United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

June 13, 2016

Service Consultation Number: 04EF2000-2015-F-0424

Memorandum to File

Subject: Biological Opinion for the proposed issuance of a Section 10(a)(1)(B) permit to JKAF Investments, LLC, and Kathryn Kendrick Davidow Trust for incidental take of the sand skink and the blue-tailed mole skink

Roxanna Hinzman
Field Supervisor

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the proposed issuance of section 10(a)(1)(B) incidental take permit (Permit) to JKAF Investments, LLC, and Kathryn Kendrick Davidow Trust, (Applicants) for a proposed Residential Development in Osceola County, Florida (Project), and its effects on the threatened sand skink (*Neoseps reynoldsi*) and blue-tailed mole skink (*Eumeces egregius lividus*) (skinks) per section 7 of the Endangered Species Act of 1973, as amended (Act) (16 United States Code [U.S.C.] 1531 *et seq.*).

This Biological Opinion is based on information provided in the Applicants' Habitat Conservation Plan (HCP), letters, email correspondence, site visit, and the Service's South Florida Multi-species Recovery Plan (Service 1999). A complete record of this consultation is maintained and available for review at the Service's South Florida Ecological Services Office, Vero Beach, Florida.

Consultation History

On January 14, 2015, the Service received a phone call from Bio-tech consultants, Inc. (Consultant) to introduce the Project. The Service and the Consultant discussed results of the skink survey of the Project parcel.

On January 28, 2015, the Service received an email with the results of a skink survey of the Project parcel dated June 6, 2014.

On August 10, 2015 the Service received a package including an application for an incidental take permit (ITP), a HCP, the results of a cultural review of the Project parcel, and the ITP application fee.

From August 2015 to May 2016, Service staff corresponded by telephone and e-mail with the Consultant to discuss the progress of the HCP and remaining tasks.

On March 21, 2016, the Notice of Availability of the HCP and National Environmental Policy Act (NEPA) document was published in the Federal Register; the public comment period closed on April 21, 2016.

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

The Service proposes to issue a Permit to the Applicants under section 10(a)(1)(B) of the Act in order to authorize take of skinks incidental to the construction of the Project located on the north side of Tri County Road to the east of U.S. 27, within Section 30, Township 25 South, and Range 27 East (Figure 1) in Osceola County, Florida. The geographic coordinates for a central location on the Project site are Latitude 28.275195, Longitude 81.64269.

The Permit would cover the construction of a residential development, paved roads, parking areas, a stormwater management system, and associated infrastructure, which would permanently alter 0.5 acres (ac) of occupied skink habitat in Polk County, Florida.

The 160-ac parcel is composed of 10 ac of wetlands and approximately 150 ac of coniferous plantation and a citrus grove in similar proportions. The Project parcel is surrounded by orange groves with urban development on the south side of the property.

Action Area

The action area is defined as all areas to be directly or indirectly affected by the action and not merely the immediate area involved in the action. The purpose of the Project is to build a residential development serviced by multiple existing roads. The Service considers the action area for this Project as all lands within the Project footprint (Figure 2).

Minimization and Mitigation

The Applicants propose the purchase of 1.0 ac of mitigation bank credits (in accordance with the Service's 2:1 mitigation ratio guidelines) from a Service-authorized conservation bank, located in Polk County, Florida to satisfy mitigation requirements. Credits will be purchased no later than 30 days after ITP issuance. A purchase receipt will be provided to the Service.

Federally listed species not likely to be adversely affected by the proposed action

Impacts to wildlife at the Project site are expected to be minimal due to the fact that the Project parcel is an active citrus grove surrounded by other citrus groves and urban development.

If modifications are made to the Project, if additional information involving potential effects to listed species becomes available, or if a new species is listed, reinitiation of consultation may be necessary.

STATUS OF THE SPECIES/CRITICAL HABITAT RANGEWIDE

Please see attachments for the Status of the Species for the blue-tailed mole skink and sand skink. Critical habitat has not been designated for the blue-tailed mole skink or sand skink; therefore, critical habitat will not be affected by the Project.

Analysis of the species likely to be affected

Skinks

The modification and destruction of xeric upland communities in Central Florida were primary considerations in listing the skinks as threatened. Another threat to skinks is habitat degradation due to lack of management, including prescribed fire. The Project's adverse effects to federally listed skinks will be discussed in the remainder of this Biological Opinion.

ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem within the action area. The environmental baseline does not include the effects of the action under review in this Biological Opinion.

Status of the species within the action area

The Applicants followed the guidance set forth in the Service's Draft Sand and Blue-tailed Mole Skink Survey Protocol (Service 2012). The skink survey resulted in the observation of two sand skink tracks during the survey period of April 8 through May 8, 2014 (Figure 2). The occupied habitat onsite was obtained by delineating a polygon enclosing the skink tracks and suitable habitat surrounding such locations (Figure 3). A reliable survey method for blue-tailed mole skink has not been developed. The entire known geographic range of the blue-tailed mole skink occurs within the known geographic range of the sand skink within Highlands, Polk, and Osceola Counties. Therefore, the Service assumes blue-tailed mole skinks are likely to occur wherever sand skinks occur in those counties.

Factors affecting the species' environment within the action area

Skinks are vulnerable within the action area due to habitat loss resulting from the intense development pressures related to Central Florida's burgeoning human population. Between 2005 and 2060, Florida's population is projected to double to approximately 36 million people (Zwick and Carr 2006). Assuming a similar pattern of development at current gross urban densities for each county, this translates into the need to convert an additional 7 million ac of undeveloped land into urban land uses (Zwick and Carr 2006). Accordingly, it is extremely likely that remaining unprotected skink habitats in the vicinity of the Project will be converted to residential subdivisions, golf courses, and shopping centers. Moreover, skinks are directly killed by land clearing and other activities associated with construction and development.

Remaining skink habitats are also threatened by degradation resulting from fire exclusion and lack of management. Xeric habitats favored by skinks require periodic fire to maintain optimal habitat, such as patches of bare sand and low shrub structure. The need to protect agricultural, residential, and commercial development has resulted in the suppression of wildfires. Furthermore, implementing prescribed burns in areas adjacent to residential areas is difficult due to safety concerns and objections of local residents. The Service is unaware of any recent fires within the action area. Xeric habitats lacking periodic fire or management become overgrown and less suitable to skinks. Over time, skinks will diminish in abundance and eventually may be extirpated.

