwestern Arizona. Four actions were addressed in the HMP, including an exchange of 640 acres near Ajo, rehabilitation work on two catchments, and assessment of livestock removal from pronghorn habitat. Exchange of land out of public ownership may facilitate development or other uses that would preclude use by pronghorn. We provided the following conservation recommendations: a study to determine the effects of water developments on pronghorn and their competitors and predators, and development of a water catchment renovation plan in coordination with Cabeza Prieta NWR. No incidental take was anticipated. The non-jeopardy opinion was issued on May 15, 1990.

The biological opinion for the Lower Gila South Resource Management Plan and Amendment (consultation number 2-21-85-F-069) addressed programmatic management of lands in southwestern Arizona, including livestock grazing, wilderness, cultural resources, fire, minerals and energy, recreation, wildlife management, wood cutting, Areas of Critical Environmental Concern, and other land uses. The biological opinion concluded that OHV restrictions and designations of Areas of Critical Environmental Concern would benefit pronghorn, but wood cutting, recreation, grazing activities, mining, and designation of utility corridors would adversely affect pronghorn. Incidental take of the pronghorn was anticipated, but not quantified.

Any decline of forage quality or increase in the amount of fencing was judged to indicate that incidental take had been exceeded. Reasonable and prudent measures and terms and conditions to minimize take included: (1) modifying grazing allotment fences to allow passage of pronghorn, (2) improving habitat conditions for the pronghorn, and (3) minimizing human disturbance. We provided conservation recommendations to monitor pronghorn use of the area, assess pronghorn use at livestock waters, and consolidate lands through land exchanges. The non-jeopardy biological opinion was issued on March 27, 1998. In accordance with the opinion, BLM has monitored livestock grazing, and allotment fences have been modified to allow passage of pronghorn. Enforcement of vehicle and camping regulations has been increased south of Ajo.

In summary, the biological opinions for BLM's Lower Gila South Planning Area anticipated adverse effects to pronghorn and their habitat from livestock grazing, recreation, a land exchange, wood cutting, mining, and designation of utility corridors, resulting in an anticipated unspecified amount of take. We determined that the proposed actions were not likely to jeopardize the continued existence of the pronghorn.

5 Remanded Biological Opinions

In response to *Defenders of Wildlife, et. al., v. Bruce Babbitt, et. al.* (Civil Action No. 99-927 [ESH]), Judge Ellen Huvelle of the United States District Court (Court) for the District of Columbia issued a Memorandum Opinion and Order on February 12, 2001. The Court found that we failed to address the impact of various Federal actions on the Sonoran pronghorn when added to the environmental baseline and failed to include in the environmental baseline the impacts of all Federal activities in the area that may affect, directly or indirectly, the pronghorn.

The Court ordered us to produce, in consultation with the defendants, revisions of the following biological opinions: Air Force (USAF) (August 1997), Army National Guard (ARNG) (September 1997), Bureau of Land Management (BLM) (December 1997), Marine Corps (April 1996), and National Park Service (NPS) (June 1997). The Court further ordered that we, in consultation with the Federal agencies whose biological opinions have been remanded, must reconsider those portions of the opinions that have been found to be contrary to the dictates of the Act. This included the scope of the action area, analysis of the environmental baseline, and analysis of the effects of incidental take in context with a revised environmental baseline. The remanded biological opinions were issued on November 16, 2001. In the following discussion, we describe both the original and remanded opinions for these five consultations.

<u>BLM grazing allotments in the vicinity of Ajo, Arizona</u>

The biological opinion (consultation number 2-21-94-F-192), issued December 3, 1997, addressed effects to pronghorn resulting from issuance of grazing permits on five allotments, four of which are located near Ajo and Why (Cameron, Childs, Coyote Flat, and Why allotments); and the fifth near Sentinel (Sentinel allotment). All but the Child's allotment were considered to be within the current distribution of the Sonoran pronghorn. According to the BLM, livestock use of the five allotments had been relatively low in the previous ten years; however, the effects of stocking the allotments at any level had not been analyzed. Monitoring of the Coyote Flat and Why allotments had not occurred. The BLM permittees had not fully stocked the Cameron, Why, Sentinel, and Childs allotments for a sustained period of time. The Coyote Flat Allotment had been billed for full stocking. According to the BLM, monitoring data had not shown overutilization of the vegetation or a change in vegetation composition. The BLM estimated that if allotments were stocked at permitted levels, forage utilization rates could approach 40 percent. Preliminary data from the BLM and the AGFD showed that there is little dietary overlap between pronghorn and cattle. Because of this, the amount of forage on

allotments, and the likely utilization levels, we found that adequate forage for the pronghorn should be available. Maintenance of livestock waters, fences, and other improvements may temporarily disrupt pronghorn activity. Pronghorn may also become entangled in livestock fences.

We determined that the proposed action was not likely to jeopardize the continued existence of the pronghorn. Incidental take of one pronghorn was anticipated to occur in the form of harassment or death due to grazing management activities during the 15 year proposed action. The following reasonable and prudent measures were provided to minimize take of pronghorn: (1) minimize impacts to pronghorn from grazing and (2) minimize habitat loss, degradation, and fragmentation of pronghorn habitat. The opinion included the following conservation recommendations: develop allotment management plans for each allotment and monitor pronghorn use within Cameron, Coyote Flat, Sentinel, and Why allotments.

The BLM has provided two reports regarding the implementation of reasonable and prudent measures. The 1998-1999 report (dated April 13, 2000) stated that no maintenance work was authorized within the "area covered by this opinion . BLM established "utilization studies on the Sentinel, Coyote Flat, and Why allotments in November 1998. The studies appear to consist of one transect for each of the allotments. The utilization transects for the Sentinel, Coyote Flat, Why, and Cameron allotments were read in 1998 and 1999. BLM reported low levels of utilization within the study areas. The 2000 report (dated November 28, 2000) stated that BLM modified 18 miles of fence within the allotments (three fencelines between Cameron, Why, and Coyote Flat and a small fence area within Coyote Flat) by replacing the bottom strand with smooth wire, raised 18 inches above ground level. The work was conducted June through August of 2000. Utilization transects for the four allotments were read in 2000. Again, BLM reported low levels of utilization. Both reports stated that there had been no incidental take of pronghorn as of the date of each report.

The 1997 biological opinion was remanded to us by the Court on February 12, 2001. A final biological opinion was issued on November 16, 2001. The Federal action considered in that opinion was the issuance of a 10-year grazing permit on the five allotments. However, because the BLM agreed to finalize their Rangeland Health Allotment Evaluations conducted during 2001, and to then reinitiate consultation regarding the continued grazing of these allotments, the 2001 biological opinion analyzed the effects of the proposed action only for the interim period. In this biological opinion we concluded that grazing activities within the interim period would not jeopardize the continued existence of the Sonoran pronghorn. Further, we concluded that these actions would not result in take of Sonoran pronghorn. The opinion included the following conservation recommendations: BLM should 1) evaluate decreasing the numbers of livestock or permanent removal of livestock from the allotments west of SR 85 to eliminate negative effects on Sonoran pronghorn, 2) work with FWS to investigate the potential for disease transmission from livestock and other common vector host pool species, 3) rehabilitate heavy-use recreation areas of Gunsite Wash and the base of the hills north of the Bates Well Road, 4) implement a seasonal (March 15 to July 15) emergency closure of roads, trails, and camping areas to the general public, 5) coordinate with Organ Pipe Cactus NM and Cabeza Prieta NWR to determine the extent of, and the appropriate measures to correct, the effects of erosion impacting BLM land as well as Organ Pipe Cactus NM and Cabeza Prieta NWR, resulting from historic and current land use practices on the Ajo allotments, 6) prepare a pronghorn database from all historic sightings in the agency files and support an annual program of documenting wildlife sightings (including pronghorn) by employees, 7) permanently remove livestock grazing over all, or a significant portion of the Sentinel Allotment, and 8) in coordination with the Sonoran Pronghorn Recovery Team, develop and implement a study to investigate and monitor the influences of

disease (particularly those that may be transmitted by livestock) and other stressors to pronghorn.

Marine Corps Air Station-Yuma in the Arizona Portion of the Yuma Training Range Complex

This biological opinion (consultation number 2-21-95-F-114), issued on April 17, 1996, addressed all proposed and authorized actions on the BMGR by MCAS-Yuma, including proposed changes to military flights over Cabeza Prieta NWR, ongoing flights over BMGR, and operation of various training facilities such as landing strips, a rifle range, targets, a parachute drop zone, a transmitter/telemetry system, and ground support areas. MCAS-Yuma conducts Weapons Tactics Instructors (WTI) courses twice a year (March-April and October-November). During a typical WTI course, one flight/day of two to eight helicopters traverse Cabeza Prieta NWR and the BMGR within established flight corridors from west to east. Helicopters use the corridors for 5-17 days. Additional low-level fixed-wing aircraft corridors over Cabeza Prieta NWR are used for six days per course.

Ground-based activities, such as those of troops and vehicles at ground-support areas were likely to adversely affect pronghorn habitat use. Over the entire project area, ground-support areas in potentially occupied pronghorn habitat would encompass approximately 32.4 mi^2. Numerous pronghorn have been located in recent years in R-2301W on the BMGR and the Cabeza Prieta NWR east of the Baker Peaks, Copper, and Cabeza Prieta mountains. In this area, ongoing and proposed military ground-based activities have the greatest potential for adversely affecting pronghorn. Military overflights do not cause habitat degradation, but pronghorn may respond with increased heart rates and flee from aircraft, particularly low-level helicopters. The increased energy expenditure associated with flight behavior may lead to lower reproductive output and/or survival. Additionally, pronghorn may avoid flight paths, which may result in an indirect loss of useable habitat. In areas where helicopters fly particularly low and create more noise and greater visual stimuli, disturbance to pronghorn would be expected to be greater. Ordnance delivery may also adversely affect pronghorn on the area. Pronghorn use both the North and South TACs, and ordnance, live fire, and shrapnel could potentially strike and kill or injure a pronghorn. Furthermore, pronghorn could be killed or injured during an encounter with unexploded live ordnance on the ground. MCAS-Yuma proposed measures to minimize, in part, the direct and indirect impacts of the proposed action, including measures to reduce or eliminate take of Sonoran pronghorn and to minimize destruction and degradation of habitat.

We determined that the proposed action was not likely to jeopardize the continued existence of the pronghorn. Incidental take of one pronghorn per 10 years was anticipated in the form of direct mortality, and undetermined numbers of pronghorn were anticipated to be taken in the form of harassment by low-level fixed wing and helicopter flights, military vehicles, or other activities authorized, funded, or carried out by MCAS-Yuma. The following reasonable and prudent measures were provided to minimize take of pronghorn: (1) personnel and visitors educational/information programs and operational procedures, (2) to the extent practicable, military activities shall be located outside of pronghorn habitat, and (3) incidental take resulting from the proposed action will be monitored and reported to us. The following conservation recommendations were provided: (1) continue to fund and support basic research, inventory, and monitoring of the pronghorn. In particular, MCAS-Yuma should investigate the effects of low-level helicopter and fixed wing aircraft flights over the BMGR and Cabeza Prieta NWR and ground based military activities on the behavior and physiology of the pronghorn; and (2) map noise level contours resulting from military flights over the Cabeza Prieta NWR. This map should be provided to Cabeza Prieta NWR for analysis of the effects of aircraft noise on pronghorn habitat use.

Implementation of MCAS's proposed mitigation (minimization) measures, the reasonable and

prudent measures, and terms and conditions is unclear because of inadequate reporting by MCAS. We have only received annual reports for 1998 and a draft report for 1999. With few exceptions, these reports have not detailed, action by action, what steps MCAS-Yuma has taken to implement the opinion. In 1999, MCAS reported that no pronghorn habitat was modified, Range Management received no reports of Sonoran pronghorn encounters, and all air and ground crews were briefed on the requirements of the opinion. We are not aware of any incidental take of pronghorn attributable to MCAS-Yuma YTRC activities. On March 18, 1998, an amendment was requested on the consultation by MCAS-Yuma. This request slightly changed the description of the equipment and personnel to be used in the Stoval Field exercise area. We determined that the changes would have no additional effects not already anticipated in the biological opinion.

The 1996 biological opinion was remanded to us by the Court on February 12, 2001. During consultation, MCAS-Yuma proposed 26 conservation measures aimed at the reduction of adverse effects of the proposed action on the environment, including impacts to the Sonoran pronghorn (Dames and Moore 1995; MCAS -Yuma 1995, 1997, 2001; letter from MCAS-Yuma to us dated October 15, 2001). We concluded that the proposed action would not jeopardize the continued existence of the Sonoran pronghorn. Further, we anticipated that no more than 6 Sonoran pronghorn would be incidentally taken as a result of the proposed action. The incidental take was expected to be in the form of harassment. This incidental take provision will be reviewed concurrent with subsequent reviews of the BMGR INRMP, which will occur every five years. The following reasonable and prudent measure was provided to minimize take of pronghorn: MCAS-Yuma shall modify low-level helicopter use to avoid areas of significant pronghorn use to minimize adverse effects from helicopters on the pronghorn and its habitat, particularly areas important for fawns and their mothers. In addition the following conservation measures in regard to Sonoran pronghorn were suggested: MCAS-Yuma should 1) continue to fund and support basic research, inventory, and monitoring of the pronghorn, 2) fund or staff Sonoran pronghorn recovery projects (a list of appropriate projects was provided as an appendix to the biological opinion), 3) eliminate use of ground support areas 43, 44, 45, and 67 because they are in significant use areas of the pronghorn, including areas used by fawns and their mothers, and 4) coordinate with Luke AFB to implement more intensive monitoring of the North and South TACs.

Organ Pipe Cactus NM General Management Plan

The biological opinion (consultation number 2-21-89-F-078), issued June 26, 1997, addressed implementation of Organ Pipe Cactus NM's General Management Plan (GMP). The purpose of the GMP is to guide management for the next 10-15 years. Plan elements included: (1) working with Arizona Department of Transportation to ensure continued travel and commerce on SR 85 while enhancing resource protection, (2) seeking designation of Organ Pipe Cactus NM as the Sonoran Desert National Park, (3) establishment of partnerships to share facilities, staff, and costs in Why and Lukeville, (4) increased wilderness and development of an interagency wilderness and backcountry management plan, (5) changes in trails at Quitobaquito, (6) changes in facilities in the Twin Peaks area, (7) increasing primitive camping and designated trails, and (8) full implementation of the Organ Pipe Cactus NM Cultural Resources Management Plan.

To reduce adverse effects on pronghorn, Organ Pipe Cactus NM proposed the following: (1) pursue an agreement with Arizona Department of Transportation to establish a vehicle for continued communication regarding road-related issues, construct underpasses at known movement corridors to facilitate safe passage of pronghorn across the highway, and establish a program to explore other measures to better understand and subsequently reduce the impacts of SR 85 on pronghorn; (2) continue working with the Arizona Department of Public Safety to

enforce the existing speed limit within Organ Pipe Cactus NM; (3) convert the bottom strands of Organ Pipe Cactus NM's north and south boundary fences to smooth wire to encourage pronghorn movements between Organ Pipe Cactus NM and surrounding areas; (4) educate motorists about the plight of pronghorn using a variety of interpretive media in an effort to encourage lower speeds and increased awareness of wildlife use of the highway corridor; (5) continue to serve as a member of the Interagency Core Working Group for Sonoran pronghorn recovery and implement activities outlined in the recovery plan, including development of a monitoring program; and (6) monitor visitor use and restrict access where necessary to minimize the potential for disturbance to pronghorn.

Recreational activities include hiking, camping, horse-back riding, and biking. These activities can disturb pronghorn and degrade habitat. Maintaining and/or adding hiking trails at Organ Pipe Cactus NM is likely to maintain or increase visitor presence in pronghorn habitat, resulting in long-term, moderate, adverse, regional disturbance to pronghorns. All proposed facilities would be located within areas of existing development and would involve relatively small tracts of land surrounded by larger areas of undisturbed habitat. However, development of facilities that result in increased visitor use may adversely affect the pronghorn. Increased use of some frontcountry and backcountry areas has the potential to adversely affect pronghorn if it causes an alteration in behavior or habitat use. Increased visitation to Organ Pipe Cactus NM was also expected to result in increased traffic along SR 85, adding to the barrier effect of existing traffic patterns. Approximately 22 miles of SR 85 lie within Organ Pipe Cactus NM. We concluded that the highway is a deterrent to expanding pronghorn populations, and resulting modified behavioral patterns may lead to a reduction in genetic exchange, reduced viability, and a concomitant reduction in the ability of pronghorn to adapt to environmental change.

We determined that the proposed action was not likely to jeopardize the continued existence of the pronghorn. Incidental take in the form of injury or death to one pronghorn associated with traffic on SR 85 was anticipated. The following reasonable and prudent measures were provided to minimize take of pronghorn: (1) work with agencies to implement actions to reduce effects of current and future traffic patterns on SR 85; (2) modify fences for pronghorns; (3) educate motorists on pronghorn vulnerability to traffic; and (4) monitor use and restrict access where necessary to minimize pronghorn disturbance. The following conservation recommendation was provided: the NPS should continue to contribute to multi-agency recovery efforts and help implement appropriate management actions as new information becomes available.

It is unclear to what extent Organ Pipe Cactus NM has begun to reduce the impacts of traffic speed and volume along SR 85. Organ Pipe Cactus NM cites "installation of new road signs and construction of "interpretive waysides as part of the "completed or continuing projects of the GMP (Organ Pipe Cactus NM 2001). According to Organ Pipe Cactus NM personnel, these projects are in the planning stages (T. Tibbitts, Organ Pipe Cactus NM, pers. comm. 2001). Organ Pipe Cactus NM has remained a member of the Recovery Team, and has continued to aid in implementation of recovery plan activities, including population monitoring and radiotelemetry studies. The livestock fence on the boundary between Organ Pipe Cactus NM and Cabeza Prieta NWR has been removed. The livestock fence along Organ Pipe Cactus NM's northern boundary with BLM lands west of SR 85 has been modified for pronghorn. It is unclear what, if anything, Organ Pipe Cactus NM has done to reduce the impacts of SR 85 through public education. Organ Pipe Cactus NM has closed the Pozo Nuevo Road seasonally, partly in response to pronghorn use. However, they used concrete Jersey barriers to block the road which resulted in habitat destruction as illegal traffic expanded out into the desert to go around the barrier. Organ Pipe Cactus NM law enforcement has been working with Border Patrol to address illegal traffic, and has incorporated pronghorn radiotelemetry data into their management of park traffic with some degree of success (T. Tibbitts, pers. comm. 2001). No incidental take of

pronghorn associated with the proposed action has been documented.

The 1997 biological opinion was remanded to us by the Court on February 12, 2001. The GMP had changed since the 1997 plan was released, most notably with regard to GMP projects which were ongoing or had been completed, and the addition of new projects. To reduce adverse effects, NPS also included 14 conservation measures for Sonoran pronghorn in its proposed action. Consequently, we did not anticipate any incidental take of Sonoran pronghorn as a result of the proposed action. However, we did specify the following conservation recommendations: NPS should 1) continue to fund and support basic research, inventory, and monitoring of the Sonoran pronghorn, and 2) explore additional methods of ameliorating the barrier effects of SR 85, such as establishing a lower speed limit and investigating the feasability of installation of underpasses on SR 85.

Implementation of agreed upon conservation measures has been incomplete since the remanded opinion was issued on November 16, 2001. No pronghorn monitoring plan was initiated; however, the Bates Well Road and Pozo Nuevo road closures, and agreed upon backcountry closures were implemented as proposed. Closure of the North Puerto Blanco Drive at a point approximately 5.1 miles from the Visitor Center was not implemented in 2002. New development was not undertaken in certain areas, according to the conservation measures, with the exception of a new, temporary Ranger/Border Patrol station established at Bates Well. NPS agreed to establish a 3-year experimental pronghorn crossing zone on SR 85 from milepost 67-71, with temporary speed limit reductions, but that measure was not implemented in 2002. Temporary waters were placed on the Monument in July, and a monitoring program was initiated to determine their effectiveness. NPS continues to maintain and has expanded a program to remove non-native bufflegrass and Sahara mustard and has contributed to implementation of the 51 recovery projects in Appendix 1. However, no financial support was provided for pronghorn radiotelemetry and soil erosion control has yet to be initiated.

Luke AFB Use of Ground-Surface and Airspace for Military Training on the BMGR

The biological opinion (consultation number 2-21-96-F-094), issued August 27, 1997, addressed military use of the airspace above and the ground space on the eastern half of the BMGR by Luke AFB. At the time of the consultation, about two-thirds of the BMGR was located on lands managed by the Department of Defense and BLM, with the remaining third located within Cabeza Prieta NWR. Approximately 5 percent (7.6 percent, if not including Cabeza Prieta NWR) of the range had been impacted by military activities. Military activities within the area of overlap with the Cabeza Prieta NWR were limited to use of airspace and operation of four Air Combat Maneuvering Instrumentation sites. The eastern part of the BMGR is known as the Gila Bend segment. Military activities occurring within the Gila Bend segment are managed by Luke AFB and include: airspace use, four manned air-to-ground ranges, three tactical air-to-ground target areas, four auxiliary airfields, Stoval Airfield, and explosive ordnance disposal/burn areas.

We determined that the proposed action was not likely to jeopardize the continued existence of the pronghorn. During each 10-year period of the project, take was anticipated in the form of harassment that was likely to injure up to two pronghorn and in the form of death of at least one pronghorn. The following reasonable and prudent measures were provided to minimize take: (1) minimize impacts of activities on pronghorn; (2) minimize habitat loss, degradation, and fragmentation of pronghorn habitat; (3) monitor and study reactions of pronghorn on the BMGR to military activities; and (4) determine the level of incidental take that results from the project. The following conservation recommendations were provided: (1) Luke AFB should pursue funding for all research needs that are identified for implementation by Department of Defense in

the final revision of the pronghorn recovery plan, as well as all research needs that are now and in the future identified by the Sonoran Pronghorn Core Working Group; (2) Luke AFB should conduct and/or fund research to determine the effects of low level flights on free-ranging pronghorn and use the information to evaluate flight ceilings and flight corridors (i.e., Military Training Routes) over Cabeza Prieta NWR; and (3) Luke AFB should fund and implement an ecosystem partnership for managing the Sonoran Desert to determine other conservation needs in the area.

Implementation of the reasonable and prudent measures have been documented in their annual reports; we are in receipt of the 1998, 1999, and 2000 reports. We are not aware of any take of pronghorn confirmed attributable to Luke AFB use of the ground-surface and airspace on the BMGR. A pronghorn found dead near a target may have been strafed, but it may have died from other causes.

The 1997 biological opinion was remanded to us by the Court on February 12, 2001. During the course of this consultation, Luke AFB made substantial commitments to minimize the effects of their activities on the Sonoran pronghorn, and additionally committed to implementing a variety of recovery projects recommended by the Sonoran Pronghom Recovery Team. A total of 12 conservation measures were added to the proposed action. We concluded that the proposed action, including conservation measures, would not jeopardize the continued existence of the Sonoran pronghorn. We further anticipated that no more than 3 Sonoran pronghorn could be incidentally taken as a result of the proposed action. The incidental take was expected to be 1 pronghorn in the form of death and 2 pronghorns in the form of harassment. The incidental take provision will be reviewed concurrent with subsequent reviews of the Barry M. Goldwater INRMP, which will occur every five years. To minimize impacts to Sonoran pronghorn, we provided the following reasonable and prudent measure: Luke AFB shall expand efforts to monitor Sonoran pronghorn on the tactical ranges to minimize the likelihood of adverse impacts to the pronghorn from military training exercises. Additionally, the following conservation recommendations were suggested: Luke AFB should 1) pursue funding for all research needs that are identified for implementation by USAF in the final revision of the Sonoran pronghorn recovery plan, as well as all research needs that have been concurrently or subsequently identified by the Sonoran Pronghorn Recovery Team, 2) conduct and/or fund research to determine the effects of low level flights by helicopters on free-ranging pronghorn and use the information to evaluate flight ceilings and low-level flight corridors over Cabeza Prieta NWR, 3) prepare a Sonoran pronghorn spreadsheet database from all historic sightings in USAF files and support an annual program of documenting Sonoran pronghorn sightings by employees, 4) study the feasability of moving or adding targets north of the Crater Range for use when TAC targets are closed due to the presence of pronghorns, and 5) continue efforts to implement the use of modular targets and electronic scoring systems to reduce the number of strafing targets.

One term and condition was stipulated in order to implement the reasonable and prudent measure described above. Luke AFB has since completed this term and condition by updating the range operating instructions to reflect the conservation measures in the proposed action. Luke AFB also continues to support the recovery of the Sonoran pronghorn through the biological monitoring contract and management of their previously obligated funds. During FY 2002, Luke AFB did not budget further funds for Sonoran pronghorn management; however, they are assisting AGFD in managing the currently obligated funds.

Western Army National Guard Aviation Training Site Expansion Project

The non-jeopardy biological opinion for the Western Army National Guard Aviation Training

Site (WAATS) (consultation number 2-21-92-F-227) was issued on September 19, 1997. The purpose of WAATS is to provide a highly specialized environment to train ARNG personnel in directed individual aviator qualification training in attack helicopters. The WAATS expansion project includes: (1) expansion of the existing Tactical Flight Training Area which includes establishing four Level III touchdown sites, (2) development of the Master Construction Plan at the Silver Bell Army Heliport, and (3) establishment of a helicopter aerial gunnery range for use by the ARNG on East TAC of the BMGR.

This biological opinion did not address the pronghorn, but, in the Court's opinion, should have and was therefore remanded by the Court. Per the final EIS for WAATS, ARNG use of East TAC did not cause existing training to shift to North or South TACs because the USAF eliminated F-15E training at BMGR, concentrating on F-16 air-to-air and air-to-ground training. This opened up opportunity to absorb the WAATS air-to-ground training on East TAC which is located closer to Gila Bend AFAF and Silver Bell Army Heliport. Therefore, the EIS did not consider impacts to the pronghorn and none were anticipated. All activities that are part of the proposed action occur outside the current range of the pronghorn, with the exception of training at North TAC. Training at East TAC could preclude recovery of historic habitat if the many other barriers that prevent pronghorn use of East TAC were removed. Training at North TAC only occurs when East TAC is closed for annual maintenance and EOD clearances. Effects to pronghorn at North TAC are minimized by monitoring protocols established by Luke AFB.

The final remanded biological opinion, issued in 2001, included 8 proposed conservation measures aimed at the reduction of adverse effects to Sonoran pronghorn and its habitat. The proposed measures minimized, but did not eliminate, habitat disturbance from the ARNG that would occur on North TAC. However, we concluded that the proposed action would not jeopardize the continued existence of the Sonoran pronghorn. Further, we did not anticipate that the proposed action would result in the incidental take of pronghorn. A single conservation recommendation was included, which states: ARNG should continue to contribute to funding and supporting basic research, inventory, and monitoring of the pronghorn.

F. Summary of Activities Affecting Sonoran Pronghorn in the Action Area

Historically, livestock grazing, hunting or poaching, and development along the Gila River and Rio Sonoyta were all probably important factors in the well-documented Sonoran pronghorn range reduction and apparent population decline that occurred early in the 20th century. Historical accounts and population estimates suggest pronghorn were never abundant in the 20th century, but recently, the estimated size of the population in the action area declined from 179 (1992) to 99 (December 2000). We estimate that with exceptional conditions and record fawn survival, the population rebounded to approximately 140 in 2001. Decreased recruitment and dramatically increased adult mortality during 2002 has reduced the population to 25-50 individuals. At this low number, genetic diversity is expected to erode, and the population is in imminent danger of extirpation due to human-caused impacts, or natural processes, such as predation or continued drought. Although the proximate cause of the population decline during the current year may be largely linked to drought conditions, human activities limit habitat use options by pronghorn and increase the effects that drought have on the population. The reasons for declines in previous years are not clear. A combination of factors are likely responsible. The U.S. pronghorn population is isolated from other populations in Sonora by a highway and the U.S./Mexico boundary fence, and access to the greenbelts of the Gila River and Rio Sonoyta, which likely were important sources of water and forage during drought periods, has been severed.