Climate change

Our analyses under the Act include consideration of observed or likely environmental effects related to ongoing and projected changes in climate. As defined by the Intergovernmental Panel on Climate Change (IPCC), "climate" refers to average weather, typically measured in terms of the mean and variability of temperature, precipitation, or other relevant properties over time; thus "climate change" refers to a change in such a measure which persists for an extended period, typically decades or longer, due to natural conditions (e.g., solar cycles) or human-caused changes in the composition of the atmosphere or in land use (IPCC 2013, p. 1450). Detailed explanations of global climate change and examples of various observed and projected changes and associated effects and risks at the global level are provided in reports issued by the IPCC (2014 and citations therein). Information for the United States at national and regional levels is summarized in the National Climate Assessment (Melillo *et al.* 2014 entire and citations therein; see Melillo *et al.* 2014, pp.28-45 for an overview). Because observed and projected changes in climate at regional and local levels vary from global average conditions, rather than using global scale projections, we use "downscaled" projections when they are available and have been developed through appropriate scientific procedures, because such projections provide higher resolution information that is more relevant to spatial scales used for analyses of a given species and the conditions influencing it. (See Melillo *et al.* 2014, Appendix 3, pp. 760-763 for a discussion of climate modeling, including downscaling). In our analysis, we use our expert judgment to weigh the best scientific and commercial data available in our consideration of relevant aspects of climate change and related effects.

Climate change may result in an increase in the intensity or frequency of tropical storms and hurricanes in Florida. The Atlantic Multi-decadal Oscillation (AMO) influences rain patterns in Florida. We are currently in an AMO wet phase that is predicted to persist through 2020 (Miller 2010). The increased rainfall associated with both of these factors could reduce our ability to effectively use prescribed burning to manage habitat in optimal conditions for skinks and their prey. Increased rainfall also could reduce the amount of bare soil patches available to skinks by increasing growth and coverage of vegetation.

It is difficult to estimate, with any degree of precision, which species will be affected by climate change or exactly how they will be affected. The Service will use Strategic Habitat Conservation planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (Service 2006).

EFFECTS OF THE ACTION

Factors to be considered

The Project site is located within the geographic range of the sand skink and blue-tailed mole skink and contains skink-occupied habitat. The timing of construction for this Project, relative to sensitive periods of the skink's life cycle, is unknown. Skinks are currently found within the proposed construction footprint. The Project will be constructed in phases. The time required to complete construction of the Project is not known. The disturbance associated with the Project will be permanent and will result in incidental mortality of skinks and a loss of habitat currently available to the skinks on-site.

Over the last 20 years, ongoing conservation efforts by public and private institutions within the geographic range of the Skinks have resulted in the acquisition of 21,498 ac (8,700 ha) of undeveloped areas in the Lake Wales Ridge (LWR) (Turner et al. 2006). The Service has also acquired portions of several tracts totaling 1,800 ac (728.4 ha) as a component of the LWR National Wildlife Refuge (Service 1993). Private organizations, such as The Nature Conservancy and Archbold Biological Station have acquired and currently manage xeric uplands within the LWR. All of these efforts have greatly contributed to the protection of imperiled species including skinks on the LWR (Turner et al. 2006).

The Service has also certified six conservation banks totaling nearly 1,500 ac for sand and blue-tailed mole skinks, two in Highlands County and four in Polk County. Conservation banking provides an avenue for collaboration of private/public partnerships to maintain and preserve habitat, providing for the conservation of endangered species. These banks conserve and manage land in perpetuity through a Conservation Easement to offset impacts occurring elsewhere to the same resource values on non-bank lands. The certification of these banks should help reduce the piece-meal approach to skink conservation that can result from separate evaluation of individual projects by establishing larger reserves and improving connectivity of habitat.

Effects of the action

Beneficial effects

As the result of Project compensation, 1.0 ac of occupied skink habitat located at a Service-authorized conservation bank will be preserved and managed in perpetuity according to the Management Plan developed for this regionally significant mitigation site.

Direct effects

Direct effects are those effects caused by the proposed action, at the time of construction, and are reasonably certain to occur. The direct effects this Project will have on skinks within the action area are discussed below.

The construction of the Project will result in the direct loss of 0.5 ac of occupied skink habitat. Incidental mortality of skinks due to and clearing and construction activities is expected to occur. Mechanical preparation of the proposed Project site can crush or injure individual skinks and skink eggs, and destroy or degrade habitat and foraging areas. In addition, any clearing activities may adversely affect skinks by causing them to leave the area and possibly miss foraging and mating opportunities. Individual skinks fleeing the area may be more vulnerable to predation. Also, the Project will add to the continued fragmentation of skink habitat in the region and result in a small reduction of the geographic distribution of these species. Therefore, the proposed work is expected to directly affect 0.5 ac of sand and blue-tailed mole skink habitat and result in the incidental mortality of skinks in the action area.

Interrelated and interdependent actions

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. Interrelated and interdependent actions are not expected to result from the Project.

Indirect effects

Indirect effects are those effects that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur. All 0.5 ac of occupied habitat on site will be developed as part of the implementation of this Project, therefore; no indirect effects are expected to occur on the Project site.

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 unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The action area for this Project was determined to be limited to the Project site itself. All activities proposed on the Project site are being reviewed as part of this Biological Opinion. Therefore, no additional cumulative effects are anticipated to occur in the action area. The Service has considered cumulative effects within the action area for skinks, and based on the above discussion, we have not identified any additional cumulative effects beyond those already discussed in the Environmental Baseline.

In the areas adjacent to the action area, we anticipate that County actions may adversely affect skink habitat, including the issuance of building permits by Polk County to construct single-family homes and commercial buildings. Many of the construction projects impacting skink habitat in the vicinity of the area of the Project will require both a County building permit and a Corps permit, and will therefore require consultation under section 7 of the Act.

CONCLUSION

Construction of the Project will result in the direct loss of 0.5 ac of occupied skink habitat. In addition, construction activities are likely to result in mortality of individual skinks and loss of skink eggs or cause skinks to leave the area and possibly miss foraging opportunities. The implementation of the Project will add to the continued fragmentation of skink habitat in the region and result in a small reduction of the geographic distribution of these species.