Within its remaining range, the pronghorn is subjected to a variety of human activities that disturb the pronghorn and its habitat, including military training, increasing recreational activities, grazing, increasing presence of undocumented immigrants and smuggling, and in response, increased law enforcement activities. MCAS-Yuma (2001) quantified the extent of the current pronghorn range that is affected by various activities and found the following: recreation covers 69.6 percent of the range, military training on North and South TACs covers 9.8 percent, active air-to-air firing range covers 5.8 percent, proposed EOD five-year clearance areas at North and South TACs and Manned Range 1 cover 1.0 percent, and MCAS-Yuma proposed ground support areas and zones cover 0.29 percent. In addition, livestock grazing occurs over 5.6 percent of the pronghorn's current range (Organ Pipe Cactus NM 2001, Bright *et al.* 2001); a total of 860 miles of roads occur in the current range (MCAS-Yuma 2001), and foot and vehicle traffic by undocumented immigrants and smugglers occurs at an increasing frequency throughout the area. Organ Pipe Cactus NM (2001) identified 165 human activities in the range of the pronghorn, of which 112 were adverse, 27 were beneficial, 26 had both adverse and beneficial effects, and 4 had unknown effects. Organ Pipe Cactus NM (2001) concluded that in regard to the pronghorn, "while many projects have negligible impacts on their own, the sheer number of these actions is likely to have major adverse impacts in aggregate.

The current range of the pronghorn in the U.S. is almost entirely comprised of lands under Federal jurisdiction; thus activities that currently affect the pronghorn in the action area are almost all Federal actions. Prior to November 2001, in seven of 12 biological opinions issued by FWS that analyzed impacts to the pronghorn, we anticipated that take would occur. In total, we anticipated take of five pronghorn in the form of direct mortality every 10-15 years, and an undetermined amount of take in the form of harassment. We are unaware of any confirmed take resulting from these actions to date. Given the small and declining population of pronghorn in the U.S., take at the levels anticipated in the biological opinions would constitute a substantial impact to the population.

Changes in the remanded biological opinions have reduced the amount or extent of incidental take anticipated to occur from Federal actions. In total, we anticipate take in 5 of 13 (the original 12 opinions plus the ARNG opinion that now considers effects on the pronghorn) biological opinions issued for the Sonoran pronghorn. This amount of take is less than that anticipated in the original opinions because FWS and the Federal agencies have worked together to minimize the effects of ongoing and proposed activities on the Sonoran pronghorn.

We believe the aggregate effects of limitations or barriers to movement of pronghorn and continuing stressors, including habitat degradation and disturbance within the pronghorn's current range resulting from a myriad of human activities, combined with periodic dry seasons or years, are responsible for the present precarious status of the Sonoran pronghorn in the U.S.

EFFECTS OF THE PROPOSED ACTION

Adverse effects of the action on the pronghorn are anticipated from: (1) livestock grazing that results in habitat degradation, loss/restriction of forage, and that restricts pronghorn movements and potential range expansion, (2) disease transmission from livestock to pronghorn, (3) and construction and maintenance of range improvements (e.g., the construction of New Well) that destroys and/or degrades foraging habitat. However, the BLM's proposed conservation measures will significantly reduce these adverse effects and, in meaningful ways, provide some benefits to pronghorn. Our balancing of these effects follows.

Livestock Grazing

The effects of grazing on Sonoran Desert scrub communities have not been well-studied. Grazing can result in reduced shrub cover (Webb and Stielstra 1979) and numbers of desirable shrubs (Orodho *et al.* 1990) in Mojave Desert scrub and Great Basin Desert scrub, respectively. In general, grazing practices can change vegetation composition and abundance, and cause soil erosion and compaction, reduced water infiltration rates, and increased runoff (Klemmedson 1956, Ellison 1960, Arndt 1966, Gifford and Hawkins 1978, Robinson and Bolen 1989, Waser and Price 1981, Holechek *et al.* 1998, and Loftin *et al.* 2000), leaving less water available for plant production (Dadkah and Gifford 1980).

Changes to the structure and composition of xero-riparian and Sonoran Desert scrub communities can result in increased susceptibility of pronghorn fawns to predators, loss or reduction of suitable thermal cover, and habitat fragmentation. Year-long grazing in Sonoran Desert scrub habitat can, in the long-term, decrease potential cover for fawns (Robinson and Bolen 1989) and reduce thermal cover by suppressing regeneration of trees in xero-riparian areas and by inhibiting growth of sufficient understory and ground cover.

Cryptobiotic crusts, consisting of lichens, fungi, algae, mosses, and cyanobacteria are important soil stabilizers of desert soils (Kleiner and Harper 1972, 1977; Belnap 1992). These crusts decrease wind erosion (Brady 1974 in Anderson *et al.* 1982) and have a significant effect on soil stability and rates of water infiltration (Kleiner and Harper 1972, 1977; Belnap 1992; Belnap and Gardner 1993). These crusts also act to increase the availability of many nutrients in sandy soils (Belnap 1992; Belnap and Gardner 1993). Grazing caused considerable damage to cryptobiotic crusts, resulting in less stable soil conditions at Navajo National Monument, Arizona (Brotherson *et al.* 1983). Trampling can reduce soil stability, soil fertility, and soil moisture retention (Belnap 1992). In cool deserts, the lichen component takes 40 years or more to fully recover (Johansen *et al.* 1991). Cryptobiotic crusts will not likely recover significantly from previous disturbances under a year-long, or even seasonal, grazing regime. Without these crusts, the reestablishment of the potential natural community may not occur (Menke 1988).

The intensity of damage to cryptobiotic crusts and vegetation caused solely by cattle is assumed to be directly proportional to the AUMs of forage used per pasture (BLM 1980). The most severe impacts occur in areas used for loading and unloading cattle, supplemental feeding, watering sites, and salt licks. Note - BLM does not authorize supplemental feeding on the Ajo allotments; however, this likely occurs on the non-BLM portions of the allotments; which is an activity that probably would not occur, but for the proposed action, and is therefore an interelated and interdependent action that must be evaluated herein. In these high use areas, effects to habitat, such as vegetation removal, soil compaction (Orodho *et al.* 1990) and resultant reduction in soil moisture (Daddy *et al.* 1988), and presumably crushing of small cacti, are most prevalent.

Disturbance of soils, including cryptobiotic crusts, and removal of vegetation by grazing combine to increase surface runoff and sediment transport, and decrease infiltration of precipitation (Gifford and Hawkins 1978, Busby and Gifford 1981, Blackburn 1984, DeBano and Schmidt 1989, Belnap 1992, Belsky and Blumenthal 1997). Loss of vegetation cover and trampling of soils promote further deterioration of soil structure, which in turn accelerates vegetation loss (Belsky and Blumenthal 1997). Vegetation loss reduces the amount of thermal and protective cover available for fawns and adults. Rutman (1996) (Appendix 2) describes such conditions within the Cuerda de Lena on BLM land in the Cameron allotment. Furthermore, erosion decreases the ability of the habitat to recover due to loss of nutrients and the seed bank usually present in the topsoil.

Holechek (1988) and Holechek *et al.* (1998) found that, in desert scrub, average utilization rates

of 25-35 percent are appropriate for maintaining range condition. Within that range, several factors determine whether a low, medium, or high value should be selected. Holechek *et al.* (1998) suggest that on ranges in good condition with relatively flat terrain and good water distribution, the higher utilization limit may be appropriate. If the range is in poor or fair condition, or the allotment has thin soils, rough topography, and poor water distribution, the lower utilization rate may be appropriate. BLM's proposal to graze the Ajo allotments at no more than 30 percent utilization is consistent with the recommendations of Holecheck.

Waser and Price (1981) found that in the Sonoran Desert of southern Arizona, "species diversity declines consistently as a function of increasingly recent grazing by cattle. Furthermore, as the vegetation community continues to regress with persistent overgrazing, degradation of the soil/water relationship occurs resulting in a reduction of the carrying capacity for grazing animals even after stocking rates are decreased (Robinson and Bolen 1989). Although grazing has been removed from the Federal lands adjacent to the Ajo allotments west of SR 85 for 15 to 22 years, full recovery of the desert plant communities will likely take a long period of time, potentially many more decades or even centuries (Organ Pipe Cactus NM 2001), without intensive recovery management (Robinson and Bolen 1989).

Waser and Price (1981) found that immediately after the removal of cattle, the increased appearance of species with fairly low abundance may occur rapidly if dormant seeds remain in the soil from production occurring prior to the introduction of cattle and/or reinvasion of the area from ungrazed areas occurs. However, the authors go on to state that at their study sites at the northern boundary of Organ Pipe Cactus NM, most of the dormant seeds are not likely to be viable as grazing was introduced to the area in the early 1900s and they presume that dispersal rate is low, keeping the abundance of under-represented species low for some time. Rutman (1996) reports that aerial photographs taken in 1987, 10 years after the discontinuation of grazing on Organ Pipe Cactus NM, show a contrast in vegetation between ungrazed Organ Pipe Cactus NM land and grazed BLM land, with greater density and higher cover on Organ Pipe Cactus NM. Photographs taken by Rutman in 1995 (Appendix 2) show a contrast in vegetation structure and density and bank stability between grazed and currently ungrazed portions of the Cuerda de Lena Wash. Although full recovery of the range from severe overgrazing will take much longer, clearly measurable recovery can occur over shorter timeframes.

Satellite imagery and aerial photography is an increasingly important tool in the analysis of vegetation communities and the impacts of land uses, and in range management (Tueller 1988, Holecheck *et al.* 2001). A portion of a satellite imagery poster published by J.C. Dohrenwend, sold retail at the Organ Pipe Cactus NM and reproduced with Mr. Dohrenwend's permission (J. Dohrenwend pers. comm. 2001), is shown in Figure 5. In the image, the boundary of BLM Ajo allotments, particularly the Cameron allotment, and their southern and western boundaries with Organ Pipe Cactus NM and Cabeza Prieta NWR, respectively, are clearly visible. We contacted Dr. Stewart Marsh, a professor at the Arizona Remote Sensing Center, University of Arizona, and an expert in the field of remote sensing and interpretation of satellite imagery, to provide input on the tonal difference seen in the image. After examining the image, Dr. Marsh informed us that these types of tonal differences, or differences in contrast, are most likely due to differences in vegetation amount or type. In the cases Dr. Marsh is familiar with, including satellite imagery of the U.S./Mexico border and the National Audubon Society Appelton-Whittle Research Ranch near Elgin, Arizona, tonal variations in the image were correlated with differences in the amount or type of vegetation due to differences in land use. The amount of contrast is usually greatest at times of "green-up" such as after a rainy period, when ephemeral growth is greatest. In all of the cases Dr. Marsh is familiar with, the land use difference was the intensity of grazing, with greater grazing intensity on the lighter side of the image. The type of contrast seen in Figure 5 can also be seen in a landsat image of the Why, Arizona, area. That

image, taken October 10, 1999, is available on the University of Arizona ARIA website (http://aria.arizona.edu, path 37, row 38, TM sensor, bands 1-8). Satellite imagery commercially available from DeLorme (Xmap software) taken during 1999-2001 also shows this same pattern. The contrast between BLM and adjacent land is most consistent with a fence line boundary where different types of land use are occurring, and more specifically where greater grazing intensity correlates with less vegetation or a difference in vegetation type on the "lighter side of the image.

In summary, there are now compelling data available to characterize the differences between grazed and recently ungrazed areas. From the satellite imagery available, it appears that either the amount of vegetation, or the type of vegetation, is markedly different between BLM lands and adjacent lands. Given apparent land uses among jurisdictions and the analyses of Dr. Marsh conducted elsewhere in the Southwest, it is reasonable to attribute the apparent difference on the satellite imagery to ongoing grazing on the BLM lands versus a 16 to 23-year absence of grazing on Organ Pipe Cactus NM and Cabeza Prieta NWR. Despite the visible differences on satellite imagery, BLM's April 2002 Rangeland Health Evaluation discerned only minor changes and differences in plant communities among sites monitored on the Cameron, Why, and Coyote Flats allotments and adjacent sites on Cabeza Prieta NWR and Organ Pipe Cactus NM. We can only assume that problems associated with selection of monitoring sites, consistent application of monitoring protocols, and other analytical and experimental design problems discussed in the Environmental Baseline (pages 28-30) 1) limited or precluded the ability of BLM to accurately evaluate differences among sites, 2) conclusions were based on sites that are not representative of the areas on the whole, and/or 3) the data or analyses are faulty.

Apparent differences on the satellite imagery between grazed and recently ungrazed areas illustrate the effects of past grazing. The BLM has proposed new grazing strategies that may over time improve the condition of the BLM lands relative to adjacent ungrazed lands. BLM proposes to reduce preference on the Cameron Allotment from 2,532 to 684 AUMs, and on the Coyote Flat and Why allotments to from 456 to 132 AUMs. The proposed reduction in preference will prevent the annual use of more than these AUMs, which could occur in the past, but long-term average use is unlikely to change much. Preference dictates the maximum number of livestock that the permittee may graze per year. However, the permittee may elect to graze fewer livestock, and historically, the Ajo allotments have not been grazed at full preference. Over the past 10 years, mean actual use (excluding periods of non-use) was 637 AUMs on the Cameron Allotment, 138 AUMs on the Why Allotment, and 405 AUMs on the Coyote Flat Allotment. Furthermore, mean actual use on the Coyote Flat Allotment over the past 5 years has been only 228 AUMs. Therefore, the proposed reduction in preference may be reflected in a change in long-term actual use only on the Coyote Flat Allotment.

Utilization has been monitored at several transects within the Ajo allotments and was summarized in the Environmental Baseline of this opinion. Table 7 provides a summary of the utilization estimates on the Sentinel, Coyote Flat, Why, and Cameron allotments from 1998 through 2001. As further discussed in the Environmental Baseline, utilization rates in 2001 exceeded 40 percent on the Coyote Flats and Cameron allotments despite the fact that actual AUMs were well below full preference. The BLM now anticipates utilization rates will fall to 30 percent, given the reduction in preference on the Cameron, Coyote Flat, and Why allotments. However, as discussed, reduction in preference is only likely to affect stocking rates, and therefore utilization rates, on the Coyote Flats allotment. Actual use on the Cameron Allotment in 2001, when utilization rates exceeded 40 percent, was 469 AUMs (69 percent of the newly

proposed preference). Utilization rates on the Sentinel allotment cannot be predicted from Table 7, because these data were collected during a period when the allotment was in non-use. Therefore, with the possible exception of the Coyote Flats Allotment, we question whether reduction in preference will result in decreased utilization levels of perennial forage. However, rotation of cattle between the Why and Coyote Flats allotments, exclusion of cattle from the southern portion of the Cameron allotment from May 1 to September 15, and rotation of cattle in the 2 northern pastures of that allotment, as proposed, is likely to allow some regeneration and recovery of perennial plant cover and soils.

Use of ephemeral forage by cattle would occur during and after wet winters that provide for substantial annual plant growth, under certain conditions. No limits are put on the number of cattle that may be authorized for such use; rather stocking levels and permitted use are based on perceived availability of forage. The BLM did not provide historical stocking rates for ephemeral forage use, but permitted ephemeral AUMs are provided in Table 1. No ephemeral use has been requested on either the Why or Coyote Flats allotments since 1971. On the Cameron, Childs, and Sentinel allotments, ephemeral use was permitted 64, 17, and 32 percent, respectively, of years for which there are records since 1970. In those years in which ephemeral use was permitted, mean permitted AUMs were 2,549, 6,308, and 1,039 for the Cameron, Childs, and Sentinel allotments, respectively. These permitted AUMs are much higher than the current permitted annual use; and because ephemeral use occurs only during a few months, large numbers of cattle are on these allotments during periodic spring green ups. For instance, if 2,549 AUMs of cattle use occurred on the Cameron allotment over a 4 month period (a typical spring greenup), this would equate to about 637 additional cattle, or an increase in stocking rate of over an order of magnitude above the base herd of 57. In 1979, 8,250 AUMs of ephemeral use was authorized on the Cameron allotment. This would equal about 2,062 additional cattle for 4 months. In years with good annual plant production, forage available to pronghorn is not limiting, unless the greenup is local. Thus, our concern with ephemeral forage use by cattle is not one of competition for forage (unless the greenup is limited to or primarily on the allotments), but rather with habitat damage associated with large numbers of cattle. Cattle are not only consuming ephemeral forage at this time, but are also eating desirable perennial shrubs and grasses; trampling cryptobiotic crusts, banklines, and germinating perennial shrubs, trees, and cacti; and causing soil compaction. It is during these periodic, brief wet periods that plants and cryptobiotic crusts have an opportunity to reproduce and achieve substantial germination and growth. Large numbers of cattle at this very crucial time for plants likely causes long-term degradation of plant communities and soils. The differences visible on the satellite imagery (Figure 5) between the allotments and the recently ungrazed adjacent portions of Organ Pipe Cactus NM and Cabeza Prieta NWR are most evident on the Cameron allotment. The primary difference in management between the Cameron allotment and the Why and Coyote Flats allotments is the absence of ephemeral grazing on the latter 2 allotments. Thus, ephemeral grazing on the Cameron allotment could be a primary cause of the deteriorated conditions visible on Figure 5 and other satellite imagery available to us.

The BLMs decision to approve ephemeral authorizations on the Cameron, Childs, Coyote Flats, and Why allotments west of SR 85 will hinge on the availability of forage and the status of the pronghorn. In regard to availability of forage, BLM would not authorize ephemeral grazing in years when ephemeral plant production is geographically limited, and ephemeral forage on the Ajo allotments is an important part of ephemeral forage available to pronghorn, either in terms of forage quality or acreage of greenup. During winter and spring periods when ephemeral plants are abundant and ephemeral use could be authorized, forage is typically not limiting for pronghorn. The winter storm systems that facilitate ephemeral greenup are generally widespread so that if the Ajo allotments green up, ephemeral forage is probably produced elsewhere within

the range of the pronghorn, as well. However, in some years winter storms and associated greenup may be localized. For instance, in 2002 some greenup occurred in the Mohawk Valley, but the remainder of the pronghorn's range did not receive enough rainfall to produce ephemeral forage. In such years, the few areas with ephemeral forage become important for recruitment of fawns (Hervert *et al.* 2000) and, based on experience in 2002, survival of pronghorn in severe drought years. BLM's decision not to authorize ephemeral grazing in years where ephemeral plant production is geographically limited and ephemeral forage on the Ajo allotments is an important part of ephemeral forage available to pronghorn, results in avoidance or minimization, of any issues regarding competition for annual plants between pronghorn and cattle.

In regard to the status of the pronghorn, the BLM would not authorize ephemeral grazing on the 4 allotments west of SR 85 unless the pronghorn population is above 100 and increasing. The Ajo allotments are important in the long-term recovery potential of the pronghorn. Availability of quality habitat is a limiting factor for pronghorn recovery and ephemeral grazing causes habitat deterioration and impedes or precludes habitat restoration. Furthermore, the Ajo allotments receive more rainfall than most portions of the pronghorn's current range, thus these lands are disproportionally important in terms of potential forage production. Based on the PVA, at 100 or fewer animals population viability declines at an increasingly steep rate. Authorization of ephemeral grazing and its habitat deterioration when the pronghorn population is below 100 would be contrary to the recovery needs of the species. By agreeing to not authorizing ephemeral grazing when the population is at 100 or below, or above 100 and not increasing, the BLM removes effects associated with ephemeral grazing at a time when pronghorn are most vulnerable. At the current estimated population 25-50 pronghorn, ephemeral grazing probably will not be authorized in the near future on the 4 allotments west of SR 85, if at all during the 10-year project life. We expect at least some improvement in habitat conditions for pronghorn resulting from anticipated reduced ephemeral authorizations on the Cameron allotment. Resumption of ephemeral grazing and the deterioration of habitat it causes will not occur until the pronghorn population is past the current crises (i.e., the population is over 100 and increasing). Also, ephemeral authorizations are now subject to BLM's ephemeral guidelines in the Arizona Standards and Guidelines, which limit ephemeral authorizations more than in the past.

Trespass of livestock from the Ajo allotments has been reported on both Cabeza Prieta NWR and Organ Pipe Cactus NM, particularly after a precipitation event that may wash out areas adjacent to fences and allow cattle to pass underneath (S. Rutman, NPS, pers. comm. 2001; D. Segura, FWS, pers. comm. 2001). Impacts to Sonoran pronghorn habitat from trespass cattle will continue to occur as a result of the proposed action. The presence of trespass cattle in these areas inhibit the on-going recovery of pronghorn habitat. In addition to the impacts from the cattle, returning cattle to the allotments causes an increase in vehicle and human disturbance in pronghorn habitat. The severity of impacts depends on the frequency, duration, distance from the allotments, time of year (i.e., during fawning season or not), and number of trespass cattle.

Burkhardt and Chamberlain (1982) found that, regardless of seasonal differences in species availability, grasses, forbs, and shrubs were consistent components of the diet of cattle in the Mojave Desert. They also found that in seasons or years when ephemeral vegetation was available, such plants "provided the bulk of the cattle food consumption (Burkhardt and Chamberlain 1982). According to BLM's 1995 EA, cattle are physiologically driven to keep their rumens full even when available forage is of low quality. Furthermore, the EA states that "in areas where grass is not an abundant part of the vegetation composition, cattle are opportunistic foragers. BLM's preliminary analysis of the range conditions of the five allotments report that in several cases, the amount of perennial grass is less than BLM resources specialists would recommend for cattle grazing. Sufficient forage, both pre- and post-natal, is

necessary for reproductive success in pronghorn, as well as maintaining the health of adult pronghorn. We believe that the continued presence of livestock within the range of the Sonoran pronghorn may result in competition for forage that is already limited by local precipitation, contributing to low fawn recruitment and increased susceptibility to predation and/or disease.

Sonoran pronghorn currently occupy less than 10 percent of their historic range. They require vast areas of unencumbered open range to meet their annual survival and reproductive needs (FWS 2001). Pronghorn travel long distances between localized, seasonally sporadic rainfall events in search of resources. The five allotments addressed in this opinion are within the historic range of this subspecies. Potential for expansion is limited, but is crucial for the continued survival and recovery of the pronghorn (FWS 2001). BLM land west of SR 85 amounts to approximately 90,000 acres (Organ Pipe Cactus NM 2001) of sporadically occupied habitat. The potential for the pronghorn to use a greater extent of this habitat is apparently limited by the continued livestock grazing and human activities associated with grazing and recreation.

Childs Valley and Valley of the Ajo, which are within and immediately west and south, respectively, of the Ajo allotments, are important pronghorn use areas and should provide corridors for seasonal movements onto the allotments. Yet telemetry data collected by AGFD from 1994 though 2001, show very few observations of radio-collared pronghorn within the Ajo allotments or the Sentinel Allotment. The lack of observations is very distinct at the fencelines between Cabeza Prieta NWR and Organ Pipe Cactus NM and the Ajo allotments (Figure 4). Pronghorn clearly use the habitat immediately west of the boundary of the Cameron and Childs allotments and the habitat immediately south of the Cameron and Coyote Flat allotments, but rarely cross the fenceline into BLM land. Both the Cabeza Prieta NWR and Organ Pipe Cactus NM fences are "pronghorn friendly (bottom strand of the fence is of smooth wire, raised 16-18 inches from ground level) and have been so since 1980-1981 and the late 1980s-1999, respectively. It is possible that the fences are still perceived as a barrier by the pronghorn. However, pronghorn had been observed passing through the fence between Cabeza Prieta NWR and Organ Pipe Cactus NM, which was not pronghorn friendly, prior to its removal (S. Rutman, NPS, pers. comm. 2001). The reason for the pronghorn's apparent reluctance to cross the fence into the Ajo allotments is not entirely clear, but is likely a combination of factors, and may include the pronghorn friendly fence still acting as a barrier, inherent differences in habitat, such as fewer chain fruit cholla on the BLM lands, a lack of adequate resources (discussed above), the human disturbances associated with the grazing operations, and recreation within the Ajo allotments.

The Sonoran pronghorn's current range is boxed in by highways, railroads, fences, and canals. The fencing between adjacent Federal lands cannot be removed unless livestock grazing ceases west of SR 85. Although pronghorn friendly, these fences may still act as a barrier to movement. We believe the presence of the fencing restricts an important movement corridor for the pronghorn and, in conjunction with habitat degradation, is restricting the pronghorn's ability to expand its current range.

Disease Transmission

Blood samples collected from Sonoran pronghorn between 1994 and 2000 tested positive for antibodies for both BTV and EHDV, and samples from 1994 tested positive for leptospirosis, documenting exposure to these diseases. Leptospirosis can be caused by any of over 189 known serovars of the spirochete *Leptospira interogans,* and the causative organism may infect a large variety of domestic and wild animals, including humans. Samples collected in 1994 documented

the pronghorn's exposure to *Leptospira interrogans* serovar *hardjo*, which is a serovar carried by cattle and sheep. Despite apparent exposure, no Sonoran pronghorn have been observed with clinical signs of these diseases (J. Hervert, pers. comm.).

Large die-offs of white-tailed deer from BTV and EHD have been documented. While white-tailed deer are particularly susceptible to these diseases; mule deer and pronghorn are also affected. In 1962, an outbreak of EHD caused the deaths of 440 white-tailed deer, as well as 18 mule deer and 13 pronghorn (Chalmers *et al.* 1964). In 1976, an epizootic of EHD resulted in the deaths of approximately 4,000 pronghorn in Wyoming (Halls 1984). Therefore, these diseases have the potential to greatly reduce, if not eliminate, the small U.S. sub-population of pronghorn, should an outbreak occur.

Cattle, mule deer, white-tailed deer, desert bighorn sheep, and the Sonoran pronghorn make up the common vector host pool of the hemorrhagic diseases within the range of the Sonoran pronghorn (T. Noon, Arizona Veterinary Diagnostic Lab, pers. comm. 2001). However, it is generally accepted that cattle serve as the major reservoir for BTV. Artificial water sources, such as charcos (livestock watering ponds), likely provide wet sediment habitat for biting midge larvae. Furthermore, in the arid Southwest concentrated water sources may present an even greater hazard, because midges transmitting these diseases will likely be concentrated in these areas. In Wyoming, BTV transmission in pronghorn occurred when animals drank from sources where low-water levels concentrated infected arthropods in drinking areas.

The presence of livestock within the action area increases the potential for the exposure of Sonoran pronghorn to leptospirosis, BTV, and EHDV. Disease transmission between cattle and wild ungulates is possible because of crowding at watering resources and also due to the herding behavior of cattle and wild hoofstock, which are different. Cattle tend to move slowly together browsing, feeding and drinking altogether; wild ungulates move more quickly, are more easily "spooked , and tend to not congregate as groups (e.g., deer and antelope herds tend to stay clear of each other). This latter behavior may suggest that transmission of disease among wild hoofstock is less likely than that between cattle and wild ungulates. This is particularly true of potential disease transmission between pronghorn and bighorn sheep, because these species use very different habitats.

While the effect of increased exposure to these diseases is not entirely known, some adult pronghorn mortality may, in whole or in part, be attributable to one or more of these diseases. Furthermore, exposure to these diseases may be a factor in the low recruitment rate through decreased productivity and fawn mortality. The survival and recovery of the Sonoran pronghorn depends on an annual fawn crop of a least 30 percent, which has only occurred twice since 1992. Given the extremely small population size and current debilitated state of the remaining Sonoran pronghorn, this species is at heightened risk for disease. The risk of exposure to disease due to the presence of livestock, no matter how slight, decreases the likelihood of a reversal in the current decline of the U.S. sub-population, and increases the risk of extirpation. During the current serious drought situation, doing nothing may have serious consequences for both cattle and pronghorn. Taking control and corrective measures is necessary now to reduce contact between cattle and pronghorn, to control potential sources of infection, and to help alleviate environmental situations that increase the risk of animals being affected by these diseases.

Construction and Maintenance of Range Improvements

The permittee of the Cameron Allotment has proposed to redevelop an existing, non-functioning range improvement to replace or supplement the earthen reservoir referred to as Bob's Tank. The redeveloped water, referred to as New Well, is proposed to consist of a submersible pump, a

10,000-gallon storage tank, approximately three miles of plastic PVC pipe, and a water trough. The pipeline will be installed adjacent to an existing road in order to decrease surface disturbance.

Construction of New Well would cause temporary disturbance of any pronghorn in the area as a result of human activity associated with such construction. Disturbance could be especially important if construction occurs during the critical fawning period (March 15 through July 15). Studies by Workman *et al.* (1992) showed American pronghorn experienced changes in heart rate and body temperature when persons walked past the animal, drove past, or when a person entered the enclosure. Degradation of habitat around the new water is expected to occur from future concentrations of cattle in the area.

Effectiveness of Conservation Measures

The BLM has proposed 14 measures to reduce adverse effects to the pronghorn and its habitat. To address impacts to vegetation communities and forage resources, the BLM will not authorize ephemeral grazing on the portions of the Cameron, Coyote Flats, Childs and Why allotments west of SR 85, except under certain conditions. As discussed on pages 49 and 50, this conservation measure avoids or largely minimizes effects of ephemeral grazing on pronghorn and its habitat. BLM will implement a forage enhancement project on the Cameron Allotment, starting in Fiscal Year 2004, although we doubt if it will be very effective (see discussion below). BLM will develop a drought policy for the Ajo allotments to more consistently guide BLM in addressing the authorization of grazing use in Sonoran pronghorn range when drought situations occur. In the short-term, this policy would determine how to assess the end of the current drought and thus determine when or under what conditions livestock would be authorized to return to the Ajo grazing allotments and to the Sentinel Allotment. In the long-term, this policy would establish conditions outlining when BLM would require removal of livestock due to future onsets of drought, and when BLM would allow grazing use to return to the public land following those future occurrences. The BLM will also install ground-level drinking troughs for use by pronghorn, outside of the corrals, on three livestock wells in the Cameron Allotment. The troughs will be located in the southern part of the allotment where the proposed action calls for no summer grazing.

Reversal of the current decline of the Sonoran pronghorn should be facilitated by ensuring adequate forage and cover is available for adult and fawn survival. The forage enhancement proposal conceptually could have some benefits in regard to offsetting the effects of forage use by cattle. Such plots are also being implemented on the BMGR. BLM proposes to water the plots during the growing season, but cattle will be in that pasture until May 1, and we suspect that in dry years, when the forage would be of most value to pronghorn, cattle will heavily use the watered areas and may preclude any benefits to pronghorn. Cattle and pronghorn may also congregate at these watered sites, increasing the chances of disease transmission. Furthermore, BLM has not said how large an area will be irrigated. Thus, this measure may not benefit pronghorn. Cattle are currently removed from 4 of the 5 allotments due to the current drought policy (there are about 14 cattle remaining on the private land portion of the Childs allotment). Removal of cattle during drought can benefit pronghorn by eliminating any potential for forage competition during periods when forage is in least supply. The effectiveness of this measure in reducing effects to Sonoran pronghorn will be dependent on the details of the drought policy. BLM proposes to construct 2-3 drinking troughs for pronghorn at corrals on the Cameron allotment. The troughs would only be filled during the summer months when cattle are not present. These troughs could be especially important for pronghorn during the hot summer months, particularly in times of drought when other water sources are dry. They may encourage

greater summer pronghorn use of the Cameron allotment and nearby portions of Organ Pipe Cactus NM and Cabeza Prieta NWR. We will work with BLM to ensure that these troughs are not near existing tanks that may support biting midges that carry diseases.

The modification of fencing between boundaries of the Cameron, Why, and Coyote Flat allotments was initially proposed (as described in the 1995 EA and the project description of the December 3, 1997, opinion) to be conducted as fencing needed to be repaired or replaced. However, BLM decided to replace the 18 miles of fencing all at once in 2000. Therefore, all of the fencing, except for some fencing around livestock water sources, within and adjacent to the Ajo allotments are pronghorn friendly, reducing the potential for pronghorn to become entangled and/or injured if they should attempt to pass through. BLM further proposes to lay down portions of the fences between Cameron allotment and Organ Pipe Cactus NM and Cabeza Prieta NWR during the summer period (May 1- September 15), when cattle are not present. Organ Pipe Cactus NM and Cabeza Prieta NWR personnel have agreed to allow the fences (which belong to those entities) to be laid down. BLM proposes to lay down 35 to 50 percent of the areas shown on Figure 2. If the fence is acting as a partial barrier, as we suspect it is, letting down portions of the fence would provide corridors for pronghorn to move onto the BLM lands during May 1 - September 15. Use of the BLM lands by pronghorn during this period would provide additional foraging opportunities during the hottest and driest periods of the year. We would work with BLM to identify portions of the fence that correspond to likely movement corridors to increase the effectiveness of this measure.

BLM will construct a pronghorn-friendly fence to contain livestock in the northern part of the Cameron Allotment from May 1 to September 15 of each year. Although we have concerns of fences acting as barriers, this fence should benefit Sonoran pronghorn by reducing the overlap with livestock during the summer months, when pronghorn are more likely to use this part of their range. Also, the fence would lie along the southern edge of Little Ajo Mountains and pronghorn have been observed north of the proposed fenceline very infrequently in the last decade (Figures 2 and 3). Separation of livestock and pronghorn during the summer months should reduce the potential for disease transmission. The fence will prevent livestock from using proposed pronghorn water developments on the Cameron allotment during the summer months, and it will reduce the possibility of livestock exiting the allotment onto Cabeza Prieta NWR and Organ Pipe NM while exterior boundary fences are laid down.

Within 60 days of the date of this Biological Opinion, BLM will provide this office with full descriptions, including photographs and diagrams, of all existing livestock water sources within the allotments west of SR 85. Based on the study described below, BLM will work with us to determine any necessary modification to each water source to 1) reduce the potential of the source to provide breeding habitat for biting midges, 2) provide safe access for Sonoran pronghorn, and 3) ensure that such modifications do not result in adverse effects to other listed species in the vicinity. Based on the assessment of water sources, work will begin in FY 2003 on those tanks and charcos on the Cameron, Why, and Coyote Flat allotments that are no longer functioning and are not needed to support livestock operations. These tanks will be breached or in other ways dried so that they do not create conditions conducive to biting midge propagation.

Within 6 months of this Biological Opinion, BLM will initiate or cooperate in development of a study of the potential for disease transmission from livestock to pronghorn in the Ajo Allotments. If funding is not made available for the study, or if the study determines that the potential for disease transmission is a significant concern for the pronghorn, this consultation will be reinitiated. This study should help determine the existence of vectors and whether or not they carry the pertinent diseases.

It is difficult to fully assess how effective the above measures will be in reducing the threat of cattle-borne diseases affecting or causing mortality of Sonoran pronghorn. Work on the non-functioning tanks and charcos will begin within a year, but disease transmission at other water sources or via other disease vectors (such ticks, aerosolized or direct contact of infected fluids or tissues, and contact with cattle feces - see Status of the Species) may not be addressed for years, pending the outcome of the disease transmission study.

Strict enforcement of the 14-day camping limit may minimize direct and indirect impacts to pronghorn habitat by decreasing unauthorized long-term use. BLM will also rehabilitate, to the extent necessary and practicable, heavy-use recreational areas. Some areas, particularly an area just west of SR 85 and north of the Organ Pipe Cactus NM boundary (Coyote Flat allotment), continue to receive heavy recreational use during the winter months. Without rehabilitation of recreational areas, these areas will continue to degrade surrounding habitat through soil compaction and loss of vegetation, increasing the potential for significant erosion (Rutman 1996). Erosion results in a loss of vegetation used by pronghorn for thermal cover and protective cover from predators, particularly for fawns. Concentrating the recreational use into the Gunsite Wash area, and demarcating the boundaries of this area to control expansion, should help reduce recreational use in other areas, which should benefit the Sonoran pronghorn.

BLM will implement a seasonal (March 15-July 15) public closure of roads, trails, and camping areas south of Darby Well/Scenic Loop Road and the road to Chico Shunie; these closures will be carried over as a proposed action in the draft Land Use Plan amendment process. These closures are consistent with those on the Organ Pipe Cactus NM, Cabeza Prieta NWR, and the Barry M. Goldwater Range. The closure will not include the Gunsite Wash area, as recreational use will be directed to that area. This closure should reduce disturbance of Sonoran pronghorn by human activities. BLM's proposed route designation process is expected to limit vehicle access to fewer routes, close routes in sensitive areas, and probably reduce illegal off-road vehicle use. The effect on pronghorn and its habitat will depend on the number of route closures that result, particularly in sensitive areas for the pronghorn

BLM's continued and additional contribution on-going monitoring, research, and implementation of recovery actions provides benefits to the survival and recovery of the pronghorn. The extent and immediacy of such benefits vary depending on the action and the degree to which BLM commits resources and funding. Monitoring and research are typically long-term efforts that indirectly benefit pronghorn by increasing our knowledge of the status, life history, and habitat requirements of this subspecies. Recovery actions may benefit the pronghorn immediately (i.e., installation of guzzlers) or later in time (i.e., habitat restoration).

Collectively, the proposed conservation measure should significantly reduce the effects of livestock grazing in the Ajo Allotments, including reduction of forage competition, adverse effects to pronghorn habitat, barriers to movement, and potential for disease transmission.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Relatively small parcels of private and State lands occur within the currently-occupied range of the pronghorn near Ajo and Why, north of the BMGR from Dateland to Highway 85, and from

the Mohawk Mountains to Tacna. State inholdings in the BMGR were recently acquired by the Department of Defense. Continuing rural and agricultural development, recreation, vehicle use, grazing, and other activities on private and State lands adversely affect pronghorn and their habitat. MCAS-Yuma (2001) reports that 2,884 acres have been converted to agriculture near Sentinel and Tacna. These activities on State and private lands and along the Mexican border, and the effects of these activities are expected to continue into the foreseeable future. Historical habitat and potential recovery areas currently outside of the current range are also expected to be affected by these same activities on lands in and near the action area in the vicinity of Ajo, Why, and Yuma.

Of particular concern are increasing illegal border crossings by undocumented immigrants and smugglers. Deportable migrant apprehensions by Border Patrol agents in the Ajo Station increased steadily from 9,150 in 1996 to 20,340 in 2000. In 2001, estimates of undocumented migrants traffic reached 1,000 per night in Organ Pipe Cactus NM alone (Organ Pipe Cactus NM 2001), and were estimated at 150,000 for that year (Milstead 2002). Increased presence of Border Patrol in the Douglas, Arizona area, and in San Diego (Operation Gatekeeper) and southeastern California, have pushed undocumented immigrant traffic into remote desert areas, such as Cabeza Prieta NWR, Organ Pipe Cactus NM, and BMGR (Klein 2000). Illegal activities result in habitat damage in the form of new roads, discarded trash, cutting of firewood, illegal campfires and increased chance of wildfire (Organ Pipe Cactus NM 2001), and likely results in disturbance of pronghorn. These activities are anticipated to continue into the future and may continue to increase.

CONCLUSION

After reviewing the current status of the Sonoran pronghorn, the environmental baseline for the action area, the effects of the proposed and ongoing BLM action, and the cumulative effects, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Sonoran pronghorn. No critical habitat has been designated for this species, therefore, none will be affected. In making our determination, we considered the following:

1. The status of two of the three sub-populations of Sonoran pronghorn are in decline and in serious danger of extirpation. Only the southernmost sub-population, south and west of Caborca, appeared stable in 2000, with numbers at 311 individuals. The current year's drought has exacerbated the decline of the U.S. sub-population, and extirpation may be imminent without immediate actions to reverse the declining trend. The response of the Mexican sub-populations to the drought is unknown; however, their numbers have likely declined as well.

2. The U.S. sub-population declined markedly from 179 in 1992 to 99 in 2000, but rebounded to an estimated 140 in 2001. Increased adult mortality, debilitation, stress, and lack of recruitment as a consequence of the severe drought in 2002, has reduced numbers to an estimated 25-50 individuals. At this level, population viability is low and genetic variability is expected to erode. The population is also aging and typically exhibits poor recruitment.

3. Although fawn survival and recruitment is correlated with precipitation and forage production, the decline in numbers observed from 1992 through 2000 occurred during a period of normal fluctuations in precipitation; no drought occurred in the 1990s. This suggests factors other than abnormally low precipitation, possibly including disease, have resulted in the overall decline of this subspecies.

Furthermore, pronghorn are adapted to the harsh conditions of the Sonoran Desert. This subspecies has undoubtedly survived periods of drought worse than the current drought of 2002. This suggests that changes to pronghorn habitat resulting from human activities and other unknown threats have decreased the subspecies' ability to endure even relatively short periods of drought. While drought is the proximate cause of the pronghorn's decline during 2002, human-induced changes to their habitat and behaviors caused a variety of factors and activities, such as past and current grazing on the BLM lands and elsewhere, military activities, illegal activities on the border and law enforcement response, and human-created barriers to movement, etc., remain the ultimate cause.

4. This U.S. population of pronghorn is subjected to a myriad of human activities that cause a variety of adverse effects to habitat and disturbance to pronghorn. Activities include, but are not limited to: livestock grazing (with concomitant increased risk of disease), recreation, military and other overflights, ground-based military activities, live ordnance delivery at military targets, and an increasing influx of undocumented aliens and corresponding response from the U.S. Border Patrol. The range of the U.S. pronghorn sub-population is limited by highways, fences, canals, and towns that act a physical barriers to pronghorn movement and prevent them from accessing forage areas and, during drought, oases such as the Gila River and Rio Sonoyta.

5. The actions proposed by BLM must be evaluated in the context of an environmental baseline and cumulative effects that have left the status of the U.S. pronghorn sub-population in a dire state and in immediate danger of extirpation. BLM activities occur over approximately 90,000 ac of Sonoran pronghorn habitat. Of greatest concern is the habitat degradation and loss/restriction of forage, restriction of movement corridors and potential for range expansion, and increased potential for disease transmission from livestock to pronghorn. Grazing changes the composition, structure, and abundance of vegetation, and causes destruction of cryptobiotic crusts, soil erosion and compaction, reduced water infiltration rates, and increased runoff reducing the habitat's ability to provide forage, fawn cover, and thermal cover. The presence of cattle in the currently limited range of the pronghorn results in a source of competition for vegetation and water resources. Habitat degradation and/or fencing at the boundary of the Ajo allotments appear to be restricting an important pronghorn movement corridor, as well as regular use of historic habitat that is now only sporadically accessed. Presence of livestock within the range of the Sonoran pronghorn increases the potential for not only continued exposure to diseases, but also those environmental situations to occur that are potentially fatal to adult pronghorn, can cause stress, debilitation and attendant reproductive failure, and increased fawn mortality.

6. The BLM has proposed conservation measures that significantly reduce the effects of the proposed action on the Sonoran pronghorn by 1) improving the accessibility of the area to pronghorn using lay-down fences; 2) improving the habitat quality and availability of forage for pronghorn by limiting ephemeral grazing, not grazing the southern portion of the Cameron allotment during the summer, rotating cattle use on the Cameron, Why, and Coyote Flats allotments, and by restoring heavy-use recreational areas; 3) increasing the availability of water by providing drinking troughs on the Cameron Allotment; 4) reducing the amount of human disturbance by focusing recreational use into the Gunsite Wash area, enforcing the 2-week visitor use limit, and seasonally closing roads; and 5) reducing the potential for transmission of disease by constructing a fence to contain livestock in the northern portion of the Cameron Allotment during the summer months

when pronghorn are most likely to use the southern portion of the allotment, modifying unneeded water sources to reduce habitat for biting midges, and conducting a study to determine the significance of the potential for disease transmission.

In summary, our conclusion that the proposed action is not likely to jeopardize the continued existence of the Sonoran pronghorn is based on our analysis of the status of the pronghorn rangewide, the environmental baseline, the effects of the proposed action, and the cumulative effects. To summarize from the "Status of the Species , the status of the pronghorn rangewide is poor, with populations in the Pinacate Region of Sonoran and in the United States being most threatened. Fragmentation of populations, loss of historical habitats, disease, and human-caused degradation of remaining habitats and disturbance of pronghorn are the most important causes of poor rangewide status. As discussed in the "Environmental Baseline , within the action area, we believe the aggregate effects of limitations or barriers to movement of pronghorn and continuing stressors, including habitat degradation and disturbance within the pronghorn's current range resulting from a myriad of human activities and disease exposure from those activities, combined with periodic dry seasons or years, are responsible for the present precarious status of the Sonoran pronghorn in the U.S. The dramatic impacts to the U.S. sub-population of pronghorn resulting from the 2002 drought have undoubtedly been exacerbated by the human-induced degradation of their habitat and human-created barriers, which restrict their movement. Cumulative effects, particularly illegal crossings of the border and travel through pronghorn habitat by smugglers and undocumented immigrants, add additional stressors to pronghorn populations.

At the current time the environmental baseline with respect to the Sonoran pronghorn is declining. However, the high fawn to doe ratio experienced in 2001 when rainfall was abundant and timed well for forage production provides evidence of the reversible nature of the current decline. BLM can mitigate its contribution to future declines of the pronghorn through prompt and full implementation of their conservation measures. BLM can do nothing to mitigate for the decline of the pronghorn caused by drought and barriers such as Interstate 8 and the U.S. border fence. When added to the environmental baseline, the status of the species, and cumulative effects, the effects of BLM's proposed action, which includes significant new conservation measures, do not reduce appreciably the likelihood of survival and recovery of the subspecies in the wild. Therefore, the continuing BLM action, with modifications and conservation measures, will not jeopardize the continued existence of the subspecies. As proposed, BLM actions do not significantly adversely affect important fawn recruitment or significantly adversely affect occupied pronghorn habitat. Concerns about habitat deterioration, forage conditions, barriers to movement, and disease are minimized. In determining that the proposed action is not likely to jeopardize the continued existence of the pronghorn, we assume that the conservation measures will be implemented fully and promptly.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA 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 FWS 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 FWS 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 provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Amount or Extent of Take Anticipated

With implementation of the proposed action with the conservation measures, we do not anticipate take of Sonoran pronghorn as a result of the proposed action.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. We recommend implementing the following actions:

1. The BLM should prepare a Sonoran pronghorn spreadsheet database from all historical sighting in the agency files and support an annual program of documenting wildlife sightings (including pronghorn) by employees that can be shared with other agencies and placed in the Sonoran pronghorn database that is being managed by Luke AFB.

2. The BLM should coordinate with Organ Pipe Cactus NM and Cabeza Prieta NWR to determine the extent of, and the appropriate measures to correct the effects of erosion.

3. BLM should propose measures to improve pronghorn habitat on the Sentinel allotment, similar to those proposed herein for the other 4 allotments.

4. BLM should find a way to develop forage enhancement plots where cattle would not have access to them. Alternatively, BLM could transfer the funds they would use to develop these plots to Cabeza Prieta NWR or DOD to develop an additional forage enhancement plot outside of the allotments.

In order for us to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, we request notification of the implementation of any conservation recommendations.

CACTUS FERRUGINOUS PYGMY-OWL (*Glaucidium brasilianum cactorum*)

STATUS OF THE SPECIES

A. Description and legal status

Cactus ferruginous pygmy-owls are small birds, averaging 6.75 inches in length. Pygmy-owls are reddish-brown overall, with a cream-colored belly streaked with reddish-brown. Males average 2.2 ounces and females average 2.6 ounces. The eyes are yellow, the crown is light streaked, and there are no ear tufts. Paired black spots on the nape suggest eyes. The tail is long for an owl and reddish-brown in color with dark bars.

FWS listed the Arizona population of the pygmy-owl as a distinct population segment (DPS) on March 10, 1997 (FWS 1997 [62 FR 10730]). The past and present destruction, modification, or curtailment of habitat is the primary reason for the decrease in population levels of the pygmy-owl. On July 12, 1999 we designated approximately 731,712 acres of critical habitat, which supported riverine, riparian, and upland vegetation and was divided into seven critical habitat units, located in Pima, Cochise, Pinal, and Maricopa counties in Arizona (FWS 1999 [64 FR 37419]). However, on September 21, 2001, the U.S. District Court for the District of Arizona vacated this final rule designating critical habitat for the pygmy-owl, and remanded its designation back to us for further consideration. A recovery plan is in preparation.

B. Life history

A detailed description of the life history and ecology of the pygmy-owl may be found in the Birds of North America (Proudfoot and Johnson 2000), Ecology and conservation of the cactus ferruginous pygmy-owl in Arizona (Cartron and Finch 2000), and other information available at the Arizona Ecological Services Field Office. Information specific to the pygmy-owl in Arizona is limited. Research in Texas has provided useful insights into the ecology of the subspecies, and in some instances represents the best available information; however, habitat and environmental conditions are somewhat different in Arizona and conclusions based on Texas information are tentative.

The pygmy-owl is crepuscular/diurnal, with a peak activity period for foraging and other activities at dawn and dusk. During the breeding season, they can often be heard calling throughout the day, but most activity is reported between one hour before sunrise to two hours after sunrise, and late afternoon/early evening from two hours before sunset to one hour after sunset (Collins and Corman 1995).

Pygmy-owls are considered non-migratory throughout their range by most authors, and have been reported during the winter months in several locations, including Organ Pipe Cactus NM (R. Johnson unpubl. data, T. Tibbitts, Organ Pipe Cactus NM, unpubl. data). Pygmy-owls begin nesting activities in late winter to early spring. In Arizona differences between nest sites may vary by as much as two months (Abbate *et al.* 1996, S. Richardson, AGFD unpubl. data). As with other avian species, this may be the result of a second brood or a second nesting attempt following an initial failure (Abbate *et al.* 1996). In Texas, juveniles remained within approximately 165 feet of adults until dispersal. Dispersal distances (straight line) of 20 juveniles monitored from their natal sites to nest sites the following year averaged 5 miles (range of 0.75 to 19 miles, G. Proudfoot unpubl. data). Telemetry studies of dispersing juveniles in Arizona during 1999 and 2000 ranged from 1.4 to 12.9 miles (straight line distance) (n = 6, mean = 6.2 miles) in 1999, and 1.6 to 11.7 miles (n = 6, mean = 5.8 miles) in 2000 (S. Richardson and M. Ingraldi, AGFD unpubl. data). Pygmy-owl telemetry studies have documented movement of owls between southern Pinal County and northwestern Tucson (S. Richardson and M. Ingraldi, AGFD unpubl. data). Juveniles typically dispersed from natal areas in July did not appear to defend a territory until September. They may move up to one mile in a night; however, they typically fly short distances from tree to tree instead of long single flights (S. Richardson, AGFD unpubl. data). Subsequent surveys during the spring have found that locations of male pygmy-owls are in the same general location as last observed the preceding fall.

Apparently unpaired females may also remain in the same territory for some period of time. In the spring of 2001, an unpaired female (the male died in 2000) remained in its previous years' territory well into the spring, exhibiting territorial behavior (calling) for 2 months until ultimately switching territories and paring with an unpaired male and successfully nesting (S. Richardson,

AGFD unpubl. data). Researchers suspect that if this unpaired female could have attracted an unpaired male during that time, she would have likely remained in her original territory. Apparently at some point the urge to pair is too strong to remain and they seek out new mates.

In Texas, Proudfoot (1996) noted that, while pygmy-owls used between 3 and 57 acres during the incubation period, they defend areas up to 279 acres in the winter. Therefore, a 280-acre home range is considered necessary for pygmy-owls. Proudfoot and Johnson (2000) indicate males defend areas with radii from 1,100 - 2,000 feet. Initial results from ongoing studies in Texas indicate that the home range of pygmy-owls may also expand substantially during dry years (G. Proudfoot unpubl. data).

C. Habitat

A variety of vegetation communities are used by pygmy-owls, such as: riparian woodlands, mesquite (*Prosopis* spp.) "bosques (Spanish for woodlands), Sonoran Desert scrub, and semidesert grassland communities invaded by mesquite and shrubs, as well as nonnative vegetation within these communities. While plant species composition differs among these communities, there are certain unifying characteristics such as the presence of vegetation in a fairly dense thicket or woodland, the presence of trees or saguaros (*Carnegiea gigantea*) large enough to support cavity nesting, and elevations below 4,000 feet. Historically, pygmy-owls were associated with riparian woodlands in central and southern Arizona. Plants present in these riparian communities include cottonwood (*Populus* spp.), willow (*Salix* spp.), and hackberry (*Celtis* spp.). Cottonwood trees are suitable for cavity nesting, while the density of mid- and lower-story vegetation provides necessary protection from predators and an abundance of prey items for the pygmy-owl. Mesquite bosque communities are dominated by mesquite trees, and are described as mesquite forests due to the density and size of the trees.

Over the past several decades, pygmy-owls have been primarily found in the Arizona Upland Subdivision of the Sonoran Desert, particularly Sonoran Desert scrub (Brown 1994). This community in southern Arizona consists of paloverde (*Cercidium* spp.), ironwood (*Olneya tesota*), mesquite, acacia (*Acacia* spp.), bursage (*Ambrosia* spp.), and columnar cacti (Phillips *et al.* 1964, Monson and Phillips 1981, Davis and Russell 1984, Johnson and Haight 1985, Johnsgard 1988). However, over the past several years, pygmy-owls have also been found in riparian and xeroriparian habitats and semidesert grasslands as classified by Brown (1994). Sonoran Desert scrub communities are characterized by an abundance of saguaros or large trees, and a diversity of plant species and vegetation strata. Xeroriparian habitats contain a rich diversity of plants that support a wide array of prey species and provide cover. Semidesert grasslands have experienced the invasion of mesquites in uplands and linear woodlands of various tree species along bottoms and washes.

The density of trees and the amount of canopy cover preferred by pygmy-owls in Arizona is unclear. However, preliminary results from a habitat selection study indicate that nest sites tend to have a higher degree of canopy cover than random sites (Wilcox *et al.* 2000). For areas outside Arizona, pygmy-owls are most commonly characterized by semi-open or open woodlands, often in proximity to forests or patches of forests. Where they are found in forested areas, they are typically observed along edges or in openings, rather than deep in the forest itself (Binford 1989, Sick 1993), although this may be a bias of increased visibility. Overall, vegetation density may not be as important as patches of dense vegetation with a developed canopy layer interspersed with open areas. The physical setting and vegetation composition varies across *G. brasilianum's* range and, while vegetation structure may be more important than composition (Wilcox *et al.* 1999, Cartron *et al.* 2000a), higher vegetation diversity is found more often at nest sites than at random sites (Wilcox *et al.* 2000).

Pygmy-owls typically hunt from perches in trees with dense foliage using a perch-and-wait strategy; therefore, sufficient cover must be present within their home range for them to successfully hunt and survive. Their diverse diet includes birds, lizards, insects, and small mammals (Bendire 1888, Sutton 1951, Sprunt 1955, Earhart and Johnson 1970, Oberholser 1974) and frogs (Proudfoot *et al.* 1994). The density of annuals and grasses, as well as shrubs, may be important to the pygmy-owl's prey base. Shrubs and large trees also provide protection against aerial predation for juvenile and adult pygmy-owls and cover from which they may capture prey (Wilcox *et al.* 2000).

D. Distribution and abundance

The cactus ferruginous pygmy-owl is one of four subspecies of ferruginous pygmy-owl. Cactus ferruginous pygmy-owls are known to occur from lowland central Arizona south through western Mexico to the States of Colima and Michoacan, and from southern Texas south through the Mexican States of Tamaulipas and Nuevo Leon. It is unclear at this time if the ranges of the eastern and western populations of the ferruginous pygmy-owl merge in southern Mexico. Recent genetic studies suggest that ferruginous pygmy-owl populations in southern Arizona and southern Texas are distinct subspecies, and that there is no genetic isolation between populations in the United States and those immediately south of the border in northwestern or northeastern Mexico (Proudfoot and Slack 2001). Results also indicate a comparatively low haplotypic diversity in the northwestern Tucson population, suggesting that it may be recently separated from those in the Altar Valley, Arizona, and in Sonora and Sinaloa, Mexico.

We are currently funding habitat studies and surveys in Sonora, Mexico to determine the distribution and relative abundance of the pygmy-owl there. Preliminary results indicate that pygmy-owls are present in northern and central Sonora (FWS unpubl. data). Further studies are needed to determine their distribution in Mexico.

The range of the Arizona DPS of the pygmy-owl extends from the International Border with Mexico north to central Arizona. The northernmost historic record for the pygmy-owl is from New River, Arizona, about 35 miles north of Phoenix, where Fisher (1893) reported the pygmy-owl to be "quite common" in thickets of intermixed mesquite and saguaro cactus. According to early surveys referenced in the literature, the pygmy-owl, prior to the mid-1900s, was "not uncommon," "of common occurrence," and a "fairly numerous" resident of lowland central and southern Arizona in cottonwood forests, mesquite-cottonwood woodlands, and mesquite bosques along the Gila, Salt, Verde, San Pedro, and Santa Cruz rivers and various tributaries (Breninger 1898, Gilman 1909, Swarth 1914). Additionally, pygmy-owls were detected at Dudleyville on the San Pedro River as recently as 1985 and 1986 (AGFD unpubl. data, Hunter 1988).