However, the loss of this habitat is expected to be offset by the purchase of appropriate off-site mitigation from a Service-authorized conservation bank. Additionally the loss of habitat due to the implementation of this Project is not expected to appreciably affect the overall survival and recovery of the skinks because is small compared the 24,790 ac of occupied skink habitat under conservation for the skink.

After reviewing the current status of the skinks, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the Project, as proposed, is not likely to jeopardize the continued existence of the skinks. Critical habitat for the skinks has not been designated. Therefore, critical habitat will not be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. "Take" is defined as to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct." "Harm" is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.

Under the terms of section 7(b)(4) and section 7(o)(2), taking, that is incidental to and not intended as part of the agency action, is not considered to be prohibited taking under the Act provided such taking is in compliance with the terms and conditions of this Incidental Take Statement.

AMOUNT OR EXTENT OF TAKE ANTICIPATED

The Service has reviewed the biological information for these species, information presented by the Applicant's Consultant, and other available information relevant to this action. Based on our review, incidental take of skinks is anticipated for 0.5 ac of skink-occupied habitat due to the construction of a new residential development. Blue-tailed mole skinks have not been located onsite; however, this species is usually found in habitats occupied by sand skinks in Polk, Highlands, and Osceola Counties, and a reliable survey technique to detect blue-tailed mole skinks is not currently available. Therefore, presence of sand skinks is used as an indicator that blue-tailed mole skinks are likely also present.

The Service anticipates incidental take of skinks will be difficult to detect and quantify for the following reasons: skink density varies considerably within and between apparently suitable habitat patches; density dependent mechanisms are currently unknown and may be due to territorial requirements, micro-habitats, and other unknown environmental influences; individuals have a small body size and spend the majority of their time underground; and finding a dead or impaired specimen is unlikely. However, incidental take of skinks is anticipated within the 0.5 ac of occupied skink habitat located in the Project footprint, due to land clearing and construction activities associated with the Project. Therefore, the Service believes all individuals occurring within this 0.5-ac portion of the Project footprint will be incidentally taken. The incidental take is expected to be in the form of harm, injury, or death due to construction activities and/or habitat loss, or harassment. Because numbers of skinks are difficult to quantify and take will be difficult to detect, take of skinks is measured by the amount of occupied habitat lost through implementation of the proposed Project (0.5 ac). Authorized take will be considered exceeded if more than 0.5 ac of occupied skink habitat are lost. If, during the course of this action, this level of take is exceeded, such take would represent new information requiring review of the reasonable and prudent measures provided. The Federal agency must immediately reinitiate consultation with the Service.

EFFECT OF THE TAKE

In the accompanying Biological Opinion, the Service determined this level of anticipated take is not likely to result in jeopardy to skinks.

REASONABLE AND PRUDENT MEASURES

When providing an incidental take statement, the Service is required to give reasonable and prudent measures it considers necessary or appropriate to minimize the take along with terms and conditions that must be complied with, to implement the reasonable and prudent measures. Furthermore, the Service must also specify procedures to be used to handle or dispose of any individuals taken. The Service believes the following reasonable and prudent measure is

necessary and appropriate to reduce take and to minimize the direct and indirect effects of the proposed Project on the sand skink and blue-tailed mole skink:

- Implementation of the Project as proposed and outlined in the "Description of the Proposed Action" section of this Biological Opinion.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Corps and the Applicants must comply with the following terms and conditions that implement the reasonable and prudent measures described above and outline reporting and monitoring requirements. These terms and conditions are non-discretionary.

1. The Service will require the Applicants to provide a copy of the Credit Receipt from the Service-approved Conservation Bank. A signed copy of this document shall be provided to the Service's South Florida Ecological Services Office prior to commencement of activities authorized under this Permit, if issued.

2. The Applicants will cease all Project activities and contact the Service's South Florida Ecological Services Office if skinks are located within the action area outside of the 0.5 ac that has been identified as occupied by skinks.

REPORTING REQUIREMENTS AND DISPOSITION OF DEAD OR INJURED SPECIMENS

Upon locating a dead sand skink or blue-tailed mole skink specimen, initial notification must be made to the nearest Service Law Enforcement Office: Ms. Janet Rider; Fish and Wildlife Service; 352-429-1037 ext. 308. Secondary notification should be made to the FWC: South Region; 3900 Drane Field Road; Lakeland, Florida, 33811-1299; 800-282-8002. Care must be taken in handling any dead specimens of proposed or listed species found in the Project area to preserve the specimen or its remains in the best possible state. In conjunction with the preservation of any dead specimens, the finder has the responsibility to ensure evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The finding of dead specimens does not imply enforcement proceedings pursuant to the Act. The reporting of dead specimens is required to enable the Service to determine if take is reached or exceeded and to ensure the terms and conditions are appropriate and effective. If not specifically instructed by Service law enforcement to submit dead specimens, all dead specimens should be provided to the Florida Museum of Natural History, 3215 Hull Road, Gainesville, Florida, 32611. Contact the museum for details on how best to preserve and provide the specimen.

CONSERVATION RECOMMENDATIONS

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

- Place any unoccupied sand skink habitat on the Project site that is not needed for construction of the Project under conservation easement and manage it such that it remains suitable for skinks.

REINITIATION NOTICE

This concludes formal consultation on the issuance of the IPT to JKAF Investments, LLC and Kathryn Kendrick Davidow Trust for the Project. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded (see below); (2) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; (3) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. The amount of incidental take authorized by this consultation (0.5 ac of occupied skink habitat) may be exceeded should skinks be observed outside the 0.5 ac of occupied habitat identified within the action area of the proposed Project. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Thank you for your cooperation in the effort to protect fish and wildlife resources. If you have any questions regarding this Project, please contact Al Begazo at 772-469-4234.

Attachments

cc: electronic only
FWC, Tallahassee, Florida (FWC-CPS)
Service, Vero Beach, Florida (Marilyn Knight)

LITERATURE CITED

IPCC 2013: Annex III: Glossary [Planton, S. (ed.)]. Pp. 1147-1465 In: *Climate Change 2013:The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_AnnexIII_FINAL.pdf

IPCC 2014: *Climate Change 2014 Synthesis Report*. [Pachauri, R.K. *et al.*] 133 pp. http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

Melillo J. M., T.C. Richmond, and G. W. Yohe, Eds. 2014. *Climate Change Impacts in the United States: The Third National Climate Assessment*. U.S. Global Change Research Program. http://nca2014.globalchange.gov/downloadsMiller, L. 2010. Climate of South Florida; Everglades Restoration Transition Plan Phase I Biological Opinion. Vero Beach, Florida: U.S. Fish and Wildlife Service.