Records from the eastern portion of the pygmy-owl's range include a 1876 record from Camp Goodwin (nearby current day Geronimo) on the Gila River, and a 1978 record from Gillard Hot Springs, also on the Gila River. Pygmy-owls have been found as far west as the Cabeza Prieta Tanks, Cabeza Prieta National Wildlife Refuge (Cabeza Prieta NWR), in 1955 (Monson 1998).

Hunter (1988) found fewer than 20 verified records of pygmy-owls in Arizona for the period of 1971 to 1988. Formal surveys for the pygmy-owl on Organ Pipe Cactus NM began in 1990, with one located that year. Beginning in 1992, survey efforts conducted in cooperation with the AGFD, located three single pygmy-owls on Organ Pipe Cactus NM (FWS and Organ Pipe Cactus NM unpubl. data). In 1993, surveys were conducted at locations where pygmy-owls had been sighted since 1970. Only one pygmy-owl was detected during these survey periods, and it was located in northwestern Tucson (Felley and Corman 1993). In 1994, a pair and single owl of

unknown breeding status were located in northwestern Tucson during informal survey work by AGFD (Abbate *et al.* 1996). In 1995, AGFD confirmed 5 adult pygmy-owl and one juvenile, one of which was the first nest in many years. In 1996, AGFD focused their survey efforts in the Tucson Basin. A total of 12 pygmy-owls was detected, including one known nesting pair and their 2 fledglings which successfully fledged. Three additional pygmy-owls and three other unconfirmed reports were also recorded at Organ Pipe Cactus NM in 1996.

While the majority of Arizona pygmy-owl detections in the last seven years have been from the northwestern Tucson area in Pima County, pygmy-owls have also been detected in southern Pinal County, at Organ Pipe Cactus NM, Cabeza Prieta NWR, Buenos Aires National Wildlife Refuge (BANWR), and on the Coronado National Forest. The following is a brief summary of recent owl numbers and distribution[1]:

In 1997, survey efforts of AGFD located a total of five pygmy-owls in the Tucson Basin study area (the area bounded to the north by the Picacho Mountains, the east by the Santa Catalina and Rincon mountains, the south by the Santa Rita and Sierrita mountains, and the Tucson Mountains to the west). Of these owls, one pair successfully fledged two young which were banded. Two adult males were also located at Organ Pipe Cactus NM, with one reported from a previously unoccupied area (T. Tibbitts, Organ Pipe Cactus NM pers. comm. 1997).

In 1998, survey efforts in Arizona increased substantially and, as a result, more pygmy-owls were documented, which may at least in part account for a larger number of known owls. In 1998, a total of 35 pygmy-owls were confirmed (S. Richardson, AGFD unpubl. data, FWS unpubl. data, T. Tibbitts, Organ Pipe Cactus NM unpubl. data, D. Bieber, Coronado National Forest unpubl. data).

In 1999, a total of 41 adult pygmy-owls were found in Arizona at 28 sites. Of these sites, 11 had nesting confirmed by AGFD and us. pygmy-owls were found in three distinct regions of the state: Tucson Basin, Altar Valley, and Organ Pipe Cactus NM. Almost half of the know owl sites were in the Altar Valley. Overall, mortality was documented for a number of fledglings due to natural (e.g., predation) or unknown causes. Of the 33 young found, only 16 were documented as surviving until dispersal (juveniles known to have successfully dispersed from their natal area). It is unclear what the survival rate for pygmy-owls is; however, as with other owls and raptors, a high mortality (50 percent or more) of young is typical during the first year of life.

Surveys conducted in 2000 resulted in 24 confirmed pygmy-owl sites (i.e. nests and resident pygmy-owl sites) and several other unconfirmed sites (S. Richardson, AGFD unpubl. data, T. Tibbitts, Organ Pipe Cactus NM unpubl. data, FWS unpubl. data). A total of 34 adult pygmy-owls were confirmed. Nesting was documented at 7 sites and 23 fledglings were confirmed; however, as in 1999, over 50 percent fledgling mortality was documented (S. Richardson, AGFD unpubl. data). A total of 9 juveniles were known to have successfully dispersed from their natal areas in 2000. Successful dispersal was not confirmed at two nests with four fledglings. The status of the remaining fledglings was unknown; however, they were presumed dead.

Surveys conducted during the 2001 season resulted in a total of 47 adult pygmy-owls confirmed

[1] To a large degree, survey effort plays an important factor in where owls have been documented. Survey effort has not been consistent over the past several years in all areas of the state, affecting the known distribution and numbers of owls in any particular area.

at 29 sites[2] in Arizona (S. Richardson, AGFD unpubl. data, T. Tibbitts, Organ Pipe Cactus National Monument unpubl. data, FWS unpubl. data). There were also several other unconfirmed sites that are not included in these totals. Nesting was documented at 17 sites and 24 young were confirmed to have successfully fledged. In addition, there were 2 nests with young that potentially could have fledged young; however, this was not confirmed. Similar to the previous three years, there was over 50 percent fledgling mortality documented in 2001 (S. Richardson, AGFD unpubl. data).

During 2002 surveys, AGFD was able to locate and is currently monitoring a total of 18 adult pygmy-owls from 14 sites or territories (S. Richardson, AGFD pers. comm.). These include 7 adults from 6 sites in northwestern Tucson, 6 adults from 4 sites in Altar Valley, 2 adults from 2 sites in Organ Pipe Cactus NM, and 3 adults from 2 sites in the Avra Valley. The 2002 drought has had severe impacts to pygmy-owl productivity. In comparison with the previous year when 17 nests were confirmed, only 3 nests were observed in 2002 (an 82 percent decline in nesting). From these 3 nests, 9 young were produced, of which 7 have already been lost. One active nest in northwestern Tucson fledged two young in late May. However, by June 3rd, neither young survived. All 7 young from two nests in Altar Valley fledged unexpectedly on 14 and 15 June. These young were only 22 - 25 days old, younger than most fledglings from any nests during previous years. Conditions at both nest sites were very harsh, with little tree cover and high temperatures. These conditions, probably compounded by the young age at fledging, resulted in the mortality of 5 of the 7 young thus far. It appears that lack of cover and/or the inability to fly very well resulted in predation of at least 2 of the young.

One factor affecting the known distribution of pygmy-owls in Arizona is where early naturalists spent most of their time and where recent surveys have taken place. For example, a majority of surveys in the recent past (since 1993) have taken place in Organ Pipe Cactus NM and in the Tucson Basin, and these areas are where most owl locations have been recorded. However, over the past three years, large, previously unsurveyed areas have been inventoried for owls, resulting in a much wider distribution than previously thought. As a result, our knowledge is changing as to pygmy-owl distribution and habitat needs as new information is collected. For example, before 1998, very few surveys had been completed in the Altar Valley in southern Pima County. Prior to 1999, the highest known concentration of pygmy-owls in the state was in northwestern Tucson. However, in 1999, after extensive surveys in Altar Valley, more owls were found there (18 adults) than in northwestern Tucson (11 adults), although until 2001, there have been fewer nest sites in Altar Valley than in the Tucson Basin (S. Richardson, AGFD unpubl. data). As a result, our knowledge is changing as to their distribution and habitat needs as new information is collected.

E. Threats

One of most urgent threats to pygmy-owls in Arizona is thought to be loss and fragmentation of habitat (FWS 1997, Abbate *et al.* 1999). The complete removal of vegetation and natural features required for many large scale and high-density developments directly and indirectly impacts pygmy-owl survival and recovery (Abbate *et al.* 1999).

Current information suggests that pygmy-owls can live and breed successfully in areas which have undergone at least some degree of low-density human development; however, they do not appear to be able to tolerate all types of development, particularly high-density development. Since widespread surveys began in Arizona in 1999, more owl sites have been documented in

[2] Pygmy-owl sites are nests and resident pygmy-owl sites that have been confirmed by AGFD or us.

areas with little or no human activity or development. For example, in 2001, of the 29 known pygmy-owl sites in the state, 24 sites (83 percent) were in undeveloped areas with very little human activity, compared to only 5 sites (17 percent) that were in areas with some level of low-density development (S. Richardson, AGFD unpubl. data, FWS unpubl. data). No pygmy-owls have been documented in high-density commercial or residential developments. In 2001, 14 (82 percent) of the 17 known nest sites were in undeveloped areas with little or no ground disturbance or human activity.

To determine the level of vegetation disturbance nesting pygmy-owls may be able to tolerate, a group of pygmy-owl experts on the Recovery Team completed an analysis of all known 2001 and earlier nest site home ranges (n = 9) occurring in developed areas in northwestern Tucson that successfully produced offspring. They calculated the amount of vegetation disturbance (e.g., roads, buildings, horse corals, pastures, parking lots, golf courses, etc.) within the estimated home range (280 acres) at each nest site. They calculated their average percent disturbance to be 23 percent (also the median). However, 5 of the 9 home ranges had levels below that average, and 6 of the 9 sites were at or below the 25 percent disturbance level. This, when added to the total number of nesting pygmy-owl breeding sites in the State , indicates that pygmy-owls select areas with very little or no human development. In addition, because the majority of surveys are conducted in areas already with some level of development as a result of a proposed project, these areas are sampled in higher proportion to areas with no current or planned development, potentially under-sampling areas without development.

It should be noted that one of the nest sites with one of the highest amounts of vegetation disturbance (33 percent) is that of a long established pair that was documented from 1997 through 1999. Development in the general vicinity of this site continued during this time. As noted above, the male of this pair was found dead in 1999. Surveys in 2000 and 2001 did not locate any pygmy-owls at this site, therefore it remains inactive. Site tenacity in the short-term may have been a factor in this pair's ability to withstand this higher level of vegetation disturbance compared to other sites in Arizona; however, the long-term effect of this amount of disturbance is unknown. There were three new nest sites[3] in 2001 with disturbance levels of 21, 30, and 34 percent (S. Richardson, AGFD, unpubl. data). Each of these territories successfully produced fledglings that dispersed to other areas in 2001. This was the first year these sites were reproductively successful and it is unknown whether they will be able to continue to remain in these territories in subsequent years. Preliminary surveys of these territories in 2002, indicate the loss of 2 females and one male from the sites. The remaining female from the territory with 34 percent disturbance has apparently paired with the male from an adjacent territory. As indicated above, two of these new nest sites, together with the other nest site that has been inactive since 1999, are at the extreme range of the amount of development occurring within all other pygmy-owl nesting territories in Arizona (greater than 30 percent disturbance).

Although there have been some nesting territories in the upper range of disturbance, other factors also play an import role in developing a recovery strategy for this species. For example, these data represent a very limited sample size for breeding sites within developed areas (n=9); little is understood regarding the long-term effects of increasing levels of development occurring within nest sites in higher developed areas and how this will affect their suitability for breeding and movement in the future; and the potential cumulative effects that increasing levels of development have on owls in this region are not fully understood. The long-term productivity and success of breeding sites in these higher disturbed areas are unknown. In 2001, all of the

[3] Two were resident male pygmy-owls establishing territories in the fall of 1999, remaining at their respective sites until paired with females in the spring of 2001.

nest sites were in new areas, resulting in a relatively large proportion (67 percent) of sites where nesting had occurred in the past but that were inactive in 2001 (S. Richardson, AGFD unpubl. data). More research and monitoring is needed to better understand habitat needs and the long-term relationship between development and pygmy-owl requirements.

There also appears to be a difference in the tolerance to the amount of vegetation disturbance (i.e., development) between nesting and non-breeding pygmy-owls. Single owls may be able to tolerate higher levels of development and more marginal habitats, while breeding owls may need less disturbed vegetation within their home ranges. An analysis of all known pygmy-owl sites in northwestern Tucson revealed a considerably lower amount of vegetation disturbance at nest sites compared to non-breeding sites (e.g., unpaired males) (S. Richardson, AGFD unpubl. data). As stated above, the average amount of vegetation disturbance within the home range of 1998-2001 nesting sites in developed areas was 23 percent. The amount of vegetation disturbance within the home range of non-breeding sites in developed areas was considerably higher, averaging 37 percent during the same period. Although these overall results are based on a small sample size, they represent the best available information and indicate that nesting pygmy-owls may require less disturbed areas than unpaired owls. For example, a juvenile male pygmy-owl established a new territory in the fall of 2000, which is surrounded on three sides by densely developed residential and commercial properties. This male has remained there throughout the 2000 and 2001 breeding seasons and failed to pair with a female owl, even after vigorous calling throughout the spring and summer months both years. In September 2001 a juvenile female pygmy-owl dispersed from its nest and paired with this resident male. They remained together for approximately 2 weeks until the female was found dead, apparently as a result of cat (*Felis domesticus*) predation. At this time, the male remains unpaired. Within this territory the habitat is highly fragmented, containing the highest degree of development (approximately 50 percent) of any other known pygmy-owl territory (S. Richardson, AGFD unpubl. data.). It is unclear whether the amount of development and vegetation disturbance is too high for successful breeding.

Differences in the tolerance of vegetation disturbance between breeding and non-breeding owls are important because nesting owls are necessary for recruitment of young owls and demographic support to achieve recovery of the pygmy-owl in Arizona. Although also important to the population from a demographic standpoint, non-breeding males do not directly contribute to the increase of the population by producing young. Therefore, we and the Recovery Team believe that; because successful breeding sites are necessary to produce offspring for the survival and eventual recovery of the pygmy-owl Arizona population, vegetation disturbance levels found at breeding sites should be used as guidelines rather than those in non-breeding territories. These guidelines are particularly important within specific areas of the state recommended by the pygmy-owl experts on the Recovery Team as Special Management Areas (SMAs).

Recovery of the pygmy-owl will require not only protection of all known sites, but also the conservation of other areas not currently known to have nesting owls, which can be measured at two spatial scales. At a large scale, connectivity is necessary among large blocks of suitable habitat that are either currently known to be occupied by owls or are important for recovery. An example is habitat connecting the Tucson Mountains west of Interstate10 to the high concentration of owls in northwestern Tucson. At a finer scale, the protection of habitat within the vicinity of known owl sites for establishment of new sites and movement between them is also essential. For example, the area located south of the 136000 N street alignment in northwestern Tucson, which recently contained the highest number and density of breeding pygmy-owls known in Arizona, also contains areas not currently known to have nesting owls and is particularly important for the expansion of the population. Based on the analysis by pygmy-

owl experts on the Recovery Team, the best available science indicates the maximum amount of ground disturbance pygmy-owls are able tolerate is 20 - 25 percent (average of 23 percent), combined with other conservation measures that provide connectivity for movement, etc. This level of disturbance is within the range of where most owls in northwestern Tucson were found and best describes their tolerance for ground disturbance based on current data.

Habitat loss, degradation, and fragmentation are widely accepted causes contributing to raptor population declines worldwide (Snyder and Snyder 1975, Newton 1979, LeFranc and Millsap 1984). Habitat fragmentation is the process by which a large and continuous block of natural habitat is transformed into much smaller and isolated patches by human activity (Noss and Csuti 1994). Fragmentation has two components: (1) reduction of the total amount of habitat type; and (2) apportionment of remaining habitat into smaller, more isolated patches (Harris 1984, Wilcove *et al.* 1986, Saunders *et al.* 1991). Casualties caused by pest control, pollution, collisions with cars, radio towers, glass windows, power lines, and domestic cat predation are often underestimated, although likely increasing in occurrence due to human population growth (Banks 1979, Klem 1979, Churcher and Lawton 1987). Even where human-related deaths are uncommon, they may still substantially affect populations of rare birds (Cartron *et al.* 2000a). Because of the proximity of pygmy-owl sites to residential areas in northwestern Tucson, these interactions may be a significant cause of owl mortality there (Cartron *et al.* 2000a).

Nesting in small natural patches may have additional risks. For example, Haug (1985) found burrowing owl home range size increases with the percentage of vegetation disturbance. In fragmented landscapes, burrowing owls may forage greater distances and spend more time away from the nest, making them more vulnerable to predators, and therefore, less efficient at reproduction (Warnock and James 1997). As fragmentation increases, competition for fewer productive pygmy-owl territories may occur (Abbate *et al.* 1999). Unlike other larger birds that can fly long distances over unsuitable or dangerous areas to establish new territories, pygmy-owls, because of their small size, and their short style of flight are exposed to greater risks from predation and other threats (Abbate *et al.* 1999).

Site tenacity in birds is one of many factors that may create time lags in response to fragmentation and other disturbances. Individuals may remain in sites where they bred successfully in the past, long after the habitat has been altered (Wiens 1985). Because of lack of data, it is unclear whether site tenacity for pygmy-owls, in increasingly fragmented landscapes, such as exists in the action area is a factor. For example, researchers have been closely monitoring an established pygmy-owl site (documented each year since 1996) in which the male died in 1999, apparently from a collision with a fence (S. Richardson, AGFD unpubl. data.). This site was not known to be occupied since 1999. This site has the highest amount of development (33 percent) within its estimated home range of any other known nest site (S. Richardson, AGFD unpubl. data.). The site will continued to be monitored to determine if new owls reestablish a nest site.

In northwestern Tucson, all currently known pygmy-owl locations, particularly nest sites, are in low-density housing areas where abundant native vegetation separates structures. Additionally, they are adjacent to or near large tracts of undeveloped land. Pygmy-owls appear to use nonnative vegetation to a certain extent, and have been observed perching in nonnative trees in close proximity to individual residences. However, the persistence of pygmy-owls in areas with an abundance of native vegetation indicates that a complete modification of natural conditions likely results in unsuitable habitat conditions for pygmy-owls. While development activities are occurring in close proximity to owl sites, particularly nest sites, overall noise levels are low. Housing density is low, and as a result, human presence is also generally low. Roads in the areas are typically dirt or two-lane paved roads with low speed limits which minimizes traffic noise.

Low density housing areas generally have lower levels of traffic noise because of the limited number of vehicles traveling through the area.

Other factors contributing to the decline of pygmy-owl habitat include the destruction of riparian bottomland forests and bosques. It is estimated that 85 to 90 percent of low-elevation riparian habitats in the southwestern U.S. have been modified or lost; these alterations and losses are attributed to woodcutting, urban and agricultural encroachment, water diversion and impoundment, channelization, groundwater pumping, non-native plant invasion, livestock overgrazing, and hydrologic changes resulting from various land-use practices (e.g., Phillips *et al.* 1964, Carothers 1977, Kusler 1985, Jahrsdoerfer and Leslie 1988, USFWS 1988, U.S. General Accounting Office 1988, Szaro 1989, Dahl 1990, State of Arizona 1990, Bahre 1991, Stromberg and Chew 1993). Cutting of trees for domestic and industrial fuel wood was so extensive throughout southern Arizona that, by the late 19th century, riparian forests within tens of miles of towns and mines had been decimated (Bahre 1991). Mesquite was a favored species because of its excellent fuel qualities. In the project area, the famous vast forests of "giant mesquites" along the Santa Cruz River in the Tucson area described by Swarth (1905) and Willard (1912) fell to this threat, as did the "heavy mesquite thickets" where Bendire (1888) collected pygmy-owl specimens along Rillito Creek, a Santa Cruz River tributary, in present-day Tucson. Only remnant fragments of these bosques remain.

Regardless of past distribution in riparian areas, it is clear that the pygmy-owl has declined throughout Arizona to the degree that it is now extremely limited in distribution in the state (Johnson *et al.* 1979, Monson and Phillips 1981, Davis and Russell 1984, Johnson-Duncan *et al.* 1988, Millsap and Johnson 1988, Monson 1998). A very low number of pygmy-owls in riparian areas in recent years may reflect the loss of habitat connectivity rather than the lack of suitability (Cartron *et al.* 2000b).

In recent decades, the pygmy-owl's riparian habitat has continued to be modified and destroyed by agricultural development, woodcutting, urban expansion, and general watershed degradation (Phillips *et al.* 1964, Brown *et al.* 1977, State of Arizona 1990, Bahre 1991, Stromberg *et al.* 1992, Stromberg 1993a and 1993b). Sonoran Desert scrub has been affected to varying degrees by urban and agricultural development, woodcutting, and livestock grazing (Bahre 1991). Pumping of groundwater and the diversion and channelization of natural watercourses are also likely to have reduced pygmy-owl habitat. Diversion and pumping result in diminished surface flows, and consequent reductions in riparian vegetation are likely (Brown *et al.* 1977, Stromberg *et al.* 1992, Stromberg 1993a and 1993b). Channelization often alters stream banks and fluvial dynamics necessary to maintain native riparian vegetation. The series of dams along most major southwestern rivers (e.g., Colorado, Gila, Salt, and Verde rivers) have altered riparian habitat downstream of dams through hydrological and vegetational changes, and have inundated former habitat upstream.

In the United States, pygmy-owls are rare and highly sought by bird watchers, who concentrate at a few of the remaining known locations. Limited, conservative bird watching is probably not harmful; however, excessive attention and playing of tape-recorded calls may at times constitute harassment and affect the occurrence and behavior of the pygmy-owl (Oberholser 1974, Tewes 1993). For example, in 1996, a resident in Tucson reported a pygmy-owl sighting which subsequently was added to a local birding hotline and the location was added to their website on the internet. Several car loads of birders were later observed in the area of the reported location (S. Richardson, AGFD pers. comm. 1999).

One of the few areas in Texas known to support pygmy-owls continues to be widely publicized as having organized field trips and birding festivals (American Birding Association 1993,

Tropical Birds of the Border 1999). Resident pygmy-owls are found at this highly visited area only early in the breeding season, while later in the season they could not be detected. O'Neil (1990) also indicated that five birds initially detected in southern Texas failed to respond after repeated visits by birding tours. It is unknown if the birds habituate to the playing of taped calls and stopped responding, or if they abandoned the area. Oberholser (1974) and Hunter (1988) additionally indicated that in southern Texas, recreational birdwatching may disturb owls at highly visited areas.

Human activities near nests at critical periods of the nesting cycle may cause pygmy-owls to abandon their nest sites. In Texas, 3 of 102 pygmy-owl nests monitored from 1994-1999 were abandoned during the early stage of egg laying. Although unknown factors may have contributed to this abandonment, researchers in Texas associated nest abandonment with nest monitoring (G. Proudfoot pers. comm.). Some outdoor recreational activities (e.g., off road vehicle [ORV] and motor bike use/racing, firearm target practicing, jeep tours, etc.) may disturb pygmy-owls during their breeding season (particularly from February through July (G. Proudfoot pers. comm. 1999 and S. Richardson, AGFD pers. comm. 1999). Noise disturbance during the breeding season may affect productivity; disturbance outside of this period may affect energy balance and, therefore survival. Wildlife may respond to noise disturbances during the breeding season by abandoning their nests or young (Knight and Cole 1995). It has also become apparent that disturbance outside of a species' breeding season may have equally severe effects (Skagen *et al.* 1991).

Individual pygmy-owls may react differently to noise disturbances, with some individuals exhibiting less tolerance than others. Noise can affect animals by disturbing them to the point that detectable change in behavior may occur. Such behavioral changes can affect their activity and energy consumption (Bowles 1995). Dangerous or unfamiliar noises are more likely to arouse wildlife than harmless and familiar noises. Habituation is the crucial determinant of success in the presence of noisy disturbances. Exposures of some experienced birds may produce no or minimal losses (Black *et al.* 1984). The habituation process can occur slowly, so it may not be detected in the short-term. In the long-term, some nesting birds become more tenacious and less responsive in the presence of human disturbance if they are not deliberately harassed (Burger and Gochfeld 1981). It is unknown if noise habituation occurs in some pygmy-owls as it does with other bird species. Robert and Ralph (1975), Schreiber *et al.* (1979), Cooke (1980), Parsons and Burger (1982), Ainley *et al.* (1983), and McNicholl (1983) found that adult birds, and chicks to some extent, habituated to the presence of humans, and their responses to people seemed to be less than those of undisturbed birds. Burger and Gochfeld (1981) and Knight *et al.* (1987) found responses to noise disturbances and habituation in nesting birds become more tenacious and less responsive in the presence of human disturbance if they were not deliberately harassed.

Because of the lack of data specific to this subspecies in Arizona, we must also rely in part on our knowledge of effects this type of action may have on pygmy-owls elsewhere and other species, particularly raptors. Raptors in frequent contact with human activities tend to be less sensitive to additional noise disturbances than raptors nesting in remote areas. However, exposure to direct human harassment may make raptors more sensitive to noise disturbances (Newton 1979). Where prey is abundant, raptors may even occupy areas of high human activity, such as cities and airports (Newton 1979, Ratcliffe 1980, White *et al.* 1988). The timing, frequency, and predictability of the noise disturbance may also be factors. Raptors become less sensitive to human disturbance as their nesting cycle progresses (Newton 1979). Studies have suggested that human activities within breeding and nesting territories could affect raptors by changing home range movements (Anderson *et al.* 1990) and causing nest abandonment (Postovit and Postovit 1987, Porter *et al.* 1973).

Application of pesticides and herbicides in Arizona occurs year-round, and these chemicals pose a potential threat to the pygmy-owl. The presence of pygmy-owls in proximity to residences, golf courses, agricultural fields, and nurseries may cause direct exposure to pesticides and herbicides. Furthermore, ingestion of affected prey items may cause death or reproductive failure (Abbate *et al.* 1999). Illegal dumping of waste also occurs in areas occupied by pygmy-owls and may be a threat to pygmy-owls and their prey; in one case, drums of toxic solvents were found within one mile of a pygmy-owl detection (Abbate *et al.* 1999).

Little is known about the rate or causes of mortality in pygmy-owls; however, they are susceptible to predation from a wide variety of species. In Texas, eggs and nestlings were depredated by racoons (*Procyon lotor*) and bullsnakes (*Pituophis catenifer*). Both adult and juvenile pygmy-owl are likely killed by great horned owls (*Bubo virginianus*), Harris' hawks *(Parabuteo unicinctus*), Cooper's hawks, and eastern screech-owls (*Otus asio*) (Proudfoot and Johnson 2000, G. Proudfoot unpubl. data). Pygmy-owls are particularly vulnerable to predation and other threats during and shortly after fledging (Abbate *et al.* 1999). Therefore, cover near nest sites may be important for young to fledge successfully (Wilcox *et al.* 1999, Wilcox *et al.* 2000). Although nest depredation has not been recorded in Arizona, only a few nests have been monitored (n = 21 from 1996-1999). Additional research is needed to determine the effects of predation, including nest depredation, on pygmy-owls in Arizona and elsewhere.

Another factor that may affect pygmy-owls is interspecific competition/predation. In Texas, depredation of two adult female pygmy-owls nesting close to screech-owls was recorded. These incidences were recorded as "depredation by screech-owl after examination of the pygmy-owl corpses and assessment of circumstances (i.e., one pygmy-owl attempted to nest in a box that was previously used as screech-owl roost site, the other established a nest in a box within 16 feet of screech-owl nest site). In 2001, an unpaired female pygmy-owl was found dead in a tree cavity, apparently killed by a screech-owl (S. Richardson, AGFD unpubl. data). Conversely, pygmy-owls and screech-owls have also been recorded successfully nesting within 7 feet of each other in the same tree without interspecific conflict (G. Proudfoot, unpubl. data). The relationship between pygmy-owl and other similar small owl species needs further study.

Direct and indirect human-caused mortalities (e.g., collisions with cars, glass windows, fences, power lines, domestic cats, etc.), while likely uncommon, are often underestimated, and probably increase as human interactions with owls increase (Banks 1979, Klem 1979, Churcher and Lawton 1987). This may be particularly important in the Tucson area where many pygmy-owls are located. Pygmy-owls flying into windows and fences, resulting in serious injuries or death to the birds, have been documented twice. A pygmy-owl collided into a closed window of a parked vehicle; it eventually flew off, but had a dilated pupil in one eye indicating serious neurological injury as the result of this encounter (Abbate *et al.* 1999). In another incident, an adult owl was found dead on a fence wire; apparently it flew into the fence and died (S. Richardson, AGFD, unpubl. data). AGFD also has documented an incident of individuals shooting BB guns at birds perched on a saguaro which contained an active pygmy-owl nest. In Texas, two adult pygmy-owls and one fledging were killed by a domestic cat. These owls used a nest box about 246 feet from a human residence. In 2001, predation by domestic cats is also suspected by researchers in two instances in northwestern Tucson (S. Richardson, AGFD unpubl. data). Two female juvenile owls, located 2 ½ miles apart, were found dead from apparent wounds sustained from cats. Free roaming cats can also affect the number of lizards, birds, and other prey species available to pygmy-owls; however, very little research has been done in the Southwest on this potential problem.

Because pygmy-owls have been observed moving around the perimeter of golf courses, avoiding

non-vegetated areas; roads and other openings may act as barriers to their movements (Abbate *et al.* 1999, S. Richardson, AGFD unpubl. data). On one occasion, a radio-tagged dispersing juvenile stopped within 0.7 mile of Interstate 10 where there were large openings and few trees or shrubs, and reversed its direction (Abbate *et al.* 1999). However, radio-tagged, juvenile pygmy-owls have been observed on several occasions crossing two-lane roads with light to moderately heavy vehicular traffic, where trees and large shrubs were present on either side (Abbate *et al.* 1999). Most recently, during the 2001 dispersal period, pygmy-owls were observed near two lane roads on several occasions (AGFD unpubl. data). Although owls were not directly observed crossing roads, radio telemetry data were collected on either side of roadways. Movement across roads appeared to occur during the night, although transmittered owls were not continuously monitored. Because of a lack of funds and personnel, AGFD researchers are at best only able to collect relocations during 2 random times during a 24-hour period, therefore, the time and location of this crossing is unknown.

Pygmy-owls are capable of flying short distances (up to 100) feet or more over undisturbed vegetation (e.g., Sonoran Desert scrub, semidesert grasslands, or riparian areas) with little or no human activities or structures such as roads, fences, buildings, etc. (G. Proudfoot, unpubl. data, S. Richardson, AGFD unpubl. data). However, as opening size (i.e., gaps between trees or large shrubs) increases, coupled with increased threats (e.g., moderate to high traffic volumes and other human disturbances) relatively wide roads (greater than 40 feet), may act as barriers or significantly restrict owl movement. Wide roadways and associated clear zones cause large gaps between tree canopies on either side of roadways, resulting in lower flight patterns over roads. This low flight level can cause owls to fly directly in the pathway of oncoming cars and trucks, significantly increasing the threat of owls being struck. Measures can be implemented in roadway design to minimize these threats and allow successful movement across roadways. Among other measures, decreasing the canopy openings between trees on either side of roads and increasing the density of trees along roadways to provide greater shelter and cover from predators and human activities can be utilized to minimize adverse effects to owls attempting to cross roads. Specific research is needed to determine the effects of varying road and clear zone widths on successful owl movement, and the types of vegetation, roadway and landscaping designs, speed limits, etc. needed to promote crossings of roads.

Telemetry data collected by AGFD in 2001 indicate that owl movement is affected by roads and traffic (S. Richardson, AGFD, unpubl. data). On two separate occasions juvenile owls fitted with radio transmitters were tracked moving along washes and upland areas with native vegetation until they came upon busy roads with relatively wide clear zones on either side of the roadways. These owls stopped and were repeatedly observed reacting to passing vehicular traffic by retreating from the road edge vegetation to nearby trees as cars and trucks passed by. They appeared to be affected by road width, the density of vegetation on either side of the roadway, and traffic volume. In both cases, they eventually crossed these roads during lower traffic periods at areas with narrower gaps in vegetation where trees were present on either side of the road.

Researchers in Arizona have found that pygmy-owls require habitat linkages, within and between territories, for movement and dispersal of young. Continuous cover or patches of trees and large shrubs spaced at close are needed at regular intervals to provide concealment and protection from predators and mobbing, as well as to provide shade and cool temperatures (S. Richardson, AGFD unpubl data, Abbate et al. 1999). Pygmy-owls, particularly juveniles because of their inexperience, are susceptible to predation, weather extremes, human-related injury/mortality factors (e.g., cars, buildings, fences, domestic cats, etc.) and other mortality factors (mortality of juveniles is typically 50 percent or more for owls and other raptors). Therefore, it is essential to maintain habitat conditions that reduce their exposure to these threats and provide protection as

they disperse from their natal areas. A high degree of cover throughout the landscape increases the likelihood of survivorship to the next breeding season. Limiting these mortality factors is critical, especially for small, depressed populations, such as pygmy-owls in Arizona.

Fires can affect pygmy-owls by altering their habitat (Abbate *et al.* 1999). A recent fire altered habitat near an active pygmy-owl nest site (Flesch 1999), and although four mature saguaros in the area survived (at least in the short-term), post-fire mortality of saguaros has been recorded (Steenbergh and Lowe 1977, 1983; McLaughlin and Bowers 1982). Flesch (1999) also noted that approximately 20 to 30 percent of the mesquite woodland within 164 feet of the nest was fire- or top-killed, and ground cover was also eliminated until the summer monsoons. Esque *et al.* (2000) observed saguaro mortality in excess of 20 percent after a 1994 fire in Saguaro National Monument. Careful use of prescribed fires in areas potentially suitable for pygmy-owls is necessary so that habitat is not lost or degraded (Flesch 1999).

Low genetic variability can lead to a reduction in reproductive success and environmental adaptability. Caughley and Gunn (1996) further note that small populations can become extinct entirely by chance even when their members are healthy and the environment favorable. The pairing of siblings or parents with their offspring, particularly in raptors, is rare, and has been documented in only 18 cases, representing 7 species (Carlson *et al.* 1998). Four of these species were owls: barn owls, burrowing owls (*Athene cunicularia*), screech-owls, and spotted owls (*Strix occidentalis*). In 1998 and 1999, two cases of sibling pygmy-owls pairing and breeding were documented (Abbate *et al.* 1999). In both cases, young were fledged from the nesting attempts. These unusual pairings may have resulted from extremely low numbers of available mates within their dispersal range, and/or from barriers (including fragmentation of habitat) that has influenced dispersal and limited the movement of young owls (Abbate *et al.* 1999). Further, because the pygmy-owl is nonmigratory, there may be an additional limitation on the flow of genetic material between populations which may reduce the chance of demographic and genetic rescue from immigration from adjacent populations.

Recent genetic research suggests that pygmy-owls in northwestern Tucson may be isolated from other populations in Arizona and Mexico (Proudfoot and Slack 2001). They have found that the low level of genetic variation and the absence of shared haplotypes between owls in northwestern Tucson and the remainder of the State and Mexico may be indicative of natural divergence of this population from the rest of the pygmy-owl population in Arizona. Specifically, this study found that pygmy-owls in northwestern Tucson are in a distinct clade and suggests a current separation between populations in northwestern Tucson and elsewhere in the State and Mexico. In addition, these owls have extremely low levels of average haplotype diversity. Researchers acknowledge this may also be a product of sampling (i.e., sampling from one maternal lineage) and/or an extremely high level of inbreeding as a result of low population numbers and geographic isolation. Given the low number of pygmy-owls in the action area, their potential isolation from source populations, the fact that inbreeding has occurred to the second generation in two documented cases, and potential pressure from urban development, there is a high level of concern for the Tucson Basin population of pygmy-owls.

Environmental, demographic, and genetic stochasticity, and catastrophes have been identified as interacting factors that may contribute to a population's extinction (Hunter 1996). Environmental stochasticity refers to random variation in habitat quality parameters such as climate, nutrients, water, cover, pollutants, and relationships with other species such as prey, predators, competitors, or pathogens. Demographic stochasticity is uncertainty due to random variation in reproductive success and survivorship of individuals. Genetic stochasticity is the random variation in gene frequencies of a population due to genetic drift, bottlenecks, inbreeding, and similar factors. Catastrophes are events such as droughts or hurricanes that occur randomly. When these factors

interact with one another, there are likely to be a combination of effects, such that a random environmental change like habitat fragmentation can result in population and genetic changes by preventing dispersal. These factors are much more likely to cause extinction when a species' numbers are already extremely low. The small, fragmented population of pygmy-owls in Arizona may not have the ability to resist change or dramatic fluctuations over time caused by one or more of the factors mentioned above.

Soule (1986) notes that very small populations are in extreme jeopardy due to their susceptibility to a variety of factors, including demographic stochasticity, where chance variations in birth and death rates can result in extinction. A series of environmental changes such as habitat reduction reduce populations to a state in which demographic stochasticity takes hold. In small populations such as with the pygmy-owl, each individual is important for its contributions to genetic variability of that population. As discussed above, low genetic variability can lead to a lowering in reproductive success and environmental adaptability, affecting recovery of this species.

Federal Projects Resulting in Incidental Take

To date, we have anticipated incidental take of pygmy-owls in only 4 instances: 1) Thornydale Road improvement project in Pima County, Arizona (consultation number 2-21-00-F-213, February 2002); 2) Dove Mountain Development in Marana, Arizona (consultation number 2-21-99-F-363, October 2000); 3) Issuance of an Endangered Species Act section 10(a)(1)(B) permit for the Lazy K Bar Ranch in association with a Habitat Conservation Plan (HCP) (consultation number 2-21-98-F-334, November 1998); and 4) the Tucson Safford BLM Office Grazing Program in southern Arizona (consultation number 2-21-96-F-0160). In order to provide a complete account of the current status of the pygmy-owl in Arizona, we describe these actions in detail below.

Thornydale Road Improvement Project

The proposed action for the Thornydale Road improvement project involved the issuance of a National Pollutant Discharge Elimination System (NPDES) general permit under section 402 of the Clean Water Act (CWA) from the EPA and a section 404 permit under the CWA from the Army Corps of Engineers (COE). The EPA was the lead Federal agency for this consultation. These permits allowed the widening and placement of flood control structures along Thornydale, Magee, and Cortaro Farms roads in Pima County, Arizona. Because of the inclusion of significant conservation measures, we did not anticipate the proposed action would incidentally cause any take in the form of harm, death, or injury of any pygmy-owl. The project site was, however, within a portion of a resident male pygmy-owl's home range. It was therefore believed possible that non-lethal incidental take (in the form of harassment only) of this pygmy-owl may occur as the result of ongoing construction activity.

The biological opinion presented four reasonable and prudent measures for reducing incidental take, which included: 1) minimize vegetation disturbance, loss of key habitat components, and other potential adverse effects to pygmy-owls within the estimated home range of the resident single or pygmy-owl pair; 2) minimize noise disturbance immediately adjacent to a pygmy-owl nest or activity center; 3) promote connectivity to allow for movement within pygmy-owl home ranges, between pygmy-owl sites and adjacent suitable habitat within the project site and Conservation Lands; and 4) monitor construction activities during and after completion of the project to ensure compliance with terms and conditions and to determine their effectiveness to accomplish their stated goals.

Dove Mountain Development

The proposed action for this consultation also involved the issuance of a NPDES general permit under section 402 of the CWA from the EPA and a section 404 permit under the CWA from the COE, with the EPA acting as the lead federal agency. These permits facilitated development within an approximately 5,924-acre residential and commercial development with parks and open space, located in Marana, Arizona.

We did not anticipate the proposed action would incidentally cause any take in the form of harm, death, or injury of a pygmy-owl. Further, there were no currently known nesting or resident pygmy-owl sites or portions of their home range within the project site. However, because nesting owls were nearby, we anticipated that, for a 20-30 year phased development project, it was reasonably certain that pygmy-owls would move onto or into the immediate vicinity of the project site and establish a nest or activity center. Therefore, it was anticipated that non-lethal incidental take (in the form of harassment only) of a pair or resident single pygmy-owl may occur if a pygmy-owl establishes a territory within 0.37 mile of ongoing development activity.

We provided the following reasonable and prudent measures in order to minimize take: 1) minimize vegetation disturbance, loss of key habitat components, and other potential adverse effects to pygmy-owls which are first detected prior to commencement of clearing vegetation for a construction phase within the estimated home range of a pair or resident single pygmy-owl; 2) minimize noise disturbance immediately adjacent to a pygmy-owl nest or activity center which is first detected prior to the commencement of clearing vegetation for a construction phase; 3) minimize vegetation disturbance, loss of key habitat components, and other potential adverse effects to pygmy-owls which are first detected after commencement of clearing vegetation for a construction phase within the estimated home range of a pair or resident single pygmy-owl; 4) minimize noise disturbance immediately adjacent to a pygmy-owl nest or activity center which is first detected after commencement of vegetation clearing for a construction phase; 5) promote connectivity to allow for movement within pygmy-owl home ranges, between pygmy-owl sites and adjacent suitable habitat, in Conservation Lands, and Open Space areas; and 6) monitor development activities within the home range of a new pygmy-owl, and conservation measures, to ensure compliance with terms and conditions.

Lazy K Bar Ranch HCP

The proposed action was the issuance of an Endangered Species Act section 10(a)(1)(B) permit for the Lazy K Bar Ranch in association with a HCP. The project included the operation of a resort/guest ranch and ultimately its conversion into a low-density, residential area. The consultation covered both the transitional and residential phases of the project. We concluded that take, in the form of harassment due to habitat loss and noise disturbance, may result in up to two pygmy-owls and their young. We provided the following reasonable and prudent measures: 1) minimize the removal of suitable habitat areas associated with project development; 2) avoid disturbance of breeding pygmy-owls and loss of nest trees or saguaros while being used by pygmy-owls; 3) minimize habitat disturbance and loss of key habitat components during project development; and 4) monitor the effects of the proposed project on habitat quality over time, and ensure adherence to HCP criteria.

Safford and Tucson Livestock Grazing Program

The proposed action for this project was the issuance of permits to graze livestock on the Safford and Tucson districts of the BLM. BLM was the lead Federal agency for the consultation. This is a large programmatic consultation covering many allotments (over 250) that has been amended several times since the original opinion was issued in 1997. The most recent amendment to

address the pygmy-owl was amendment four, which also addressed newly designated critical habitat. As mentioned above, pygmy-owl has since been remanded to us by the district court and is not currently in effect.

We found, given the documentation of nesting pygmy-owls and good habitat on the Guild Wash and Owl Head allotments, and presence of a pygmy-owl nest within three miles of Bureau lands on the Cross Triangle allotment, that take of pygmy-owls is reasonable likely to occur over the life of the proposed action (BLM grazing leases can be of any length of time, but cannot exceed ten years). We anticipated that up to one nesting pair of pygmy-owls and one unpaired pygmy-owl could be harmed due to: 1) construction of range improvement projects (corrals, fences, pipelines, tanks, etc.) or implementation of mechanical of chemical vegetation treatments, or prescribed fire that destroys nesting or foraging habitat, and 2) planting or seeding of non-native plants that may alter fire regimes and increase the chance that a wildfire would occur in occupied pygmy-owl habitat.

We provided the following reasonable and prudent measures in order to minimize take: 1) Actions shall be taken to minimize direct effects of cattle grazing on those habitats that, based on current knowledge, have the greatest potential to support pygmy-owls, 2) Activities that may result in a take of cactus ferruginous pygmy-owl or destruction of pygmy-owl habitat shall be evaluated, monitored, and modified as needed to reduce potential adverse effects to the pygmy-owl, 3) the Bureau shall monitor incidental take resulting from the proposed action and report to the Service the findings of that monitoring.

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all Federal, state, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of state and private actions which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

A. Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR §402.02). We have determined that the action area for the pygmy-owl includes the Ajo block allotments and areas within 19 miles of these allotments. We based this determination on the dispersal distance of juvenile pygmy-owls in Texas and Arizona (Proudfoot unpubl. data, S. Richardson, AGFD unpubl. data).

B. Terrain, Vegetation Communities, and Climate in the Action Area

A complete description of the Ajo allotments and surrounding areas has been given previously provided (see "Environmental Baseline, part B. Terrain, Vegetation Communities, and Climate in the Action Area for the Sonoran pronghorn).

C. Status of the Cactus Ferruginous Pygmy-Owl in the Action Area

Pygmy-owls have been documented on both the Cameron and Childs allotments. On the Cameron Allotment, a single pygmy-owl was detected at the Cuerda de Lena Wash in 1998. Surveys conducted by BLM contract during 2001 also detected a single pygmy-owl along Sikort

Chuapo Wash on the Childs Allotment. The initial detection was followed up by Tim Tibbitts of NPS, who stated that although the response call was somewhat atypical for a pygmy-owl, he was about 70 percent certain of his determination. Due to the nature of the habitat, its proximity to other pygmy-owl locations, and the degree of confidence in the determination, we treat this observation as a confirmed sighting and it is now included in a recovery area in the draft recovery plan (K. Hartwig, FWS pers. comm.). No pygmy-owls were documented on the Ajo allotments during 2002 surveys.

Within the Ajo allotments, only the Cameron and Childs allotments contain suitable pygmy-owl habitat. The Coyote Flat and Why allotments do not contain suitable or potential pygmy-owl habitat. According to the BLM, these allotments do not have the capability to produce potential or suitable habitat in the future because the washes are too small to support dense vegetation patches > 3 acres in size.

The action area, as defined for the pygmy-owl, includes the Ajo allotments, as well as a 19-mile buffer area surrounding the allotments. Therefore, the action area also includes portions of Organ Pipe Cactus NM, Cabeza Prieta NWR, and BMGR. Although the majority of Arizona pygmy-owl detections in the last seven years have been from the northwestern Tucson area, pygmy-owls have also been detected in southern Pinal County, including Organ Pipe Cactus NM and Cabeza Prieta NWR. While there are no confirmed current records for pygmy-owl on BMGR, the Range overlaps the pygmy-owl's historic distribution and contains potentially suitable habitat (Dames and Moore 1995). In 2001, 2 new pygmy-owl sites were documented for Cabeza Prieta NWR.

Pygmy-owl habitat at Organ Pipe Cactus NM is of moderate to above-average quality. The area offers relatively dense and diverse upper bajada Sonoran Desert scrub, with a number of larger xeroriparian areas, and numerous smaller washes, including wash confluence areas. Pygmy-owl presence at the Monument has been surveyed since 1977 when two pairs were recorded. In 1982, one pair of pygmy-owls was found followed by two pairs in 1992. Through limited surveys, approximately 3 to 5 pygmy-owl territories have been located and monitored since 1995. Four pairs of pygmy-owls were located in 1999 and 4 pairs and 2 individuals were discovered in 2000. Surveys in 2001 detected 5 occupied territories, including 3 confirmed pairs with an additional pair strongly suspected. In contrast, during 2002 only 2 adults from 2 sites in Organ Pipe Cactus NM were detected, and no pairs or nesting was observed.

Construction and development projects in Organ Pipe Cactus NM have impacted the pygmy-owl and its habitat. Most of the construction and development is related to maintaining, improving, and/or expanding facilities used for management of and providing services to the visiting public. The majority of these actions center on the Twin Peaks area (Visitor Center, residence area, maintenance area, and campground) and have taken place in or adjacent to pygmy-owl habitat and territories. Furthermore, additional maintenance and upgrading projects are planned. Although a number of section 7 consultations regarding potential impacts to pygmy-owls at Organ Pipe Cactus NM, as well as other locales within the action area have been conducted, we did not anticipate any incidental take would result from these actions.

The significance of number of pygmy-owl locations in the areas surrounding the Ajo allotments is the high probability of the dispersal of owls onto the allotments containing suitable and potential habitat. Of particular significance is the allotments' close proximity to Organ Pipe Cactus NM, where the nesting of pygmy-owls occurs during most years. Therefore, in addition to the recent sighting of pygmy-owls on the allotments, there is also a reasonable certainty that pygmy-owls may attempt to disperse to locations on the Ajo allotments in the future.

EFFECTS OF THE ACTION

We have, in cooperation with BLM, developed guidance criteria for determinations of effects of proposed grazing authorizations on listed species. The guidance criteria for a may affect, not likely to adversely affect determination for pygmy-owl are as follows:

1. Suitable upland and wash habitat would not likely be maintained because utilization on perennial, palatable shrubs or grasses would be > 30 percent, which would likely change the plant species composition and/or structural components of suitable habitat or preclude the establishment of vegetation which eventually would develop into suitable habitat.

2. Disruption of individuals during nesting by interrelated or interdependent activities (e.g., livestock gathering, range improvement construction or maintenance) would likely occur within a 0.25 mile radius, of an occupied site, previously occupied territory, or unsurveyed suitable habitat between January 1 and June 30.

3. Damage to perennial vegetation or disruption of foraging, nesting, breeding, or roosting behavior of pygmy-owls would likely occur from ephemeral grazing of large numbers of animals from January 1 to June 30.

Criterion 1 applies because utilization levels have exceeded 30 percent on the Cameron Allotment, and were as high as 76 percent on chuparosa in 2001. However, BLM stated that the proposed reduction in preference for the Cameron Allotment, in combination with the rotation of livestock between different areas by manipulating water sources, will result in a reduction of utilization rates to the desired 30 percent. As discussed above in "Effects of the Action for the Sonoran pronghorn, we do not believe that the proposed reduction in preference for the Cameron Allotment will result in a reduction in actual use. Therefore, a reduction in utilization levels is not anticipated. However, BLM has further stated that when and if utilization exceeds 30 percent, the number of cattle will be reduced.

Utilization rates have not been measured for the Childs Allotments. However, the permittee for this allotment has typically retained his cattle on private land, and therefore utilization rates have likely remained below 30 percent. When we visited this allotment in June 2002, we found little evidence of any recent use by livestock.

A range improvement, consisting of a well and corral, are located within 0.25 mile of the 2001 pygmy-owl location on the Childs Allotment. Therefore, criterion 2 also applies. However, because of the low level of use on the Childs Allotment, the corral and well are not frequently used, and the BLM does not anticipate their use in the immediate future. Also, the BLM has committed to not using the corral during the breeding season (January 1-June 30). Maintenance or construction of range improvements in suitable pygmy-owl habitat, as well as renewed use of the existing well and corral, will be preceded by 2 years of pygmy-owl surveys, and all work will be done outside of the breeding season.

According to the BLM, criterion 3 does not apply. BLM policy on ephemeral grazing is that it will only be authorized when sufficient green up to support additional animals occurs. The policy further requires that sufficient annual growth is available to deter livestock use of perennial vegetation. To ensure compliance with this policy, ephemeral authorizations will be issued in 30-day increments.

Based on the grazing guidance criteria, the proposed action is likely to adversely affect the

pygmy-owl. Potential effects of grazing on the pygmy-owl include: 1) increased dominance of nonnative annuals caused by grazing, which together may alter fire regimes and increase the chance that a wildfire would occur in occupied pygmy-owl habitat (Schmid and Rogers 1988); 2) reduced productivity and vigor of desert ecosystems; 3) trampling and browsing of vegetation cover, including saguaros and their nurse plants; 4) reduction of cryptobiotic crusts; 5) soil erosion and compaction; 6) reduced water infiltration rates and increased runoff, leaving less water for plant production; and 7) harm or harassment of pygmy-owls, particularly in areas where cattle are gathered or where they water. Changes in the vegetation community can also result in decreased pygmy-owl prey base, increased susceptibility of pygmy-owls to aerial predators, lack of suitable nesting structures, and habitat fragmentation. As discussed in the effects of the action for the pronghorn, vegetation communities have apparently been adversely affected by land management practices, including grazing, on the Ajo allotments (see Figure 5, Appendix 2).

Direct Effects

Unloading of livestock is generally done near water sources to allow the cattle to become familiar with the location; gathering is also most easily achieved at water. A corral and well exist within 0.25 mile of a previously occupied territory on the Childs Allotment. Currently, these structures are not frequently utilized due to the low stocking rate on the Childs Allotment. However, livestock gathering and unloading may occur in this area in the future. Livestock gathering and unloading, which may involve hundreds of cattle, numerous vehicles, and many people, could potentially disturb pygmy owls if they occur nearby. The Bureau has committed to not using the corral during the breeding season for the pygmy-owl, which alleviates the potential for disturbing breeding owls due to livestock gathering and unloading. While the Bureau does not anticipate regular use of the existing facilities, two years of pygmy-owl surveys will be conducted prior to initiation of renewed use of the area, and reinitiation of consultation may be necessary.

Indirect Effects

Potential Effects of Livestock Grazing on Natural Vegetation Communities

Grazing may reduce the structure and composition of vegetation communities below the site's potential and thereby reduce the suitability of the site as pygmy-owl habitat. Although grazing in semidesert grassland and Chihuahuan Desert scrub can cause a decrease in grasses and increases in shrubby species (Bahre 1995, Holecheck *et al.* 1994), this effect has not been documented in Sonoran Desert scrub. Grazing can result in reduced shrub cover (Webb and Stielstra 1979) and reduced desirable shrubs (Orodho *et al.* 1990) in Mojave Desert scrub and Great Basin Desert scrub, respectively. Browsing of shrubs and young trees, trampling or browsing of saguaros and their nurse plants (Abouhalder 1992), and adverse effects to soils and cryptobiotic crusts (see "Effects of the Action for the Sonoran pronghorn) are mechanisms by which the structure and composition of Sonoran Desert scrub could be affected by grazing. Reduction in shrub, tree, and columnar cacti cover and regeneration would degrade pygmy-owl habitat.

Potential Effects of Livestock Grazing on Saguaros

Effects to saguaros and their nurse plants resulting from grazing have been studied by several authors in Sonoran Desert scrub in Arizona. Saguaros may be affected both directly and indirectly by grazing activities. Direct impacts may occur from trampling of young saguaros, grazing of nurse plants which results in reduction or removal of protective cover, or grazing of the young saguaros themselves (Abouhalder 1989). Abouhalder (1989) noted statistical

differences in the age structure of saguaros between grazed and ungrazed areas of Saguaro National Monument, which he attributed to the Monument's grazing history. Nurse plants, which shade sensitive saguaro seedlings (Shreve 1931), may be reduced by grazing, and germination sites may be adversely altered due to soil compaction, erosion, and reduced infiltration. Benson (1982) noted that seedbeds of saguaros have been locally obliterated by grazing. Neiring *et al.* (1963) found that enhanced reproduction of saguaros on slopes was correlated with reduced localized levels of grazing.

Steenbergh and Lowe (1977) examined saguaro density and recruitment within Saguaro National Park which, until recently, was grazed by livestock. In addition, Burgess (1964) examined saguaro populations on the Tonto National Forest. These studies found that in Sonoran Desert scrub, direct destruction of young saguaros has resulted from the trampling by cattle seeking shade and forage beneath the crowns of desert trees, particularly paloverdes and mesquite. They also found that livestock grazing has had the greatest impact in non-rocky habitats where germination, establishment, and survival of young saguaros are most directly dependent upon the physical protection of other vegetation. Grazing in rocky habitats has had far less impact upon young saguaro recruitment. They summarized that grazing has reduced the density of saguaro populations by decreasing the number of sites suitable for germination and establishment of young plants by increasing exposure to natural mortality-causing factors. Therefore, since most recent nest cavities used by pygmy-owls have been in saguaros in non-rocky habitat (Kim Hartwig, FWS pers. comm. 2002), activities which affect saguaro recruitment could be significant.

BLM has established a saguaro demography study plot on the Cameron Allotment and a comparison plot on Cabeza Prieta NWR. Both plots are on relatively flat land within 0.5 mile of a grazed focal point on the Cameron grazing allotment called Cameron Tank, which has hosted livestock grazing for many decades. Both plots show very similar bell-shaped size-age distributions in saguaro height. Further, in 1999, BLM established long-term saguaro recruitment monitoring plots on the Cameron and Childs allotments in moderate to dense saguaro stands. These plots will be reread every 10 years and changes in recruitment analyzed. Any changes will not be evident for many years; however, BLM stated that thus far the evidence does not show a lack of recruitment in areas used by livestock. BLM has agreed to notify us, should a change in saguaro recruitment occur.

Potential Effects of Livestock Grazing on Fire Frequency

Grazing in desert scrub communities probably has mixed effects on fire frequency and behavior. Weedy nonnative plants, split grass (*Schismus barbatus*), checker fiddleneck (*Amsinckia intermedia*), filaree (*Erodium cicutarium*), Sahara mustard *(Brassica tournefortii*), and cheatgrass (*Bromus rubens*) may benefit from grazing, while native perennial bunchgrasses, which are highly palatable grazing forage, may become less abundant (Berry and Nicholson 1984, Kie and Loft 1990, Minnich 1994). When nonnative annual plants cure, they can form continuous stands of fine fuels that carry fire. These fine fuels have resulted in increased fire frequency in desert scrub (Rogers and Steele 1980, Minnich 1994). While livestock grazing has contributed to the spread of nonnative annuals into desert scrub communities, livestock grazing can also reduce fuel loads, making it less likely that fire will occur. The alteration of fire regimes may have either positive or negative effects to listed species, but it is generally deleterious to ecosystem functioning (Bahre 1991).

Many desert shrubs and cacti, including saguaro, are poorly adapted to fire and decline in burned areas. For example, Esque *et al.* (2000) reported mortality of adult saguaros in excess of 20 percent after a fire in desert scrub at Saguaro National Park. Thus, any activity that has the

potential to increase fire frequency or intensity may result in a reduction of pygmy-owl nesting structures.