Miller, L. 2010. Climate of South Florida; Everglades Restoration Transition Plan Phase I Biological Opinion. Vero Beach, Florida: U.S. Fish and Wildlife Service.

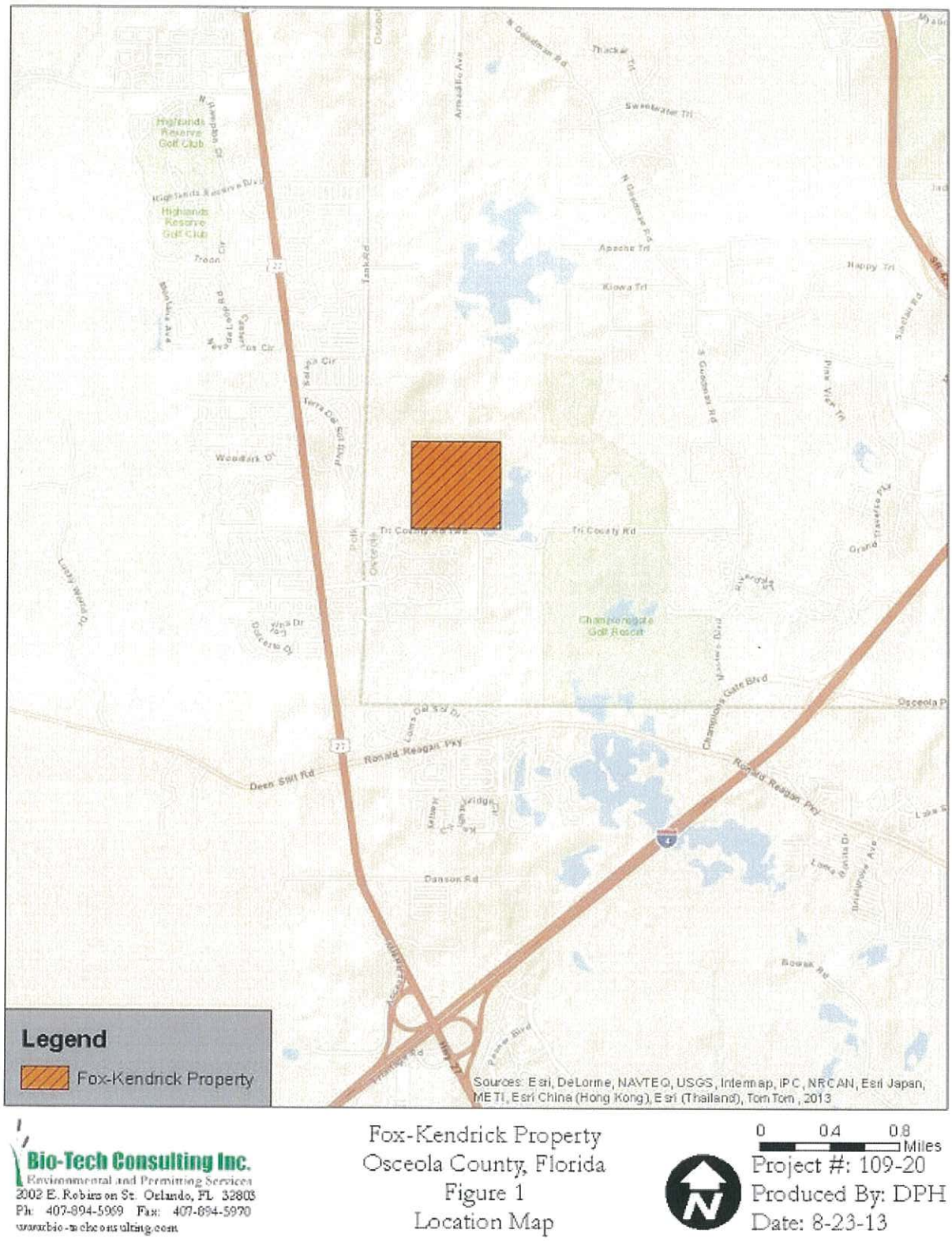
Turner W.R., D.S. Wilcove, and H.M. Swain. 2006. State of the Scrub: Conservation progress, management responsibilities, and land acquisition priorities for imperiled species of Florida's Lake Wales Ridge [Internet]. Archbold Biological Station; Lake Placid, Florida [cited October 29, 2008]. Available from: www.archbold-station.org/ABS/publicationsPDF/Turner_etal-2006-StateotScrub.pdf

U.S. Fish and Wildlife Service (Service). 2006. Strategic Habitat Conservation. Final Report of the National Ecological Assessment Team to the U.S. Fish and Wildlife Service and U.S. Geologic Survey. 48 pages.

U.S. Fish and Wildlife Service (Service). 2012. Species Conservation Guidelines, South Florida – Sand Skink and Bluetail Mole Skink [Internet]. U.S. Fish and Wildlife, South Florida Ecological Services Office; Vero Beach, Florida [cited October 29, 2008]. Available from: http://www.fws.gov/verobeach/ReptilesPDFs/20120206_Skink%20CCG_Final.pdf

U.S. Fish and Wildlife Service. 1993. Recovery plan for the sand skink and the blue-tailed mole skink. Atlanta, Georgia.

Zwick, P.D., and M.H. Carr. 2006. Florida 2060. A population distribution scenario for the State of Florida. A research Project prepared for 1000 Friends of Florida. Prepared by the Geoplan Center at the University of Florida, Gainesville, Florida.



Bio-Tech Consulting Inc.
Environmental and Permitting Services
2002 E. Robinson St. Orlando, FL 32803
Ph: 407-894-5969 Fax: 407-894-5970
www.bio-techconsulting.com

Fox-Kendrick Property
Osceola County, Florida
Figure 1
Location Map

Project #: 109-20
Produced By: DPH
Date: 8-23-13

Figure 1. Map showing the location of the Project parcel.