Potential Effects of Livestock Grazing on Prey Species

Grazing can affect densities of potential pygmy-owl prey. Jones (1981) found that grazing reduced lizard abundance and variety in a number of habitats in western Arizona. Pianka (1966, 1986) discussed the importance of vegetation structure, and found vegetation communities with increased plant structures supported more lizard species than those with less structure. In general, complex vegetation communities with a high degree of species diversity and structural heterogeneity provide habitat for many prey species including birds, insects, and mammals.

Pygmy-owls coexist with livestock grazing in Sonoran Desert scrub northwestern of Tucson, in Altar Valley southwest of Tucson and in Mexico. Thus, although adverse effects to the pygmy-owl and its habitat may occur from livestock grazing activities, the birds are at least somewhat tolerant of this type of disturbance.

Summary of Effects

Livestock grazing has the potential to adversely affect pygmy-owl habitat by changing the structure and/or composition of the vegetation community. Such alteration may include the trampling and browsing of vegetation cover, including saguaros and their nurse plants. Grazing may also lead to the reduction of cryptobiotic crusts and increase soil compaction, which may result in increased soil erosion, reduced water infiltration rates, increased runoff, and subsequently leave less water for plant production. Changes in the vegetation community can result in decreased pygmy-owl prey base, increased susceptibility of pygmy-owls to aerial predators, lack of suitable nesting structures, and habitat fragmentation.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Cumulative effects to pygmy-owls are similar to those described earlier for Sonoran pronghorn. Agricultural, residential, and commercial development, recreation, off-road vehicle use, grazing, and other activities on state and private lands continue to degrade or destroy pygmy-owl habitat and increase the likelihood of disturbance to pygmy-owls due to increased human presence. The ever increasing number of illegal border crossings by undocumented immigrants and smugglers, and associated illegal activities result in damage to habitat. Cutting of firewood can remove potential nest trees, and illegal campfires result in an increased risk of wildfire (Organ Pipe Cactus NM 2001).

CONCLUSION

After reviewing the current status of the cactus ferruginous pygmy-owl, the environmental baseline for the action area, the effects of the proposed and ongoing BLM action, and the cumulative effects, it is our biological opinion that continued grazing on the Ajo allotments, is not likely to jeopardize the continued existence of the pygmy-owl. No critical habitat is designated for this species, therefore, none will be affected. Our findings are based on the following:

1. BLM has committed to limiting utilization rates to 30 percent. If the target utilization rate is exceeded livestock numbers will be reduced.

2. Although a corral exists within 0.25 mile of a previously occupied pygmy-owl site, the Bureau has committed to not using the corral during the breeding season for the owl. BLM does not anticipate renewed use of these facilities in the immediate future, will conduct two years of pygmy-owl surveys prior to any such activity, and may reinitiate consultation depending on the results of surveys.

3. All construction or maintenance of range improvements within suitable pygmy-owl habitat will be preceded by 2 years of surveys, or will be conducted outside of the pygmy-owl breeding period.

4. Fire wood will be harvested from July 1 through December 31 in Zone 5, and only dead-and-down material will be taken.

5. BLM has initiated a saguaro recruitment study. Currently no change in recruitment has been observed and no differences in age structure of saguaros was found between plots located on BLM land and Cabeza Prieta NWR.

6. BLM will notify us if a change in saguaro recruitment is observed.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA 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 FWS 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 FWS 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 provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Amount or Extent of Take Anticipated

We do not anticipate the proposed action will incidentally take any pygmy-owl based on the current project description. However, should the project description change (i.e., if utilization exceeds 30 percent on the Cameron or Childs allotments and livestock numbers are not consequently reduced in order to attain the 30 percent target utilization), then the effects of the action would be different than those described herein, and BLM should reinitiate consultation pursuant to 50 CFR 402.16(b).

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to

minimize or avoid effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. We recommend implementing the following actions:

1. Complete and submit to us annual monitoring of utilization levels in each allotment with potential pygmy-owl habitat.

2. Continue to conduct annual pygmy-owl surveys in areas containing suitable or potential habitat.

3. Limit livestock gathering activities that concentrate livestock or humans within unsurveyed suitable habitat during the breeding season (January 1 - June 30).

4. Assist with the implementation of the pygmy-owl recovery plan, once finalized.

5. Fund and/or conduct studies to determine the effects of ephemeral grazing intensities on the alteration of native plant communities, including such factors as the mortality of seedling trees, shrubs, and saguaros; disruption of soil crusts; soil compaction; and erosion.

6. Prohibit all firewood collection in the Childs, Cameron, Why, and Coyote Flats allotments.

REINITIATION NOTICE

This concludes formal consultation on BLM livestock grazing on five allotments near Ajo. 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; (2) 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; (3) the agency action is subsequently modified in a manner that causes an effect to a listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation. If conservation measures or other aspects of the proposed action are not implemented as anticipated herein, including schedules for implementation, reinitiation may be warranted.

Thank you for your cooperation and assistance throughout this consultation process. Any questions or comments should be directed to Sherry Barrett of the Tucson Suboffice at 520/640-4617.

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LITERATURE CITED

Abbate, D., A. Ditty, and S. Richardson. 1996. Cactus ferruginous pygmy-owl surveys and nest monitoring in the Tucson Basin area, Arizona. Final Report to the Arizona Game and Fish Dept., Phoenix 25pp.

Abbate, D., S. Richardson, R. Wilcox, M. Terrio, and S. Belhumeur. 1999. Cactus ferruginous pygmy-owl investigations in Pima and Pinal and Fish Department Region 5 Wildlife Program. Phoenix. 83 pp.

Abouhalder, F. 1989. Influence of Livestock Grazing on Saguaro Seedling Establishment. Masters Thesis. Arizona State University. 50 pp.

Abouhalder, F. 1992. Influence of livestock grazing on saguaro seedling establishment. Pages 57-61 *in* C.P. Stone and E.S. Bellantoni (eds), Proceedings of the Symposium on research in Saguaro National Monument, Tucson, AZ.

Ainley, D.G., R.E. LeResche, and W.J.L. Sladen. 1983. Breeding biology of the Adelie penguin. Univ. of Calif. Press. Berkeley.

American Birding Association. 1993. Good birds from the hotline. April 1993. Winging it 5(5):3.

Anderson, D.C., K.T. Harper, and S.R. Rushforth. 1982. Recovery of cryptogamic soil crusts from grazing on Utah winter ranges. Journal of Range Management 35(3):355-359.

Anderson, D.E., O.J. Rongstad, and W.R. Mytton. 1990. Home range changes in post-breeding raptors exposed to increased human activity levels in southeastern Colorado. Wildlife Society Bulletin. 18:134-142.

Arizona Game and Fish Department. 1981. The Sonoran pronghorn. Special Report No. 10. Arizona Game and Fish Department, Phoenix, AZ.

Arizona Game and Fish Department. 1985. Interim report on the Sonoran pronghorn (*Antilocapra americana sonoriensis*). Oct. 1983 - March 1985. Arizona Game and Fish Department, Phoenix, AZ.

Arndt, W. 1966. The effects of traffic compaction on a number of soil properties. Journal of Agricultural Engineering Research 11:182-187.

Bahre, C.J. 1991. A legacy of change. Historic human impact on vegetation in the Arizona borderlands. Univ. of Arizona Press, Tucson.

Bahre, C.J. 1995. Human impacts on the grasslands of Southeastern Arizona. Pages 230-264 in M.P. McClaran and T.R. VanDevender (eds.), The Desert Grassland, University of Arizona Press, Tucson.

Banks, R.C. 1979. Human-related mortality of birds in the United States. USDI, Fish and Wildlife Service, Spec. Sci. Rep. Wildl. No. 215.

Belnap, J. 1992. Potential role of cryptobiotic soil crusts in semiarid rangelands. Paper presented at the Symposium on Ecology, Management, and Restoration of Intermountain Annual Rangelands, Boise, Idaho, May 18-22, 1992.

Belnap, J., and J.S. Gardner. 1993. Soil microstructure in soils of the Colorado Plateau: The role of the cyanobacterium *Microcoleus vaginatus*. Great Basin Naturalist 53(1):40-47.

Belsky, A.J., and D.M. Blumenthal. 1997. Effects of livestock grazing on stand dynamics and soils in upland forests of the interior west. Conservation Biology 11(2):315-327.

Belsky, A.J., A. Matzke, and S. Uselman. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. J. Soil and Water Conservation 54(1):419-431.

Bendire, C.E. 1888. Notes on the habits, nests, and eggs of the genus *Glaucidium* Boie. Auk 5:366-372.

Benson, L. 1982. The cacti of the United States and Canada. Stanford Univ. Press, Stanford, California.

Berry, K.H., and L.L. Nicholson. 1984. A summary of human activities and their impacts on desert tortoise populations and habitat in California. Chapter 3 in K.H. Berry (ed.) 1984, The status of the desert tortoise (*Gopherus agassizii*) in the United States. Report to the Fish and Wildlife Service, Sacramento, California, from the Desert Tortoise Council. Cont. No. 11310-0083-81.

Binford, L.C. 1989. A distributional survey of the birds of the Mexican state of Oaxaca. Ornithological Monographs No. 443. American Ornithologists' Union, Washington, D.C. 418 pp.

Black, B.B., M.W. Collopy, H.F. Percival, A.A. Tiller, and P.G. Bohall. 1984. Effects of low-level military training flights on wading bird colonies in Florida. Report by Florida Coop.

Fisheries and Wildlife Resources Unit. Tech. Rpt. No. 7. Univ. of Florida, Gainesville. 190 pp.

Blackburn, W.H. 1984. Impacts of grazing intensity and specialized grazing systems on watershed characteristics and responses. *In* Developing Strategies for Range-land Management. National Research Council/National Academy of Science, Westview Press, Boulder, CO.

Bowels, A.E. 1995 Responses of wildlife to noise. 1995. Pp. 109-144 *in* R.L. Knight and K.J. Gutzwiller (eds.), Wildlife and recreationists coexistence through management and research. Island Press, Washington D.C.

Brady, N.C. 1974. The nature and properties of soils. 8th edition. MacMillan Publishing Co., Inc., New York, New York.

Breninger, G.F. 1898. The ferruginous pygmy-owl. Osprey 2(10):128 (*in* Bent 1938).

Bright, J.L., J.J. Hervert, L.A. Piest, R.S. Henry, and M. T. Brown. 1999. Sonoran pronghorn 1998 aerial survey summary. Nongame and Endangered Wildlife Program Technical Report No. 152. Arizona Game and Fish Department, Phoenix, AZ.

Bright, J.L., J.J. Hervert, and M.T. Brown. 2001. Sonoran pronghorn 2000 aerial survey summary. Technical Report No. 180. Arizona Game and Fish Department, Phoenix, AZ.

Brotherson, J.D., S.R. Rushforth, and J.R. Johansen. 1983. Effects of long-term grazing on cryptogamic crust cover in Navajo National Monument, Arizona. Journal of Range Management 36:579-581.

Brown, D.E. 1994. (ed) Biotic communities: Southern United States and Northwestern Mexico. Univ. of Utah Press, Salt Lake City.

Brown, D.E, C.H. Lowe, and J.F. Hausler. 1977. Southwestern riparian communities: their biotic importance and management in Arizona *in* R.R. Johnson and D.A. Jones (eds.), Importance, preservation, and management of riparian habitats: a symposium. Gen. Tech. Rep. Rm-43. USDA Forest Service, Denver, CO.

Brotherson, J.D., S.R. Rushforth, and J.R. Johansen. 1983. Effects of long-term grazing on cryptogamic crust cover in Navajo National Monument, Arizona. Journal of Range Management 36:579-581.

Burger, J. and M. Gochfeld. 1981. Discrimination of the threat of direct versus tangential approach to the nest by incubating herring an great black-backed gulls. Journal of comparative and physiological psychology (Series A) 95: 676-684.

Burgess, R.L. 1964. Preliminary reports on the botany of Tonto National Monument. II. Quantitative analysis of the saguaro population. Unpublished Report. 99pp.

Burkhardt, J.W. and D. Chamberlain. 1982. Range cattle food habits on the Mojave Desert. Unpublished report for the Nevada Agricultural Experiment Station, University of Nevada, Reno, NV.

Busby, F.E., and G.F. Gifford. 1981. Effects of livestock grazing on infiltration and erosion rates measured on chained and unchained pinyon-juniper sites in southeastern Utah. Journal

of Range Management 34:400-405.

Byers, J.A. 1997. American Pronghorn, Social Adaptations and the Ghosts of Predators Past. University of Chicago Press, Chicago, IL.

Campbell, R.C. 1989. Statistics for Biologists. Cambridge University Press, New York, NY.

Canadian Cooperative Wildlife Health Center Newsletter, Winter 1999, volume 6(2).

Carlson, P.C., W.S. Lahaye, and A.B. Franklin. 1998. Incestuous behavior in spotted owls. Wilson Bull. 110 (4): 562-564.

Carothers, S.W. 1977. Importance, preservation, and management of riparian habitats: an overview *in* R.R. Johnson and D.A. Jones (eds.), Importance, preservation, and management of riparian habitats: a symposium. Gen. Tech. Rep. RM-43. USDA Forest Service, Denver, CO.

Carr, J.N. 1970. Endangered species investigation. Sonoran pronghorn. Arizona Game and Fish Department, Phoenix, AZ.

Carr, J.N. 1971. Progress report-Endangered species investigation. Sonoran pronghorn. Arizona Game and Fish Department, Phoenix, AZ.

Carr, J.N. 1972. Progress report-Endangered species investigation. Sonoran pronghorn. Arizona Game and Fish Department, Phoenix, AZ.

Carr, J.N. 1974. Complete report-Endangered species investigation. Sonoran pronghorn. Arizona Game and Fish Department, Phoenix, AZ.

Catron, J.E., and D.M. Finch (eds.). 2000. Ecology and conservation of the cactus ferruginous pygmy-owl. USDA, Forest Service, General Technical Report RMRS-GTR-43.

Cartron, J.E., W.S. Richardson, and G.A. Proudfoot. 2000a. The cactus ferruginous pygmy-owl taxonomy, distribution, and Natural History. Pp. 5-15 *in* J.E. Cartron and D.M. Finch (eds.), Ecology and conservation of the cactus ferruginous pygmy-owl in Arizona. Gen. Tech. Rpt. RMRS-GTR-43. USDA, Forest Service, Rocky Mountain Research Station, Ogden, UT.

Cartron, J.E., S.H. Soleson, S. Russell, G.A. Proudfoot, and W.S. Richardson. 2000b. The ferruginous pygmy-owl in the tropics and at the northern end of its range: habitat relationships and requirements. Pp. 47-53 *in* J.E. Cartron and D.M. Finch (eds.), Ecology and conservation of the cactus ferruginous pygmy-owl in Arizona. Gen. Tech. Rpt. RMRS-GTR-43. USDA, Forest Service, Rocky Mountain Research Station, Ogden, UT.

Castro, A. E. 2001. Other Herpesviruses. Bovine Herpesvirus 1. *In* Infectious Diseases of Wild Mammals, 3rd Edition, Williams, Elizabeth, S. and Ian K. Barker (eds). Iowa State Press, Ames, IA.

Caughley, G. and A. Gunn. 1996. Conservation biology in theory and practice. Blackwell Science Inc. United States. 459 pp.

Chalmers, G. A., H. N. Vance, and G. J. Mitchell. 1964. An outbreak of epizootic hemorrhagic disease in wild ungulates in Alberta. Wildlife Diseases 42:1-6.

Cherkovich, G.M., and S.K. Tatoyan. 1973. Heart rate (radiotelemetric registration) in macaques and baboons according to dominant-submissive rank in a group. Folia Primatol 20:265-273.

Churcher, P.B. and J.H. Lawton. 1987. Predation by domestic cats in an English village. Journal of Zoology, London 212: 439-455.

Collins, M.D. and T.E. Corman. 1995. Cactus ferruginous pygmy-owl Surveys in Arizona: 1993-1994 season. Nongame and Endangered Wildlife Program Technical Report No. 37. Arizona Game and Fish Department, Phoenix.

Cooke, A.S. 1980. Observations on how close certain passerine species will tolerate an approaching human in rural and suburban areas. Biological Conservation 18:85-88.

Daddy, F., M.J. Trlica, and C.D. Bonham. 1988. Vegetation and soil water differences among big sagebrush communities with different grazing histories. The Southwestern Naturalist 33(4):413-424.

Dadkhah, N., and G. F. Gifford. 1980. Influences of vegetation, rock cover, and trampling on infiltration rates and sediment production. Water Resources Bulletin 16:979-986.

Dahl, T.E. 1990. Wetland losses in the United States, 1780s to 1980s. USDI, Fish and Wildlife Service, Washington, D.C. 13 pp.

Dames and Moore. 1995. Biological assessment for the Marine Corps Use of the Barry M. Goldwater Range, Arizona. Report to Marine Corps Air Station, Yuma, AZ.

Davis, W.A. and S.M. Russell. 1999. Finding birds in southeastern Arizona. 5th edition. Tucson Audubon Society, Tucson, AZ. 302 pp.

DeBano, L.F., and L.J. Schmidt. 1989. Interrelationship between watershed condition and riparian health. *In* Practical Approaches to Riparian Resource Management, U.S. Bureau of Land Management, Billings, MT.

Defenders of Wildlife. 1998. Population viability analysis workshop for the endangered Sonoran pronghorn (*Antilocapra americana sonoriensis*) in the United States. Defenders of Wildlife unpublished manuscript, Washington, D.C.

deVos, J.C. 1990. Selected aspects of Sonoran pronghorn research in Arizona and Mexico. *In* P.R. Krausman and N.S. Smith, eds., Proceedings of the Symposium: Managing Wildlife in the Southwest. Tucson, AZ.

deVos, J.C. 1998. Habitat selection patterns by Sonoran pronghorn in southwest Arizona. *In* T.J. Tibbetts and G.J. Maender, eds., First Conference on Research and Research Management in Southern Arizona: Extended abstracts. Organ Pipe Cactus National Monument and Cooperative Park Studies Unit, University of Arizona, Tucson, AZ.

Earhart, C.M., and N.K. Johnson. 1970. Size dimorphism and food habits of North American owls. Condor 72(3):251-264.

Ehrlich, P.R., and J. Roughgarden. 1987. The Science of Ecology. MacMillan Publishing Co., New York, N.Y.

Ellison, L. 1960. Influence of grazing on plant succession on rangelands. Botanical Review 26(1):1-78.

Esque, T.C., C.R. Schwalbe, P.J. Anning, and W.L. Halvorson. 2000. Exotic grasses, long-lived species, and managing desert landscapes: a case history at Saguaro National Park. Page 20, *in* Program and Abstracts, Creative Cooperation in Resource Management, Third Conference on Research and Resource Management in the Southwestern Deserts, Tucson, May, 2000.

Felger, R.S. 1980. Vegetation and flora of the Gran Desierto. Desert Plants 2(2):87-114.

Felger, R.S. 2000. Flora of the Gran Desierto and Rio Colorado of Northwestern Mexico. University of Arizona Press, Tucson, AZ.

Felley, D.L. and T.E. Corman. 1993. Spring 1993 cactus ferruginous pygmy-owl surveys in Arizona. Nongame and Endangered Wildlife Program Technical Report. Arizona Game and Fish Department, Phoenix. 16 pp.

Fisher, A.K. 1893. The hawks and owls of the United States in their relation to agriculture. USDA Div. Ornithol. and Mammal. Bull. 3:1-210.

Flesch, A.D. 1999. Cactus ferruginous pygmy-owl surveys and nest monitoring on and around the Buenos Aires National Wildlife Refuge, Altar Valley, Arizona. A report to the USDI Fish and Wildlife Service, FWS Coop. Agreement No. 1448-00002-99-G943. 21 pp.

Fox, L.M., P.R. Krausman, M.L. Morrison, and R.M. Kattnig. 1997. Nutritional content of forage in Sonoran pronghorn habitat, Arizona. Masters Thesis, University of Arizona, Tucson, AZ.

Fox, L.M., P.R. Krausman, M.L. Morrison, and R.M. Kattnig. 2000. Water and nutrient content of forage in Sonoran pronghorn habitat, Arizona. California Fish and Game 86(4): 216-232.

Geist, V. 1971. A behavioral approach to the management of wild ungulates. *In* E. Duffy and A.S. Watts, eds., The Scientific Management of Animal and Plant Communities for Conservation. Symposium of the British Ecological Society No. 11. Blackwell Science Publications, Oxford, U.K.

Gifford, G.F., and R.H. Hawkins. 1978. Hydrologic impact of grazing on infiltration: A critical review. Water Resources Research 14:305-313.

Gilman, M.F. 1909. Some owls along the Gila River in Arizona. Condor 11:145-150.

Gilpin, M.E. and M.E. Soulé. 1986. Minimum viable populations: processes of extinction. *In* M.E. Soulé, ed., Conservation Biology: The science of scarcity and diversity. Sinauer Associates, Sunderland, MA.

Goldman, E.A. 1945. A new pronghorn from Sonora. Proceedings of the Biological Society, Washington 58:3-4.

Hall, E.R. 1981. The mammals of North America. John Wiley and Sons, New York, NY.

Halls, L. K. 1984. White-tailed deer: ecology and management. Wildlife Management Institute. Washington, D.C. 870 pp.

Harris, M.P. 1984. The puffin. T & A D Poyser, Calton, Staffordshire, England. (81).

Haug, E.A. 1985. Observations on breeding ecology of burrowing owls in Saskatchewan. M.S. thesis. Univ. of Saskatchewan.

Hecht, A. and P.R. Nickerson. 1999. The need for predator management in conservation of some vulnerable species. Endangered Species Update 16:114-118.

Hervert, J.J. 1996. Deposition; Defenders of Wildlife *et al.* vs Sheila Widnal *et al.* Recorded by Bort Court Reporting Services, Yuma, AZ.

Hervert, J.J., L.A. Piest, R.S. Henry, and M.T. Brown. 1997a. Sonoran pronghorn 1996 aerial survey summary. Nongame and Endangered Wildlife Program Technical Report No. 124. Arizona Game and Fish Department, Phoenix, AZ.

Hervert, J.J., L.A. Piest, W. Ballard, R.S. Henry, M.T. Brown, and S. Boe. 1997b. Sonoran pronghorn population monitoring: progress report. Nongame and Endangered Wildlife Program Technical Report 126. Arizona Game and Fish Department, Phoenix, AZ.

Hervert, J.J., J.L. Bright, M.T. Brown, L.A. Piest, and R.S. Henry. 2000. Sonoran pronghorn population monitoring: 1994-1998. Nongame and Endangered Wildlife Program Technical Report No. 162. Arizona Game and Fish Department, Phoenix, AZ.

Heuschele, W.P. 2002. Center for Reproduction of Endangered Species (CRES) Zoological Society of San Diego (San Diego Zoo). University of Georgia, College of Veterinary Medicine Foreign Animal Diseases: Malignant Catarrhal Fever. *At* www.vet.uga.edu

Heuschele, W.P. and H.W. Reid. 2001. Malignant Catarrhal Fever. *In* Infectious Diseases of Wild Mammals, 3rd Edition, Williams, Elizabeth, S. and Ian K. Barker (eds). Iowa State Press, Ames, IA.

Hoff, G.L. and D.O. Trainer. 1981. Hemorrhagic Diseases of Wild Ruminants. *In* J.W. Davis, L.H. Karstad, and D.O. Trainer, eds, Infectious Diseases of Wild Mammals. Iowa State University Press, Ames, Iowa.

Holechek, J.L. 1988. An approach for setting the stocking rate. Rangelands 10(1):10-14.

Holecheck, J.L., R.D. Pieper, and C.H. Herbel. 1998. Rangeland Management: Principles and Practices. Prentice-Hall, NJ.

Holecheck, J.L., R.D. Pieper, and C.H. Herbel. 2001. Range Management: Principles and Practices. Prentice-Hall, NJ.

Howerth, E.W. and D.E. Stallknect. 2002. Hemorrhagic Disease in Wildlife in the United States. *At* Western College of Veterinary Medicine, University of Saskatchewan website www.usask.ca/wcvm

Howerth, E.W., D.E. Stallknecht, and P.D. Kirkland. 2001. Bluetongue, Epizootic Hemorrhagic Disease, and Other Orbivirus-Related Diseases. *In* Infectious Diseases of Wild Mammals, 3rd Edition, Williams, Elizabeth, S. and Ian K. Barker (eds). Iowa State Press, Ames, IA.

Hughes, K.S., and N.S. Smith. 1990. Sonoran pronghorn use of habitat in Southwest

Arizona. Report to Cabeza Prieta National Wildlife Refuge, Ajo, AZ.

Humphrey, R.R. 1987. 90 Years and 535 Miles, Vegetation Changes Along the Mexican Border. University of New Mexico Press, Albuquerque, NM.

Hunter, M.L., Jr. 1996. Fundamentals of conservation biology. Rand McNally, Taunton, MA. 482 pp.

Hunter, W.C. 1988. Status of the cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*) in the United States and Northern Mexico. US Fish and Wildlife Service, Phoenix. 13pp.

Inouye, R.S. 1991. Population biology of desert annual plants. Pages 27-54 *in* G.A. Polis (ed), The Ecology of Desert Communities. University of Arizona Press, Tucson.

Jahrsdoerfer, S.E. and D.M. Leslie, Jr. 1988. Tamaulipan brushland of the Lower Rio Grande Valley of South Texas: description, human impacts, and management options. USDI, Fish and Wildlife Service, Biol. Rep. 88(36). 63 pp.

Jeffries, D.L., and J.M. Klopatek. 1987. Effects of grazing on the vegetation of the blackbrush association. Journal of Range Management 40:390-392.

Johansen, J.R., S.R. Rushforth, and L.L. St. Clair. 1991. Cryptogamic crusts: recovery following disturbance. Supplement to American Journal of Botany 78(6):3.

Johnsgard, P.A. 1988. North American owls. Smithsonian Institution Press, Washington, D.C. 295 pp.

Johnson, B.K., F.G. Lindzey, and R.J. Guenzel. 1991. Use of aerial line transect surveys to estimate pronghorn populations in Wyoming. Wildlife Society Bulletin 19:315-321.

Johnson, R.R., and L.T. Haight. 1985. Status of the ferruginous pygmy-owl in the southwestern United States. Abstracts, 103rd Stated Meeting of the American Ornithologists' Union, Arizona State University, Tempe.

Johnson, R.R., L.T. Haight, and J.M. Simpson. 1979. Owl populations and species status in the southwestern United States. Pp. 40-59 *in* P. Schaffer and S.M. Ehler (eds.), Owls of the west: their ecology and conservation. Proc. Natl. Audubon Soc., George Whittel Education Center, Tiburon, CA.

Johnson-Duncan, E.E., D.K. Duncan, and R.R. Johnson. 1988. Small nesting raptors as indicators of change in the southwest desert. Pp. 232-236 *in* R.L. Glinski et al. (eds.), Proceedings of the Southwest Raptor Management Symposium and Workshop. Nat. Wildl. Fed., Washington, D.C. 395 pp.

Jones, K.B. 1981. Effects of grazing on lizard abundance and diversity in western Arizona. Southwestern Naturalist 26(2):107-115.

Kie, J.G., and E.R. Loft. 1990. Using livestock to manage wildlife habitat: Some examples from California annual grassland and wet meadow communities. Pages 7-24 in: K.E. Severson (ed.). Can livestock be used as a tool to enhance wildlife habitat? Proceedings of the 43rd Annual Meeting of the Society for Range Management, Reno, Nevada. Forest

Service Technical Report RM-194.

Kindschy, R.R., C. Sundstrom, and J.D. Yoakum. 1982. Wildlife habitats in managed rangelands - the Great Basin of southeastern Oregon: pronghorn. General Technical Report PNW-145. U.S. Department of Agriculture, Northwest Forest and Range Experimental Station, Portland, OR.

Klein, K. 2000. Mass smugglings of immigrants on the increase. March 13, Desert Sun, Palm Springs, www.thedesertsun.online.com.

Kleiner, E.F., and K.T. Harper. 1972. Environmental and community organization in grasslands of Canyonlands National Park. Ecology 55:229-309.

Kleiner, E.F., and K.T. Harper. 1977. Soil properties in relation to cryptogamic ground cover in Canyonlands National Park. Journal of Range Management 30:202-205.