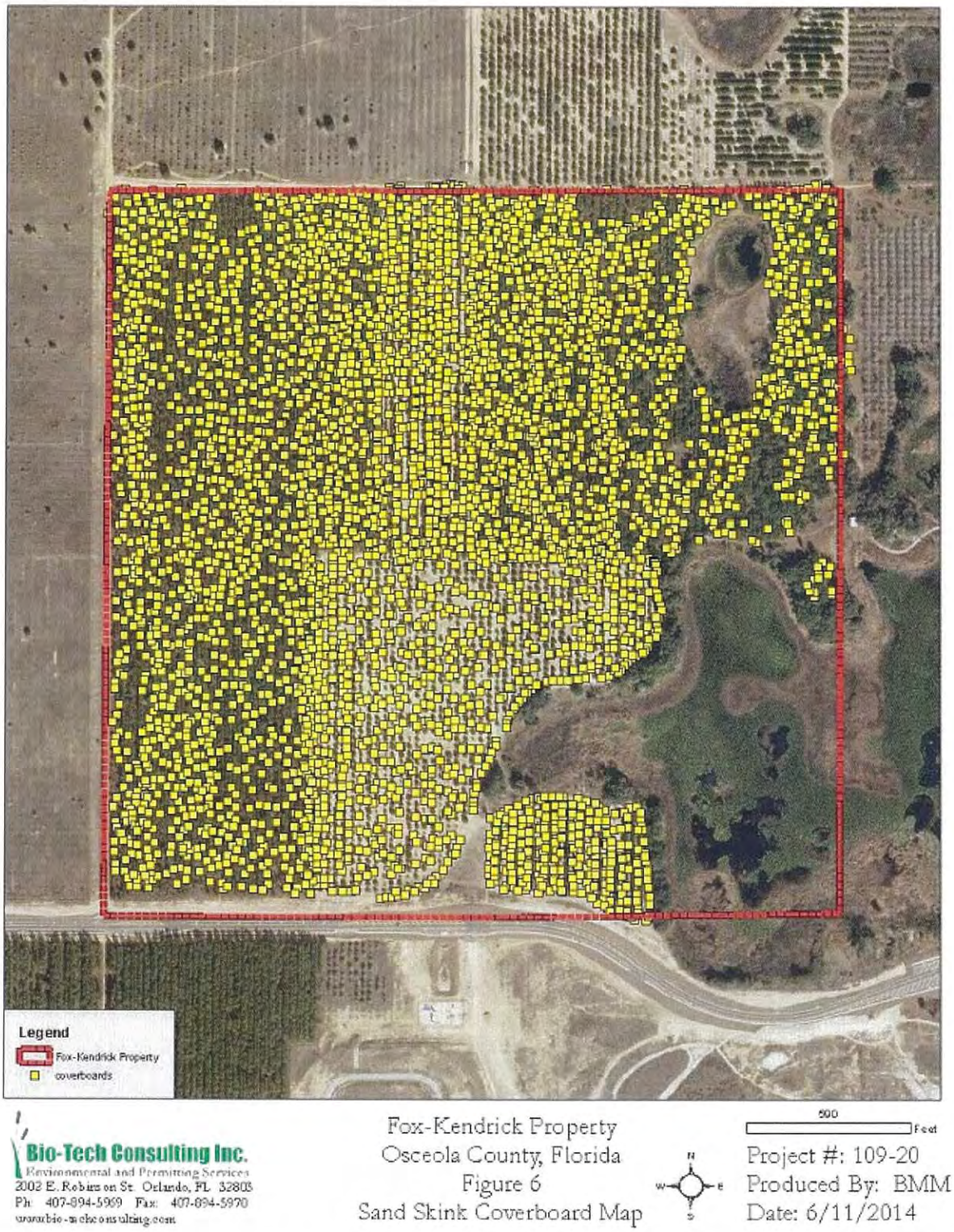


Figure 2. Map showing the Project site with the location of the coverboards used to survey for skinks.

Figure 3. Map showing skink locations and skink-occupied habitat on the Project site.

Set of Findings and Recommendations on an Application Submitted by JKAF Investments, LLC, and Kathryn Kendrick Davidow Trust for Incidental Take of Sand skinks and Blue-tailed mole skinks in Osceola County, Florida.

I. DESCRIPTION OF PROPOSAL

JKAF Investments, LLC, and Kathryn Kendrick Davidow Trust (Applicants) are seeking an incidental take permit (ITP) from the U.S. Fish and Wildlife Service (Service) pursuant to section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (Act) (87 Stat.884; 16 U.S.C. 1531 *et seq.*). The ITP, if issued, would authorize take of the threatened sand skink (*Neoseps reynoldsi*) and blue-tailed mole skink (*Eumeces egregius lividus*) (Skinks) incidental to construction of a residential development and accompanying infrastructure (Project) on about 160 acres (ac) in Section 30, Township 25 South, Range 27 East in Osceola County, Florida.

II. SECTION 10(a)(2)(A) HCP CRITERIA - ANALYSIS AND FINDINGS

1. <u>The impact to result from such taking.</u>

The continued survival and recovery of skinks in this area may be dependent on the maintenance of suitable habitat, restoration of unsuitable habitat, and land acquisition.

Skink use of the Project area was documented by the environmental consultant for this Project. Based on this information, skinks appeared to occupy 0.5 ac of the Project site.

The proposed Project will impact land currently used as an active coniferous plantation and citrus grove. The 160-ac parcel is located on the north side of Tri County Road and to the east of U.S. 27, surrounded by mostly citrus groves with urban development to the south. The general area is currently experiencing rapid growth.

Land clearing in preparation for residential construction will permanently alter occupied skink habitat and could result in death of, or injury to, skinks, incidental to the carrying out of these otherwise lawful activities. Habitat alteration associated with the proposed development will adversely affect feeding, breeding, and sheltering behavioral patterns for skinks.

The Service anticipates that 0.5 ac of skink-occupied habitat within the action area of the proposed Project may be taken due to the implementation of the proposed Project.

2. <u>The steps taken to minimize and mitigate such impacts and the funding that will be available to implement such steps.</u>

The Applicant's Habitat Conservation Plan (HCP) and the Service's Low-effect Screening Form (Screening Form) for categorical exclusion describes the following

minimization and mitigation strategy to be employed by the Applicant to offset the impacts of the Project to the skinks:

The Applicant will mitigate the unavoidable impacts associated with the alteration of 0.5 ac of occupied skink habitat through the purchase of 1.0 ac of skink-occupied habitat from a Service-approved Conservation Bank.

3. Alternative actions to the take that were considered by the Applicant and reasons why such alternatives are not being utilized.

In the HCP, the Applicant describes two alternatives for the proposed action. The no action alternative was considered but rejected because it is not economically feasible for the Applicant.

The purchase of another lot that would not impact skinks was considered as an alternative. Land costs have increased dramatically in recent years making purchase of alternate lands economically infeasible.

The preferred alternative is for the Applicant to purchase 1.0 ac of skink-occupied habitat from a Service-approved Conservation Bank. We believe this alternative at this specific Conservation Bank is best for the long-term survival of the skinks.

4. Other measures the Secretary may require as being necessary or appropriate for the purposes of the HCP.

The Service finds that any other measures not outlined in the HCP, but required to implement its intent and purpose are detailed in the ITP.

III. ENVIRONMENTAL ASSESSMENT AND PUBLIC COMMENT - ANALYSIS AND FINDINGS

The Service prepared a Low-effect Screening Form (Screening Form) for this ITP request. A Notice of Availability was published in the *Federal Register* notifying the public of the availability of the HCP and Screening Form from March 21, 2016, through April 21, 2016. The Service received one comment on this ITP application during the comment period.

The commenter was concerned that the proposed mitigation did not adequately represent the ecological worth of the skinks. The Service believes the Applicant's mitigation proposal is practicable and commensurate with the impact, and is consistent with the section 10 issuance criteria. Consequently, response to this comment does not require amendment or readvertisement of the HCP or Screening Form.

IV. SECTION 10(A)(2)(B) PERMIT ISSUANCE CRITERIA - ANALYSIS AND FINDINGS

1. Criterion - The taking will be incidental.

   Findings - The take will be incidental to the otherwise lawful activity that would occur as a result of clearing and construction activities related to the proposed Project.

2. Criterion - The Applicant will, to the maximum extent practicable, minimize and mitigate the impacts of the taking.

   Findings - The Applicant, in consultation with the Service, has developed an adequate HCP pursuant to the ITP requirements provided in the Act and implementing regulations. The HCP provides for measures to minimize Project impacts on site. Unavoidable impacts will be mitigated to the extent practical. These measures have been summarized above. The Service believes the proposed mitigation measures are sufficient for the following reasons:

   On July of 1999, the Service promulgated guidance to be used during the development of mitigation strategies for skinks during the preparation of HCPs. The guidance specifies priorities for skinks mitigation and indicates that an applicant must reasonably exhaust all opportunities for obtaining mitigation from a higher priority mitigation strategy before opting for a lower priority mitigation strategy. Based on the Applicant's coordination with the Service over the past year, we believe that the financial contribution to a Service-approved skink conservation bnak would be most beneficial to the skinks.

   By increasing the amount of scrub habitat under conservation, most scrub dependent species (including skinks) will benefit due to greater protection and management of habitat.

3. Criterion - The Applicant will ensure that adequate funding for the HCP and procedures to deal with unforeseen circumstances will be provided.

   Findings - The Applicant proposes to purchase 1.0 ac of skink-occupied habitat from a Service-approved Conservation Bank before land clearing and construction occurs. Unforeseen circumstances are not anticipated because of the small scope of the project relative to range-wide biology and ecology of skinks. However, the Applicant has committed to coordinate with the Service in the event unforeseen circumstances occur.

4. Criterion - The taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild.

Findings - The wording of this criterion is identical to the "jeopardy" definition under section 7 regulations (50 CFR 402.02), which defined the term "jeopardize the continued existence of" as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." As a result, issuance of this section 10(a)(1)(B) permit was reviewed by the Service under section 7 of the Act. In the Biological Opinion, which is attached hereto, and incorporated herein by reference, the Service concluded that issuance of the ITP is not likely to jeopardize the continued existence of the skinks.

5. Criterion - Additional measures as required by the Director of the Service will be implemented.

   Findings - Additional measures as required by the Director of the Service would be implemented because they have been incorporated into the special conditions of the ITP.

6. Criterion - The Director of the Service has received the necessary assurances that the plan will be implemented.

   Findings - The permit will only be effective when the mitigation measures have been carried out in accordance with the special conditions of the ITP. Failure to perform the obligations outlined by the conditions of the section 10(a)(1)(B) permit may be grounds for suspension or revocation of the ITP.

V. General Criteria and Disqualifying Factors - Analysis and Findings

The Service has no evidence that the ITP application should be denied on the basis of criteria and conditions set forth in 50 CFR 13.21(b)-(c).

VI. National Environmental Policy Act Analysis

As determined in the screening Form prepared for this action:

The effects of the HCP on Federally listed, proposed, or candidate species and their habitat covered under the HCP are minor or negligible prior to implementation of the mitigation plans.

The effects of the HCP on other environmental values or resources (*e.g.*, air quality, geology, soils, water quality, socio-economic, cultural resources, recreation, visual resources, etc.) are minor or negligible prior to implementation of the mitigation plans.

The impact of this HCP, considered together with the impacts of other past, present, and reasonably foreseeable, similarly situated projects will not result, over time, in cumulative effects to environmental values or resources which would be considered significant.

VII. Recommendations on Issuance of ITP

Based on our findings with respect to the ITP application, HCP, Screening Form, and section 7 Biological Opinion, issuance of a section 10(a)(1)(B) incidental take permit number TE81666B-0, to JKAF Investments, LLC, and Kathryn Kendrick Davidow Trust is recommended. I have determined that this application meets the issuance criteria found in section 10(a)(1)(B) of the Act. Within the spirit and intent of the Council of Environmental Quality's regulations for the implementation of the National Environmental Policy Act of 1969 (as amended) and other statutes, orders, and policies that protect fish and wildlife resources, I have determined ITP application number TE81666B-0, for JKAF Investments, LLC, and Kathryn Kendrick Davidow Trust, is a categorical exclusion as provided by 516 DM 2, Appendix 1, and 516 DM 6, Appendix 1.4c(2). No further documentation will be made.

Submittal:

Roxanna Hinzman
Field Supervisor
South Florida Ecological Services Office

6/14/14
Date

STATUS OF THE SPECIES – blue-tailed mole skink (*Eumeces egregius lividus*)

Legal Status – Federal: *threatened*, 1987; State: *threatened*

The blue-tailed mole skink was listed as threatened under the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*) on December 7, 1987 (52 FR 42658- 52 FR 42662), and is listed as threatened by the State of Florida. The historic and anticipated future modification and destruction of xeric upland communities in central Florida were primary considerations in listing. Almost 90 percent of the xeric upland communities on the Lake Wales Ridge (LWR) have already been lost because of habitat destruction and degradation due to residential development and conversion to agriculture, primarily citrus groves (Turner et al. 2006). Remaining xeric habitat on private lands is especially vulnerable because projections of future human population growth suggest additional demands for residential development within the range of the blue-tailed mole skink. Critical habitat has not been designated for the blue-tailed mole skink.