Klem, D.A. 1979. Biology of collisions between birds and windows. Ph.D. thesis. Southern Illinois Univ.

Klemmedson, J.D. 1956. Interrelationships of vegetation, soils, and range conditions induced by grazing. Journal of Range Management 9:134-138.

Knight, R.L., D.L. Grout, and S.A. Temple. 1987. Nest behavior of the American crow in urban and rural areas. Condor 89:175-177.

Knight, R.L. and D.N. Cole. 1995. Wildlife responses to recreationists. Pp. 51-62 *in* R.L. Knight and K.J. Gutzwiller (eds.), Wildlife and recreationists coexistence through management and research. Island Press, Washington D.C.

Krausman, P.R., L.K. Harris, and J. Francine. 2001. Long-term study of the noise effects of military overflights on the Sonoran pronghorn, Barry M. Goldwater Range, Luke Air Force Base, Arizona. U.S. Air Force Contract F41624-98-C-8020-P00003.

Kreplin, C. 2002. Leptospirosis in Farm Animals. University of Alberta, Agriculture, Food and Rural Development Home Page, www.agric.gov.ab.ca

Kusler, J.A. 1985. A call for action: protection of riparian habitat in the arid and semi-arid West *in* R.R. Johnson et al. (eds.), Riparian ecosystems and their management: reconciling conflicting uses: First North American Riparian Conference. Gen. Tech. Rep. RM-120. USDA Forest Service, Fort Collins, CO.

LeFranc, M.M. Jr. and B.A. Millsap. 1984. A summary of state and federal agency raptor management programs. Wildl. Soc. Bull. 12:274-282.

Leftwich, T.J., and C.D. Simpson. 1978. The impact of domestic livestock and farming on Texas pronghorn. Pronghorn Antelope Workshop Proceedings 8:307-320.

Leighton, F.A. 2001. Other Bacterial Infections. *Fusobacterium necrophorum* Infection. *In* Infectious Diseases of Wild Mammals, 3rd Edition, Williams, Elizabeth, S. and Ian K. Barker (eds). Iowa State Press, Ames, IA.

Leighton, F.A. and Kuiken, T. 2001. Miscellaneous Bacterial Diseases: Leptospirosis. *In*

Infectious Diseases of Wild Mammals, 3rd Edition, Williams, Elizabeth, S. and Ian K. Barker (eds). Iowa State Press, Ames, IA.

Loftin, S.R., C.E. Bock, J.H. Bock, and S.L. Brantley. 2000. Dessert grasslands. *In* R. Jemison and C. Raish, eds., Livestock management in the American southwest: ecology, society, and economics. Elsevier Science, Amsterdam, The Netherlands.

Lovich, J.E., and D. Bainbridge. 1999. Anthropogenic degradation of the Southern California desert ecosystem and prospects for natural recovery and restoration. Environmental Management 24(3):309-326.

Marine Corps Air Station-Yuma. 2001. Yuma Training Range Complex draft supplemental environmental impact statement. U.S. Department of Defense, Marine Corps Air Station, Yuma, AZ.

McLaughlin, S.P. and J.E. Bowers. 1982. Effects of wildlife on the Sonoran desert plant community. Ecology 61:246-248.

McNicholl, M.K. 1983. Reactions of male blue grouse to intrusions by an observer. J. Field Ornithology. 54:77-83.

Mearns, E.A. 1907. Mammals of the Mexican boundary of the United States, Part 1. Bulletin of the U.S. National Museum 56:XVT530.

Menke, J.W. 1988. Report on range status and expected responses to absence of domestic livestock grazing in the Coso Geothermal area. Department of Agronomy and Range Science, University of California, Davis, CA. June 16, 1988.

Merck and Company. 1986. The Merck Veterinary Manual, Sixth Edition. Merck and Company, Inc., Rahway, NJ.

Millsap, B.A. and R.R. Johnson. 1988. Ferruginous pygmy-owl. Pages 137-139 in R.L. Glinski et al., eds. Proceedings of the Southwest Raptor Management Symposium and Workshop. Nat'l. Wildl. Fed., Washington.

Milstead, B. 2002. Life on the border: monitoring the effects of border-crossing and law enforcement on natural resources. Page 32 *in* Abstracts of the Fourth Conference on Research and Resource Management in the Southwestern Deserts: Meeting Resource Management Information Needs. May 15-17, 2002, Tucson, AZ.

Mikkelsen, C.W. and Woodbury, M. 2000. Necrobacillosis in Deer. University of Saskatchawan, Western College of Veterinary Medicine website. *At* www.usask.ca/wcvm

Minnich, R.A. 1994. Postfire succession in desertscrub communities of southern California. Pages 93-112 *in* Fletcher-Jones, A., ed., Proc. of the Desert Tortoise Council Symposium.

Moen, A.N., M.A. DellaFera, A.L. Hiller, and B.A. Buxton. 1978. Heart rates of white-tailed deer fawns in response to recorded wolf howls. Canadian Journal of Zoology 56:1207-1210.

Monson, G. 1998. Ferruginous pygmy-owl. Pages 159-161 *in* Glinski, R.L., ed., The Raptors of Arizona, University of Arizona Press, Tucson.

Monson, G. and A.R. Phillips. 1981. Annotated checklist of the birds of Arizona. The Univ. of Arizona Press, Tucson. 240 pp.

Monson, G. 1968. The desert pronghorn. *In* Desert Bighorn Council Transactions. Las Vegas, NV.

Nelson, F.W. 1925. Status of the pronghorn antelope, 1922-1924. U.S. Department of Agriculture Bulletin No. 1346.

Newton, I. 1979. Population ecology of raptors. Poyser Ltd., Hertfordshire, England. 399 pp.

Neiring, W.A., R.H. Whittaker, and C.H. Lowe. 1963. The saguaro: A population in relation to environment. Science 142:15-23.

Noss, R.F. and B. Csuti. 1994. Habitat fragmentation. Pp. 237-264 *in* G.K. Meffe and C.R. Caroll (eds.), Principles of conservation biology. Sinauer Assoc., Sunderland, MA.

Nowak, R.M., and J.L. Paradiso. 1983. Walker's mammals of the world. 4th Ed. Vol. II. Johns Hopkins University Press, Baltimore, MD.

Oberholser, H.C. 1974. The bird life of Texas. University of Texas Press. Austin, Texas. 1069 pp.

Officer, J.E. 1993. Kino and agriculture in the Pimeria Alta. Journal of Arizona History 34:287-306.

Omar, S.A.S. 1991. Dynamics of range plants following 10 years of protection in arid rangelands of Kuwait. Journal of Arid Environments 21:99-111.

O'Neil, A.W. 1990. Letter, Appendix B *in* Tewes, M.E. 1993. Status of the ferruginous pygmy-owl in south Texas and northeast Mexico. Draft Project Report No. 2, Job 25, Texas Parks and Wildlife Department. Texas A & I Univ., Kingsville. 42 pp.

Organ Pipe Cactus National Monument. 2001. Draft supplemental environmental impact statement, re-analysis of cumulative impacts on the Sonoran pronghorn. Organ Pipe Cactus National Monument, Ajo, AZ.

Orodho, A.B., M.J. Trlica, and C.D. Bonham. 1990. Long-term heavy grazing effects on soil and vegetation in the four corners region. Southwestern Naturalist 35(1):9-15.

Paradiso, J.L., and R.M. Nowak. 1971. Taxonomic status of the Sonoran pronghorn. Journal of Mammalogy 52(4):855-858.

Parsons, K.C. and J. Burger. 1982. Human disturbance and nestling behavior in black-crowned night herons. Condor 84:184-187.

Pfizer Animal Health. 2002. Respiratory Diseases in Dairy Cattle. Website *At* www.pfizer.com

Phelps, J.S. 1981. Habitat of the Sonoran pronghorn. *In* The Sonoran Pronghorn. Special Report No. 10. Arizona Game and Fish Department, Phoenix, AZ.

Phillips, A.R., J. Marshall, and G. Monson. 1964. The birds of Arizona. University of Arizona Press, Tucson. 212pp.

Pianka, E.R. 1986. Ecology and natural history of desert lizards. Princeton University Press, Princeton, N.J.

Pianka, E.R. 1966. Convexity, desert lizards and spatial heterogeneity. Ecology 47:1055-1059.

Pinkava, D.J. 1999. Cactaceae Cactus Family, Part Three. In: Vascular Plants of Arizona: Cactaceae - Cylindropuntia. Journal of the Arizona- Nevada Academy of Science 32(1):32-47.

Porter, R.D., C.M. White, and R.J. Erwin. 1973. The peregrine falcon in Utah, emphasizing ecology and competition with the prairie falcon. Brigham Young Univ., Bulletin of Biological Science. 18:1-74.

Postovit, H.R. and B.C. Postovit. 1987. Impacts and mitigation techniques. Pp. 183-213 *in* G.B. Pendleton, B.A. Mildsap, K.W. Cline, and D.M. Bird (eds.), Raptor management techniques manual. National Wildlife Federation, Washington, D.C. Scientific Technical Series 10.

Proudfoot, G. 1996. Natural history of the cactus ferruginous pygmy-owl. MS Thesis, Texas A & M University, Kingsville, Texas.

Proudfoot, G, S.L. Beasom, D. Graul, and T. Urban. 1994. Food habits of the cactus ferruginous pygmy owl. Page 19 *in* the Annual Report to the Caesar Kleberg Foundation for Wildlife Conservation from the Caesar Kleberg Wildlife Research Institute, Texas A & M University, College of Agriculture and Human Sciences, Kingsville, Texas.

Proudfoot, G.A., and R.R. Johnson. 2000. Ferruginous pygmy-owl. In A. Poole and F. Gill (eds.), The Birds of North America. Cornell Laboratory of Ornithology and The Academy of Natural Sciences, No. 498.

Proudfoot, G.A. and R.D Slack. 2001. Comparisons of ferruginous pygmy-owls mtDNA at local and international scales. A report to Pima County Arizona. 11 pp.

Ratcliffe, D.A. 1980. The peregrine falcon. Poyser Ltd., Hertfordshire, England. 416 pp.

Reed, J.M., P.D. Doerr, and J.R. Walters. 1986. Determining minimum population sizes for birds and mammals. Wildlife Society Bulletin 14:225-261.

Reichenbacher, F.W., and R.B. Duncan. 1989. Sanbom's bat and rare plant studies at Barry M. Goldwater Bombing Range, Yuma County, AZ. Final Report. F.W. Reichenbacher and Associates, Tucson, AZ.

Richter-Dyn, N., and N.S. Goel. 1972. On the extinction of a colonizing species. Theoretical Population Biology 3:406-433.

Robert, H.C. and C.J. Ralph. 1975. Effects of human disturbance on the breeding success of gulls. Condor. 77:495-499.

Robinson, W.L. and E.G. Bolen. 1989. Wildlife Ecology and Management. Macmillian Publishing Company, New York, NY.

Rogers G.F., and J. Steele. 1980. Sonoran desert fire ecology. In Proceedings of the Fire History Workshop, October 20-24, 1980, Tucson, AZ. Rocky Mountain Forest and Range Experiment Station General Technical Report, RM-81. USDA Fort Collins, CO.

Roundy, B.A., and G.L. Jordan. 1988. Vegetation changes in relation to livestock exclusion and rootplowing in southeastern Arizona. Southwestern Naturalist 33:425-436.

Rowlands, P.G. 2000. Low temperature and other climatic trends at Organ Pipe Cactus National Monument. *In* W.L. Halvorson and B.S. Gebow, eds., Creative Cooperation in Resource Management, extended abstracts. U.S. Geological Survey, Western Ecological Research Center, Sonoran Desert Field Station, University of Arizona, Tucson, AZ.

Rutman, S. 1996. An assessment of accelerated erosion and its management at Organ Pipe Cactus National Monument. Unpublished report by Organ Pipe Cactus National Monument, Ajo, AZ.

Rutman, S. 1997. Dirt is not cheap: livestock grazing and a legacy of accelerated soil erosion on Organ Pipe Cactus National Monument, Arizona. *In* J. M. Feller and D. S. Strouse, eds., Environmental, economic, and legal issues related to rangeland water developments. The Center for the Study of Law, Science and Technology, Arizona State University, Tempe, AZ.

Samuel, M.D., and K.H. Pollock. 1981. Correction of visibility bias in aerial surveys where animals occur in groups. Journal of Wildlife Management 45(4):993-997.

Saunders, D.A., R.J. Hobbs, and C.R. Margules. 1991. Biological consequences of ecosystem fragmentation: a review. Conservation Biology. 5: 18-32.

Schmid, M.K., and G.F. Rogers. 1988. Trends in fire occurrence in the Arizona Upland Subdivision of the Sonoran Desert, 1955 to 1983. The Southwestern Naturalist 33(4):437-444.

Schreiber, E.A, R.W. Schreiber, and J.J. Dinsmore. 1979. Breeding biology of laughing gulls in Florida. Part 1: Nesting, egg, and incubation parameters. Bird Banding. 50:304-321.

Scott, M.D. 1990. Determining a minimum genetically viable population size for Yellowstone pronghorns. Proceedings Pronghorn Antelope Workshop 14:26-27.

Sheridan, T.E. 2000. Human ecology of the Sonoran Desert. *In* S.J. Phillips and P.W. Comus, eds., A natural history of the Sonoran Desert. Arizona-Sonora Desert Museum Press, Tucson, AZ.

Shreve, F. 1931. Physical conditions in sun and shade. Ecology 12:96-104.

Sick, H. 1993. Birds in Brazil: a natural history. Princeton, N.J.:Princeton Univ. Press.

Simmons, N.M. 1969. The social organization, behavior, and environment of the desert bighorn sheep on Cabeza Prieta Game Range, Arizona. PhD Dissertation, University of Arizona, Tucson, AZ.

Skagen, S.K., R.L. Knight, and G.H. Orians. 1991. Human disturbance of an avian scavenging guild. Ecological Applications 1(2):215-225.

Snyder and Snyder. 1975. Raptors in range habitat. Pp. 190-209 *in* Proc. symposium on management of food and range habitat for nongame birds (D.R. Smith, tech. coord.). USDA Forest Serv. Gen. Tech. Rep. W0-1.

Soule, M.E. 1986. Conservation biology. The science of scarcity and diversity. Sinauer Assoc., Inc. Sunderland, MA. 584 pp.

Sprunt, A. 1955. North American birds of prey. National Audubon Society, Harper and Brothers, New York. 227pp.

State of Arizona. 1990. Final report and recommendations of the Governor's riparian habitat task force. Executive Order 89-16. Streams and riparian resources. October 1990. Phoenix, AZ. 28 pp.

Steenbergh, W.F. and C.H. Lowe. 1977. Ecology of the saguaro: II, reproduction, germination, establishment, growth, and survival of the young plant. National Park Service Scientific Monograph Series No. 8. U.S. Government Printing Office, Washington D.C.

Steenbergh, W.F. and C.H. Lowe. 1983. Ecology of the saguaro: III, growth and demography. National Park Service Scientific Monograph Series No. 17. U.S. Government Printing Office, Washington D.C.

Stellijes, K.B. 1999. The bluetongue triangle. Agricultural Research Magazine, July 1999.

Stott, J.L. 2002. Foreign Animal Diseases: Bluetongue and Epizootic Hemorrhagic Disease. University of Georgia, College of Veterinary Medicine *At* www.vet.uga.edu

Stromberg, J.C., J.A. Tress, J.D. Wilkins, and S.D. Clark. 1992. Response of velvet mesquite to groundwater decline. J. Arid Environments 23:45-58.

Stromberg, J.C. 1993a. Fremont cottonwood-Goodding willow riparian forests: a review of their ecology, threats, and recovery potential. Journal of the Arizona-Nevada Academy of Science 26(3):97-110.

Stromberg, J.C. 1993b. Riparian mesquite forests: A review of their ecology, threats, and recovery potential. Journal of the Arizona-Nevada Academy of Science 27(1):111-124.

Stromberg, J.C., and and M.K. Chew. 1997. Herbaceous exotics in Arizona's riparian ecosystems. Desert Plants 1997(2):11-17.

Sutton, G.M. 1951. Mexican birds: First impressions based upon an ornithological expedition to Tamaulipas, Nuevo Leon and Coahuila. Univ. of Oklahoma Press, Norman. 282pp.

Swarth, H.S. 1905. Summer birds of the Papago Indian Reservation and of the Santa Rita Mountains, AZ. Condor 7:22-28.

Swarth, H.S. 1914. A distributional list of the birds of Arizona. Cooper Ornithological Club,

Hollywood, CA.

Szaro, R.C. 1989. Riparian forest and scrubland community types of Arizona and New Mexico. Desert Plants 9:70-138.

Tewes, M.E. 1993. Status of the ferruginous pygmy-owl in south Texas and northeast Mexico. Draft Project Report #2, Job 25, Texas Parks and Wildlife Department. Texas A & I Univ. Kingsville. 42 pp.

Thompson, R.D., C.V. Grant, E.W. Pearson, and G.W. Corner. 1968. Cardiac response of starlings to sound: effects of lighting and grouping. American Journal of Physiology 214:41-44.

Tropical Birds of the Border. 1999. Sixth Annual Rio Grande Valley Birding Festival. Harlingen, TX.

Tueller, P.T. (Ed.). 1988. Vegetation science applications for rangeland analysis and management. Kluver Academic Publications, Boston, MA.

Turner, R.M. and D.E. Brown. 1982. Sonoran desertscrub. *In* D.E. Brown, ed., Biotic communities of the American Southwest-United States and Mexico. Desert Plants 4(1-4):181-222.

U.S. Bureau of Land Management. 1980. Shivwits Resource Area Grazing Environmental Impact Statement. Bureau of Land Management, Arizona Strip District, St. George, UT.

U.S. Bureau of Land Management. 2002. Draft-Final Ajo Block rangeland health evaluation. Bureau of Land Management, Phoenix, AZ

Van Campen, H. and Early, G. .2001. Orthomyxovirus and Paramyxovirus Infections. *In* Infectious Diseases of Wild Mammals, 3rd Edition, Williams, Elizabeth, S. and Ian K. Barker (eds). Iowa State Press, Ames, IA. P. 273.

Waser, N.M., and M.V. Price. 1981. Effects of grazing on diversity of annual plants in the Sonoran Desert. Oecologia (1981)50:407-411.

Williams, E.S. and I.K. Barker, (eds). 2001. Infectious Diseases of Wild Mammals, 3rd Edition, Iowa State Press, Ames, IA.

Wobeser, G. 2001. Miscellaneous Bacterial Infections. *Actinomyces* and *Arcanobacterium* Infections. *In* Infectious Diseases of Wild Mammals, 3rd Edition, Williams, Elizabeth, S. and Ian K. Barkmer (eds). Iowa State Press, Ames, IA.

World Organisation for Animal Health. 2002. Paris, France, *At* website www.oie.int

Yuill, T.M. and C. Seymour. 2001. Arbovirus Infections: St. Louis Encephalitis. *In* Infectious Diseases of Wild Mammals, 3rd Edition, Williams, Elizabeth, S. and Ian K. Barker (eds). Iowa State Press, Ames, IA. P.100

Yuill, T.M. an Seymour, C. 2001. Arbovirus Infections: St. Louis Encephalitis. *In* Infectious Diseases of Wild Mammals, 3rd Edition, Williams, Elizabeth, S. and Ian K. Barker (eds). Iowa State Press, Ames, IA. p 100.

Yuill, T.M. an Seymour, C. 2001a. Arbovirus Infections: Vesicular Stomatitis. *In* Infectious Diseases of Wild Mammals, 3rd Edition, Williams, Elizabeth, S. and Ian K. Barker (eds). Iowa State Press, Ames, IA. p 109.

U.S. Fish and Wildlife Service. 1982. Sonoran pronghorn recovery plan. United States Fish and Wildlife Service, Denver, CO.

U.S. Fish and Wildlife Service. 1988. Riparian Habitat: An Unrecognized Resource. Pamphlet.

U.S. Fish and Wildlife Service. 1997. Endangered and threatened wildlife and plants; determination of endangered status for the cactus ferruginous pygmy-owl in Arizona. Fed. Reg. 62:10730-10747.

U.S. Fish and Wildlife Service. 1998a. Final revised Sonoran pronghorn recovery plan. United States Fish and Wildlife Service, Albuquerque, NM.

U.S. Fish and Wildlife Service. 1998b. Final programmatic environmental assessment for the future management of Cabeza Prieta National Wildlife Refuge and draft comprehensive conservation plan. United States Fish and Wildlife Service, Albuquerque, NM.

U.S. Fish and Wildlife Service. 1999. Endangered and threatened wildlife and plants; designation of critical habitat for the cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum)*. Fed. Reg. 64:37419-37440.

U.S. Fish and Wildlife Service. 2001. Draft recovery criteria and estimates of time for recovery actions for the Sonoran pronghorn: a supplement and amendment to the 1998 final revised Sonoran pronghorn recovery plan. United States Fish and Wildlife Service, Albuquerque, NM.

U.S. General Accounting Office. 1988. Public rangelands: Some riparian areas restored but widespread improvement will be slow. Report to Congressional Requesters, U.S. General Accounting Office, Washington D.C.

U.S. Immigration and Naturalization Service. 2001. Draft report, environmental assessment for the proposed expansion of the Ajo U.S. Border Patrol Station, Why, Arizona. Immigration and Naturalization Service, Washington D.C.

Warnock, R.G. and P.C. James. 1997. Habitat fragmentation and burrowing owls (*Speotyto cunicularia*) in Saskatchewan. Pp.477-484 *in* J.R. Duncan, D.H. Johnson, and T.H. Nicholls (eds.), Biology and conservation of owls of the northern hemisphere. USDA Forest Service, North Central Forest Experimental Station, Gen. Tech. Rpt. NC-190. Winnipeg, Manitoba. February 5-9, 1997.

Waser, N.M. and M.V. Price. 1981. Effects of grazing on diversity of annual plants in the Sonoran Desert. Oecologia 50:407-411.

Webb, R.H., and S.S. Stielstra. 1979. Sheep grazing effects on Mohave Desert vegetation and soils. Environmental Management 3(6):517-529.

White, C.M., W.B. Emison, and W.M. Bren. 1988. Atypical nesting habitat of the peregrine falcon (*Falco peregrinus*) in Victoria, Australia. J. Raptor Res. 22:37-43.

Wiens, J.A. 1985 Vertebrate responses to environmental patchiness in arid and semiarid ecosystems. Pp 169-193 *in* S.T.A. Pickett, and P.A. White (eds.), The ecology of natural disturbance and patch dynamics. New York: Academic Press.

Wilcove, D.S., C.H. McLellan, and A.P. Dobson. 1986. Habitat fragmentation in the temperate zone. Pp. 237-256 *in* M.E. Soule (ed.), Conservation biology: the science of scarcity and diversity. Sinauer Assoc., Sutherland, MA.

Wilcox, R.L., S. Richardson, and D. Abbate. 1999. Habitat characteristics of occupied cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*) sites at the suburban/rural interface of north Tucson, Arizona. Report to Arizona Game and Fish Dept., Phoenix, AZ.

Wilcox, R.L., S. Richardson, and D. Abbate. 2000. Habitat selection by cactus ferruginous pygmy-owls in southern Arizona - preliminary results. Arizona Game and Fish Dept., Tucson, AZ. 13 pp.

Wildeman, G., and J.H. Brock. 2000. Grazing in the southwest: history of land use and grazing since 1540. *In* R. Jemison and C. Raish, eds., Livestock management in the American southwest: ecology, society, and economics. Elsevier Science, Amsterdam, The Netherlands.

Willard, F.C. 1912. A week afield in southern Arizona. The Condor 14:53-63.

Workman, G.D., T.D. Bunch, J.W. Call, F.C. Evans, L.S. Neilson, and E.M. Rawlings. 1992. Sonic boom and other disturbance impacts on pronghorn antelope (*Antilocapra americana*). Report to the U.S. Air Force, Hill Air Force Base, UT.

Wright, R.L,. and J.C. deVos. 1986. Final report on Sonoran pronghorn status in Arizona. Contract No. F02604 83MS143, Arizona Game and Fish Department, Phoenix, AZ

Yoakum, J.D., B.W. O'Gara, and V.W. Howard, Jr. 1996. Pronghorn on western rangelands. *In* P.R. Krausman, ed., Rangeland wildlife. The Society for Range Management, Denver, CO.

Table 1. Authorized use of the Cameron, Coyote Flat, Why, Childs, and Sentinel allotments, 1970-2001. Parentheses indicate established preferences in Animal Unit Months (AUMs). Shaded cells indicate that data is unavailable. Adapted from the Bureau of Land Management's September 1995 "Biological Evaluation on Grazing Activities Within Sonoran Pronghorn Habitat and additional information provided by the Bureau, 1992 - 2001 (Philip Cooley, BLM, pers. comm. 2001).

Year	Cameron (4076 through 1975; 2526 from 1976[1]-present)		Coyote Flat[2] (456)	Why[2] (452)	Childs (3802)		Sentinel (360)	
	Permitted Use	Ephemeral Use	Permitted Use	Permitted Use	Permitted Use	Ephemeral Use	Permitted Use	Ephemeral Use
1970	1896							
1971	2064		456	21				
1972	3096		456	238				
1973	2376	212	456	0				
1974	2172	900	456	456				
1975	1548	1548	456	456	2528			
1976	1548	1548	456	120	2376			
1977	2148	820	456	216	2376			
1978	2472	3640	0	216	2871			
1979	1452	8250	456	456	3802			
1980	1452		456	456	1664		0	0
1981	360		456	456	1103		11	0
1982	996		456	0	1685		255	0
1983	2524	130	456	180	2464	990	268	1437
1984	1236	5561	456	180	3802	11627	360	1472
1985	1200	4605	456	240	0		24	1268
1986	672	4000	456	360	0		308	1493
1987	672		456	360	0		96	0
1988	636		456	144	0		0	0
1989	180		456	144	0		360	781
1990	164	16	456	0	546		360	413
1991	241		456	0	679		0	0
1992	120	0	456	0	784	0	0	0
1993	539	0	456		862	0	360	0
1994	108	1149	456	100	1034	0	0	406

Year	Cameron (4076 through 1975; 2526 from 1976[1]-present)		Coyote Flat[2] (456)	Why[2] (452)	Childs (3802)		Sentinel (360)	
	Permitted Use	Ephemeral Use	Permitted Use	Permitted Use	Permitted Use	Ephemeral Use	Permitted Use	Ephemeral Use
1995	175	3305	456	132	1037	0	0	0
1996	1281	0	456	83	1651	0	0	0
1997	814	0	0	120	832	0	0	0
1998	1472	0	228	108	832	0	0	0
1999	696	0	228	108	748	0	0	0
2000	700	0	228	168		0	0	0
2001	469	0	228	282[3]	380	0	0	0

[1]A portion of the Cameron Allotment was relinquished for establishment of the Cabeza Prieta National Wildlife Refuge in 1976, reducing the preference by 1550 (i.e., 4076 - 1550 = 2526).
[2]There has been no ephemeral use requested on this allotment.
[3]Permit transfer completed 05/01; 26 AUMs used by previous permittee.

Table 2. A summary of population estimates from literature and field surveys for Sonoran pronghorn in the U.S.

Date	Population estimate (95 percent CI[a])	Source
1925	105	Nelson 1925
1941[b]	60	Nicol 1941
1957	<1,000	Halloran 1957
1968	50	Monson 1968
1968-1974	50 - 150	Carr 1974
1981	100 - 150	Arizona Game and Fish Department 1981
1984	85 - 100	Arizona Game and Fish Department 1986
1992	179 (145-234)	Bright *et al.* 1999
1994	282 (205-489)	Bright *et al.* 1999
1996	130 (114-154)	Bright *et al.* 1999
1998	142 (125-167)	Bright *et al.* 1999
2000	99 (69-392)	Bright *et al.* 2001

[a] Confidence interval; there is only a 5 percent chance that the population total falls outside of this range.
[b] Population estimate for southwestern Arizona, excluding Organ Pipe Cactus National Monument.

Table 3. Comparison of U.S. Sonoran pronghorn population surveys, 1992-2000.