Species Description

Appearance/Morphology

The blue-tailed mole skink (*Eumeces egregius lividus*) is a small, fossorial lizard that occupies xeric upland habitats of the southern LWR in central Florida (Mount 1965; Christman 1992). It reaches a maximum length of about 5 inches (in) (12.7 centimeters [cm]), and the tail makes up about half the body length (Christman 1978; 1992). The body is shiny, and brownish to pink in color, with lighter paired dorsolateral stripes diverging posteriorly (Christman 1978; 1992). Males develop a colorful orange pattern on the sides of the body during breeding season (Christman 1992). Juveniles usually have a blue tail (Christman 1978; 1992). Regenerated tails and the tails of older individuals are typically pinkish. The legs are somewhat reduced in size and used only for surface locomotion and not for "swimming" through the sand (Christman 1978; 1992).

Taxonomy

Mount (1965) described the blue-tailed mole skink largely on the basis of a bright blue tail in juveniles and restricted this subspecies to the southern LWR in Polk and Highlands Counties. Christman (1978) also limited the range of blue-tailed mole skink to these two counties, but later added Osceola County to the range, based on the collection of a single blue-tailed mole skink juvenile just north of the Polk County line on the LWR (Christman 1992). Analysis of mitochondrial DNA (Branch et al. 2003) supports Mount's (1965) hypotheses that blue-tailed mole skink from the lower LWR represents the ancestral stock, which radiated from there. Genetic analysis also indicates substantial population variability with limited dispersal in mole skinks among sandy habitats (Branch et al. 2003). Based on conventional estimates of molecular evolutionary clocks, these authors suggest a separation of approximately 4 million years between mole skinks occurring on the two oldest ridges (LWR and MDR), which overlaps the proposed Pliocene origin of scrub habitats (Webb 1990).

Five subspecies of mole skinks have been described, all of which occupy xeric upland habitats of Florida, Alabama, and Georgia (Mount 1965), but only the blue-tailed mole skink (*Eumeces egregius lividus*) is federally listed as threatened (52 FR 42658). The taxonomic classification of the mole skink has been reevaluated, and there is evidence to suggest that it should be revised (Griffith et al. 2000; Brandley et al. 2005; Smith 2005). Brandley et al. (2005) and Smith (2005) formally proposed that the name *Plestiodon* be used to describe the Genus of the North American skinks. However, until such time as it can be officially designated through the Federal Register process, the Service continues to use the scientific name as published in the final listing rule (52 FR 42658). A detailed description of the recent taxonomic review can be found in Service (2007).

Life History

Blue-tailed mole skinks are typically found in a variety of xeric upland communities, including rosemary and oak-dominated scrub, turkey oak barrens, high pine, and xeric hammocks (Christman 1992). They are primarily found within the top 2 in (5 cm) of the soil surface (Mount 1963). Roaches, crickets, and spiders make up the bulk of the diet (Mount 1963; Smith 1982; McCoy et al. 2010). Smith (1982) suggested that their diet is more generalized than that of the fossorial sand skink (*Neoseps reynoldsi*), which probably reflects their tendency to feed at the surface. However, McCoy et al. (2010) suggest that the dietary diversity of mole skinks is very similar to sand skinks or perhaps even more specialized. Also, like sand skinks, mole skinks show an activity peak in spring (Mount 1963; Smith 1982).

The reproductive biology of the blue-tailed mole skink is poorly known. Reproduction is presumably very much like that of the peninsula mole skink (*Eumeces egregius onocrepis*) where courtship and mating occur in the fall and winter (Mount 1963; Christman 1978). In the peninsula mole skink, individuals probably become reproductively active at 1 to 2 years of age (Mount 1963; Christman 1978). Two to nine eggs are laid in a shallow nest cavity less than 12 in (30.5 cm) below the surface (Mount 1963; Christman 1978). The eggs incubate for 31 to 51 days, during which time the female tends the nest (Mount 1963; Christman 1978). Females have a large clutch size (maximum nine) of relatively small eggs (Mount 1963).

Habitat

A variety of xeric upland communities provide habitat for the blue-tailed mole skink, including rosemary and oak-dominated scrub, turkey oak barrens, high pine, and xeric hammocks (Christman 1992). Areas with few plant roots, open canopies, scattered shrub vegetation, and patches of bare, loose sand provide optimal habitats (Christman 1988; 1992). Within these habitat types, blue-tailed mole skinks are typically found under leaves, logs, palmetto fronds, and other ground debris (Christman 1992). Shaded areas presumably provide suitable microhabitat conditions for thermoregulation, egg incubation, and foraging (Mount 1963).

Specific physical structures of habitat that sustain sand skink populations, and likely blue-tailed mole skink populations as well, include a well-defined leaf litter layer on the ground surface and

shade from either a tree canopy or a shrub layer, but not both (McCoy 2011, University of South Florida, pers. comm.). Leaf litter likely provides important skink foraging opportunities. Shade provided by a tree canopy or a shrub layer likely helps skinks regulate body temperature to prevent overheating. However, having both a tree canopy and a shrub layer appears to be detrimental to skinks (McCoy 2011, University of South Florida, pers. comm.).

Turner et al. (2006) reported that development and agriculture have resulted in the loss of approximately 85% of the scrub and sandhill habitats on the LWR, and what remains contains high concentrations of imperiled species. Over the last 20 years, more than 87 square kilometers (km^2) (48.9%) of the remaining 187 km^2 of these habitat types on the Lake Wales Ridge have been acquired and protected (Turner et al. 2006). Therefore, only 6.3% of pre-settlement scrub and sandhill habitats are currently protected (Turner et al. 2006).

In addition to the need for these remaining scrub and sandhill habitats to be protected, these habitats along with those on sites that have already been acquired for conservation depend upon active management, most often prescribed fire, to persist long-term (Turner et al. 2006). Much of the remaining habitat occurs in small, isolated fragments surrounded by residential areas or citrus groves, making them difficult to protect and manage. Many of these fragments are overgrown and in need of restoration. It is unknown whether or not small, fragmented properties are able to maintain viable populations.