	Pronghorn observed		Population estimates		
Date	On transect	Total observed	Density estimate using DISTANCE (95 percent CI[a])	Lincoln-Peterson (95 percent CI)	Sightability model (95 percent CI)
Dec 92	99	121	246 (103-584)	---	179 (145-234)
Mar 94	100	109	184 (100-334)	---	282 (205-489)
Dec 96	71	82 (95[b])	216 (82-579)	162 (4-324)	130 (114-154)
Dec 98	74	86 (98[b])	---	172 (23-321)	142 (125-167)
Dec 00	67	69[b]	---	---	99 (69-392)

[a] Confidence interval; there is only a 5 percent chance that the population total falls outside of this range.
[b] Includes animals missed on survey, but located using radio telemetry.

Table 4. Population estimates from literature and field surveys for Sonoran pronghorn in Mexico.

Date	Population estimate (95 percent CI[a])	Source
1925	595	Nelson 1925
1957	>1,000	Villa 1958
1981	200-350	Arizona Game and Fish Department 1981
1993	414 (317-644)	Bright *et al.* 1999
2000	346 (288-445)	Bright *et al.* 2001

[a] Confidence interval; there is only a 5 percent chance that the population total falls outside of this range.

Table 5. Comparison of Sonoran pronghorn surveys in Mexico, 1993 and 2000.

	Total number of pronghorn seen	Sightability model (95 percent CI[a])
March 1993		
Southeast of Highway 8	163	289 (226-432)
West of Highway 8	51	124 (91-211)
Total	214	414 (317-644)
December 2000		
Southeast of Highway 8	249	311 (261-397)
West of Highway 8	17	34 (27-48)
Total	266	346 (288-445)

[a] Confidence interval; there is only a 5 percent chance that the population total falls outside of this range.

Table 6. Utilization studies within Sentinel, Coyote Flat, Why, and Cameron allotments as reported in the 1998-1999 and 2000 reports from the Bureau of Land Management to the Service per the terms and conditions of the December 3, 1997, biological opinion (consultation number 2-21-94-F-192).

Allotment	Year	Date Read	Species		Estimated Utilzation (%)
Sentinel	1998[1]	11/09/98	mesquite (*Prosopis velutina*)		0.0
			big galleta (*Hilaria rigida*)		0.0
	1999[1]	11/04/99	mesquite		0.0
			big galleta		0.0
	2000[1]	10/24/00	mesquite		3.0
			big galleta		3.0
Coyote Flat	1998	11/22/98	*Lycium* spp.		0.0
			mesquite		0.0
	1999	10/05/99	*Lycium* spp.		0.0
			mesquite		0.0
	2000[2]	10/25/00	*Lycium* spp.		3.0
			mesquite		3.0
	2001	?	R-KP-1	mesquite	2.5
				wolfberry	2.5
				bush muhly	16.0
			R-DW-1	big galleta	43.1
			R-DW-2	palo verde	3.6
Why	1998	11/23/98	*Lycium* spp.		2.5
			mesquite		2.5
	1999	10/13/99	*Lycium* spp.		0.0
			mesquite		0.0
	2000[3]	10/25/00	*Lycium* spp.		3.0
			mesquite		3.0
	2001		R-KP-1	mesquite	2.5
				wolfberry	2.5
			R-DW-2	mesquite	2.5

Allotment	Year	Date Read	Species		Estimated Utilzation (%)
Cameron	1998	04/29/98	R-KP-1	fairy duster (*Calliandra eriophylla*)	2.5
			R-KP-2	big galleta	0.0
				bush muhly (*Muhlenbergia porteri*)	0.0
			R-KP-3	mesquite	0.0
				blue palo verde (*Parkinsonia floridum*)	0.0
	1999	11/03/99	R-KP-1	fairy duster	2.5
			R-KP-2	big galleta	3.6
				bush muhly	2.5
			R-KP-3	mesquite	2.5
				blue palo verde	2.5
	2000[4]	10/25/00	R-KP-1	fairy duster	2.5
			R-KP-2	big galleta	9.0
				bush muhly	10.0
			R-KP-3	mesquite	3.0
				blue palo verde	3.0
	2001	?	R-KP-1	false mesquite	2.5
			R-KP-2	big galleta	13.1
				bush muhly	41.7
			R-KP-3	mesquite	2.5
				blue palo verde	3.6
			R-KP-3a	big galleta	48.1
			R-DW-2	mesquite	2.5
			R-DW-3	mesquite	3.6
				white bursage	5.3
			R-DW-4	chuparosa	76.8
				mesquite	5.7

[1]Allotment was in non-use.
[2]Permittee was licensed for 20 cows (228 AUMs) and took non-use on 20 cows (228 AUMs).
[3]Permittee was licensed for 14 cows (168 AUMs) and took non-use on 24 cows (288 AUMs).
[4]Permittee was licensed for 50 cows (600 AUMs) and 8 horses (96 AUMs) and took non-use on 153 cows (1836 AUMs).

Table 7: Diseases Transmissable Between Cattle and Pronghorn

Actual Documented Disease	**Reservoirs/Odditie s/ Transmission Routes**	**Clinical Signs**	**Control**	**Citation(ts)**
BACTERIAL DISEASES				
Leptospirosis *Leptospira interrogans* serovar *hardjo*	transmitted thru infected urine, fetal tissues or rarely aerosol; organism can live outside host for up to 6 months in soil, water or on vegetation; asymptomatic shedders can transmit the disease over the long-term	fever, blood-tinged urine, jaundice, renal failure, abortion	reduce contact among domestic and wild animals; reduce incidence of stagnant water and moist, warm conditions; control situations where virus can be shed	Merck, 1986 Kreplin, 2002 Leighton and Kuiken, 2001
VIRAL DISEASES				
Bluetongue Bluetongue orbivirus (BTV)	vector = infected biting midge *Culicoides sonorensis*; BTV also associated with cattle lice *Haematopinus eurysternus*; infected blood and semen can also directly transmit disease; highest incidence of disease in July-Sept	fever, inflamed, ulcerated erosion in mouth; lameness; abortion; emaciation; sterility, growth delay, death	reduce vector attraction to fetid water sources; reduce contact, overcrowding and competition, particularly July to September	Howerth, *et al.*, 2001 World Organisation for Animal Health, 2002 Stott, 2002
Epizootic hemorrhagic disease Epizootic hemorrhagic disease orbivirus (EHDV)	vector = infected biting midges *Culicoides sonorensis* and *C. insignis*	depression, fever, uncoordinated gait (ataxia), "running fits /convulsions/ seizures, sudden death; sick and dead animals often found in or near water	reduce vector attraction to fetid, fecal-infested water sources; reduce contact, overcrowding and competition, particularly July to September	Howerth, *et al.*, 2001 Howerth and Stallkneckt, 2002 Stott, 2002
Pronghorn Exposure Documented by Antibody/Seroconversion				

BACTERIAL

Arcanobacterium Infection associated with Fusobacterium Infection *Arcanobacterium pyogenes* (previously known as *Corynebacterium pyogenes*) and *Fusobacterium necrophorum*	wound contact associated with bacterial buildup at overcongregated water sources, particularly during summer drought	mucopurulent, suppurative abscesses; swollen mandible; difficulty chewing; bronchopneumonia;intracranial abscesses leading to derangement lameness when footrot exists, mouth lesions result in excess salivation, difficulty chewing and swallowing, infections of the stomach lining and labored breathing with debilitation	separate animals so that contact does not occur; keep animals from overcrowding watering sources	Wobeser, 2001 Canadian Cooperative Wildlife Health Center, 1999 Leighton, 2001 Mikkelsen and Woodbury, 2000

VIRAL

Parainfluenza Parainfluenza 3 Virus (PI-3V)	aerosol	fever, runny nose, coughing, difficulty breathing, ocular discharge, depression, poor appetite	handle animals with care; provide adequate feed and water; minimize exposure to contributing environmental conditions; avoid overcrowding; reduce stress	AGFD, unpubl.data Pfizer Animal Health, 2002
St. Louis Encephalitis St. Louis Encephalitis arbovirus (SLEV)	vectors = mosquitoes; bats may serve as overwintering hosts	meningitis, encephalitis; central nervous system disease; death	mosquito control; surveillance of disease epidemic cycles	Yuill and Seymour, 2001

Vesicular Stomatitis Vesicular Stomatitis-New Jersey rhabdovirus (VSNJ)	vector = sand flies; disease of No. Am. horses, cattle, swine; documented in Mexico in pronghorn, bighorn sheep and deer	fever, large fluid-filled blisters on mouth, nose, lips, muzzle, above hoof, teats, loss of appetite, depression, excessive salivation	vector control; separation of affected species of ungulates	Yuill and Seymour, 2001a
Malignant Catarrhal Fever Malignant Catarrhal Fever (MCF) gammaherpesvirus	aerosol or contact with nasal or ocular fluids; fecal contamination	Fever, profuse nasal discharge, corneal opacity, swollen lymph nodes, inflamed oral, ocular and nasal mucosas; occasionally central nervous signs with diarrhea, skin lesions and arthritis; high mortality rate	cattle kept separated from potential reservoirs; "stocking of cattle ranches with ...antelope, wild sheep or goats should be discouraged	Heuschele and Reid, 2001 Heuschele, 2002

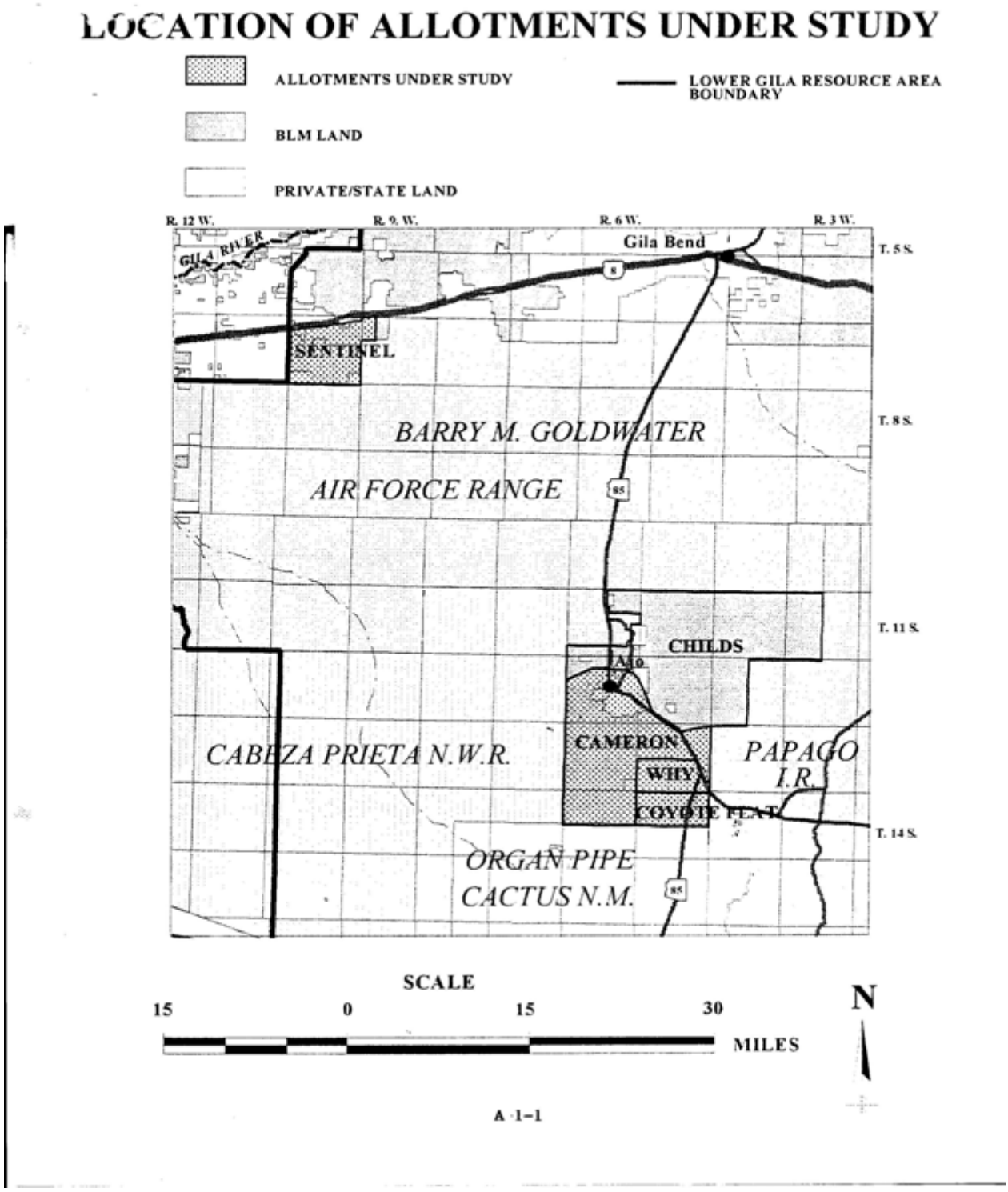

Figure 1. Location of the Coyote Flat, Why, Cameron, Childs, and Sentinel grazing allotments as designated in the Bureau of Land Management's September 1995, "Biological Evaluation on Grazing Activities Within Sonoran Pronghorn Habitat.

Figure 3. Historic range of Sonoran pronghorn in the United States and Mexico.

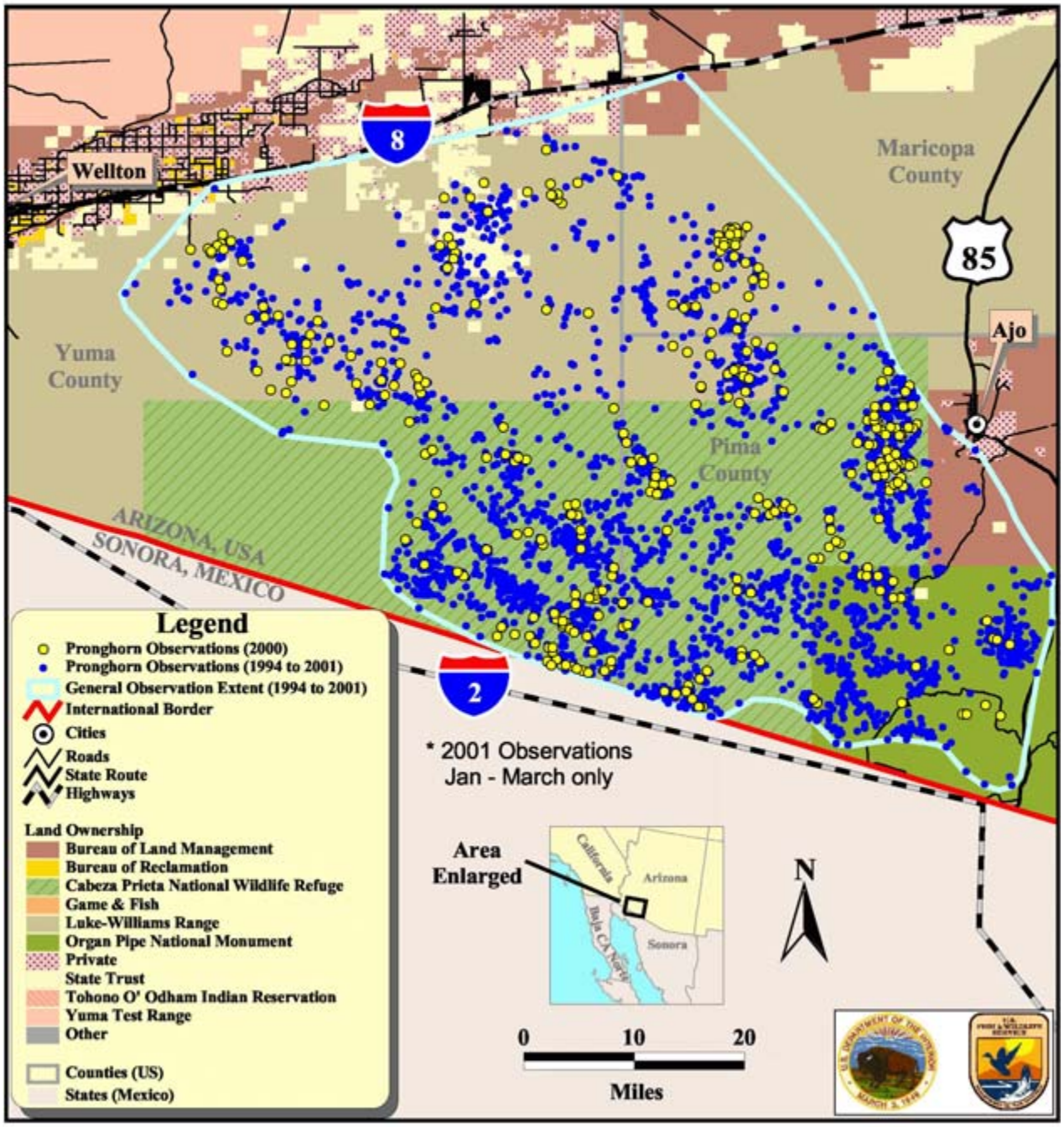

Figure 4. Current Sonoran pronghorn distribution in the United States: Records from 1994-2001.

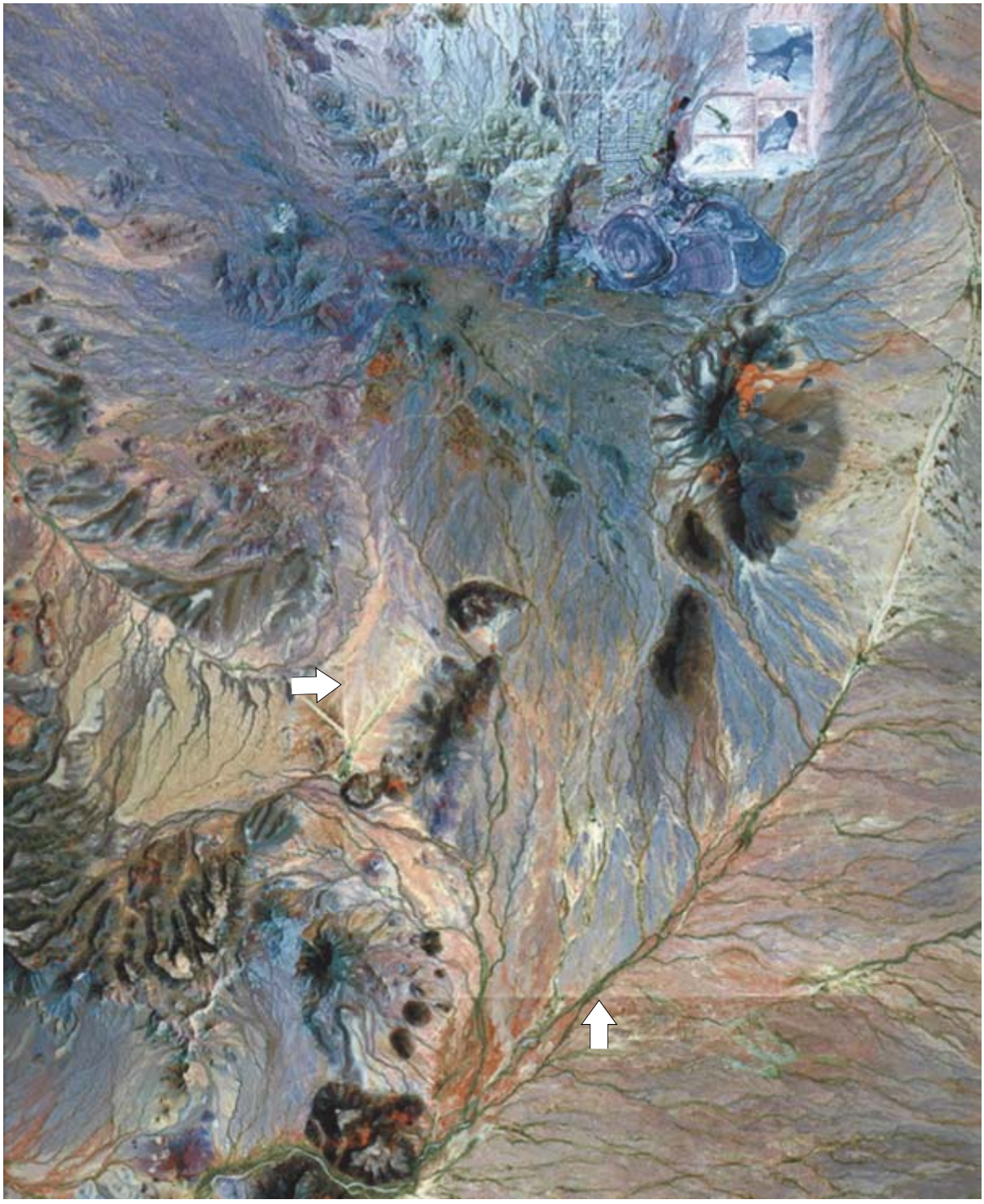

Figure 5. Satellite image of Ajo allotments. White arrows indicate boundary fence lines between the allotments and Cabeza Prieta National Wildlife Refuge and Organ Pipe Cactus National Monument. (Adapted from the poster, "Organ Pipe Cactus and Surrounding Areas: A Portrait from Above and Beyond, J.C. Dohrenwend, 2000).

Appendix 1. Sonoran pronghorn 51 recovery actions as presented to the Service's Region 2 Regional Director by the Sonoran Pronghorn Recovery Team.

Ranking		Sonoran Pronghorn Recovery Actions
Priority	**Average**	
1	1.00	Maintain active radiocollars on ~10% of the Sonoran pronghorn population for population monitoring and other study purposes
2	1.18	Experimentally place small, portable, temporary waters in occupied habitat during the summer months, and evaluate their use and efficacy
3	1.18	Develop a white paper that addresses the full range of captive breeding alternatives (e.g., capture alternatives; age and sex of wild caught animals; husbandry requirements, herd monitoring, holding facilities, transportation, release criteria, need for predator control, post-release monitoring, and etc.)
4	1.18	Continue biennial, or possibly annual, population survey of the U.S. subpopulation
5	1.18	Continue weekly aerial monitoring of radiocollared pronghorn (i.e., distribution, movements, mortality signals, fawn status, predator presence)
6	1.27	Develop an intensive monitoring program to quantitatively investigate pronghorn use of water tanks (i.e., permanent, semi-permanent, temporary, emergency)
7	1.27	Continue monitoring fawn recruitment while conducting weekly telemetry flights
8	1.27	Implement and monitor experimental forage enhancement project on BMGR
9	1.36	Identify, evaluate, and prioritize potential reintroduction sites in the U.S. and Mexico
10	1.36	Initiate biennial population surveys for the 2 Mexico subpopulations to be timed in conjunction with the U.S. survey
11	1.45	Continue monitoring (and closing as needed) of military targets, relative to pronghorn locations, by contract biologists on NTAC and STAC on BMGR on live fire days
12	1.45	Continue ongoing program of hauling water as needed to permanent tanks in currently occupied pronghorn habitat (e.g., Jose Juan Charco, Halliwill Catchment, etc.) until proposed pronghorn/water investigations are conducted and program can be quantitatively reevaluated
13	1.73	Develop a study looking at seasonal diets (e.g., fecal analysis)
14	1.73	Continue restrictions on types of use in important pronghorn habitat during critical periods of the year (e.g., OPCNM periodic seasonal closure of Pozo Nuevo Road; CPNWR closure to public use of Chico Shunie Loop Road, Marine use of certain ground sites on BMGR)
15	1.73	Contract with a population geneticist or American Zoological Association to conduct an analysis of what comprises a minimum population in order to maintain the gene pool and to assess at what point if the U.S. subpopulation continues to decline, all remaining pronghorn should be taken into captivity
16	1.82	Initiate study by AGFD to evaluate effects of Border Patrol helicopter flights on pronghorn
17	1.91	Develop study to investigate potential contaminant concerns from military activities on BMGR (e.g., soil/vegetation sampling; blood and tissue samples from captured pronghorn; sampling of other resident wildlife) for baseline data
18	1.91	Continue aggressively investigating and documenting all incidences of mortality (collared and uncollared) and likely causes
19	1.91	Deploy remote data loggers as needed to document use of water sources, travel corridors, and/or foraging areas by radiocollared pronghorn

20	1.91	Initiate AGFD/USAF study to evaluate effects of night missions on pronghorn behavior/activity
21	1.91	Experimentally mark a sample of coyotes with GPS collars to determine behavior and seasonal movements relative to pronghorn locations, free water, rainfall events
22	2.00	Develop a study to monitor/investigate influences of disease and other stressors on pronghorn
23	2.00	Assess effectiveness of current aerial population survey methodology and compare with current literature
24	2.00	Continue law enforcement activities designed to reduce illegal border traffic (e.g., foot and vehicle UDA's, drug smuggling) and as a consequence movement through pronghorn habitat
25	2.09	Investigate Culicoides sp. as a vector source in the transmission of bluetongue and EHD to pronghorn from cattle and other native ungulates
26	2.09	Continue field work by U of A and preparation of vegetation association map for OPCNM, BLM, CPNWR, BMGR
27	2.09	Develop a water balance study (e.g., double-labeling, water deprivation, use of pre-formed/metabolic water in diet) using a surrogate race of captive pronghorn
28	2.09	Expand genetic determinations to include Mexico as opportunity allows (e.g., Peninsular pronghorn and Sonoran subpopulations)
29	2.18	Investigate impacts of helicopters from other program activities (e.g., Marine Corps WTI, other military activities, U.S. Customs Service, other State and Federal management agencies) on pronghorn
30	2.18	Initiate periodic aerial surveys in Mexico at other times of the year than the population census to monitor herd size, composition, distribution, natality, etc.
31	2.18	Investigate effects of public use and other ground-based activity (e.g., military training, ordnance clean-up, law enforcement, land management agency activities such as grazing, firewood cutting, and mining) on pronghorn
32	2.18	Complete AGFD contract with Purdue University to look at taxonomic status using established genetic markers of Sonoran pronghorn relative to other races of pronghorn
33	2.27	Continue to promptly notify CPNWR of all pronghorn mortalities; recovery team leader keeps a file on all reports and maintains a summary table of all mortalities and known facts
34	2.27	Incorporate a habitat assessment component in currently used population survey technique to monitor annual change/variation in range condition
35	2.27	Complete range assessment of 4 allotments by the BLM and application of Standards and Guidelines to ensure adequate forage for pronghorn and habitat improvement
36	2.27	Evaluate pronghorn location data relative to available habitat using normalized digital vegetation index and/or other forms of satellite data
37	2.36	Develop a narrowly-defined and rigidly controlled coyote removal plan
38	2.36	Develop study to continue to evaluate water quality at bomb craters that fill with water and are frequented, at least seasonally, by pronghorn
39	2.36	Update the PVA in light of new, more quantified data on various aspects of pronghorn biology and PVA techniques
40	2.36	Evaluate occurrence of bluetongue and EHD in cattle and native ungulate species and their potential to serve as a reservoir for these diseases
41	2.45	Fix highway (e.g., Highway 85, Interstate 8), International Boundary, and other fences to make them pronghorn accessible or pronghorn barriers as determined necessary
42	2.45	Prepare a written protocol for dealing with injured or dead pronghorn including permit

		authority, agency and veterinarian contact numbers, notification protocol, transportation, housing and/or disposal procedures
43	2.55	Compile extant reports of pronghorn watering (documented and anecdotal), review of literature, and prepare a technical reviewed article
44	2.55	Continue timely coordination with Recovery Team and Phoenix Ecological Services Office on all proposed use changes on Tactical Ranges
45	2.55	Investigate blank spots in current pronghorn range distribution maps (e.g., targeted aerial surveys, remote sensing)
46	2.55	Experimentally provide mineral supplement blocks
47	2.55	Conduct a comprehensive literature review of pronghorn/barrier interactions and wildlife passage devices and designs (to include literature for other ungulate species when appropriate)
48	2.63	Develop a back-up plan in the event of a hoof and mouth outbreak
49	2.7	Construct and staff a Sonoran Desert greenhouse for producing key forage plants for transplanting
50	2.7	Assess all wildlife and livestock waters on 4 BLM allotments as to pronghorn accessibility and/or potential traps
51	2.9	Develop a medical kit with all necessary materials for treatment, salvage, and/or necropsy with description of procedures and handling of biological samples

Each recovery team member assigned a rank of high = 1, medium = 2, or low = 3 to each project. Since there are 51 projects and 3 rankings, exactly 1/3 of the projects were ranked high, medium, or low by individual team members. The assigned rankings were averaged and the lower the score, the higher the priority. In the event of a tie between 2 or more projects, the project with the lowest variance was ranked higher. The theoretical highest and lowest possible rank that can be achieved by a given recovery action is 1.0 and 3.0, respectively.