Either natural fire started by lightning or prescribed fire is necessary to maintain habitat in natural scrub ecosystems. However, if fire occurs too frequently, leaf litter might not build up sufficiently to support skink populations. At Archbold Biological Station (ABS), fossorial sand skinks appear to be most abundant after 10 years of leaf litter development. The ideal fire frequency to maintain optimal leaf litter development for skinks likely varies by site and other environmental conditions (Mushinsky 2011, University of South Florida, pers. comm.). Although this information is specific to sand skinks, the same may be true for blue-tailed mole skinks.

Distribution

The blue-tailed mole skink historically occurred on the LWR in Highlands, Polk, and Osceola Counties (Service 1999). Despite intensive sampling efforts in scrub habitat with similar herpetofauna, neither the sand skink nor blue-tailed mole skink have been recorded at Avon Park Air Force Range on the Bombing Range Ridge (Branch and Hokit 2000). It appears that skinks are still distributed throughout their historic range, although we believe their numbers have likely declined substantially because of habitat loss and degradation.

Turner et al. (2006) reported that blue-tailed mole skinks are known to occur in 23 locations, 22 of which are on the LWR. The authors did not indicate where the single site occurs from which blue-tailed mole skink is reported off of the LWR, but we believe that this record may be in error. The subspecies has not been documented elsewhere off of the LWR and is believed to be restricted to this ridge alone (Moler 2007; Mushinsky 2007).

Blue-tailed mole skinks often seem absent or rare on the same LWR study sites where sand skinks are common, and when present, are patchily distributed (Christman 1988, 1992; Mushinsky and McCoy 1995). Mount (1963) noted peninsula mole skinks also are patchily distributed and mostly occurred on xeric sites greater than 100 acres (ac) (40 hectares [ha]) in size. The distribution of the blue-tailed mole skink appears to be closely linked to the distribution of surface litter and, in turn, suitable microhabitat sites. Campbell and Christman (1982) characterized blue-tailed mole skinks as colonizers of a patchy, early successional, or disturbed habitat, which may occur as a result of natural or anthropogenic factors. Susceptibility of mature sand pine to windthrow may be an important factor in maintaining bare, sandy microhabitats required by blue-tailed mole skinks and other scrub endemics (Myers 1990).

Population Dynamics

The population dynamics of the blue-tailed mole skink are not well known because the skinks' diminutive size and secretive habits make their study difficult. The best current method available to detect blue-tailed mole skinks involves the raking of sand and organic liter and intensive searching, or the use of pit-fall traps and drift fences. Because these methods are laborious and time-consuming, they are not well suited for use over large areas. Unfortunately, cover board surveys used to detect sand skinks are not useful for specifically detecting the presence of blue-tailed mole skinks. As such, assessing the abundance and population trends of the blue-tailed mole skink over large areas is problematic.

Early maturity and a large clutch size of relatively small eggs (Mount 1963) suggest the population dynamics of mole skinks are different from sand skinks. Blue-tailed mole skinks appear to be far less common than sand skinks A survey of seven protected sites conducted in 2004-2005 by Christman (2005) reported a density of 1.3 individuals per acre (0.53 per ha), compared to 56 sand skinks per acre (22.7 per ha), or a ratio of 1 blue-tailed mole skink for every 43 sand skinks collected. Previous studies indicated lower blue-tailed mole skink to sand skink ratios of 1:1.89 based on 54 total skinks captured in six trap arrays (Christman 1988), 1:4.3 based on 332 total skinks in 58 trap arrays (Mushinsky and McCoy 1991) and 1:2.7 based on 49 total skinks in 31,640 pitfall trap-days (Meshaka and Lane 2002). Christman (1992) suggested only 1 blue-tailed mole skink is encountered for every 20 sand skinks.

Peninsula mole skinks tend to be clumped in distribution with variable densities that may approach 25 adults per acre (10.12 per ha) (Mount 1963); however, it appears that blue-tailed mole skinks are much rarer (Christman 1992). Telford (2007) suggests that this disparity in relative abundance of the two species may be explained by seasonal variation in activity and movements and year-round surveys should be conducted over an adequate number of years to minimize the effect of variation in rainfall in order to obtain better estimates.

Unfortunately, determining population stability and viability is unattainable with current information. Because of the ongoing habitat loss and degradation on the LWR, it is likely that overall populations are declining (Moler 2007).

Critical habitat

Critical habitat is not designated for this species.

Threats

Present or Threatened Destruction, Modification or Curtailment of its Habitat or Range

It is likely that ongoing residential and agricultural development of xeric upland habitat in central Florida has destroyed or degraded extensive tracts of habitat containing the blue-tailed mole skink. Continued habitat loss, fragmentation, and changes in land use threaten the existence of the subspecies. Unlike sand skinks, their tracks cannot be easily detected in the sand, and most of the extant scrub, including protected sites, on the LWR has not been adequately surveyed for blue-tailed mole skinks. Populations on private sites are threatened with destruction or habitat modification due to improper or lack of management.

The LWR encompasses approximately 517,303 ac (209, 345 ha) (Weekley et al. 2008). Roughly 69,683 ac of this area is protected in refuges, parks, State forests, wildlife and environmental areas, and on private lands, and, therefore, protected from general destruction (Turner et al. 2006). However, Turner et al. (2006) indicated that blue-tailed mole skinks seem to be underrepresented in the reserve network of protected public lands, but the authors could not determine if their absence reflects actual exclusion or a lack of survey effort. If the former is true, then additional lands must be protected and managed in perpetuity to ensure the survival of this subspecies (Turner et al. 2006).

Another concern is whether relatively small, isolated properties are able to maintain viable populations. There is evidence of an edge effect on sand skink distribution on isolated scrub fragments bordered by non-scrub habitat (Gianopulos 2001, Mushinsky et al. 2001). Gianopulos (2001) found that on scrub fragments bordered by non-scrub habitat, sand skinks were found more frequently within the middle of the sites than along the edges bordered by non-scrub habitat, and this difference was detected as far as 50 m (164 ft) into the sites. This could be a concern for blue-tailed mole skinks, as well.

Between 2005 and 2060 Florida's population is projected to double from approximately 18 to 36 million people (Zwick and Carr 2006). Assuming a similar pattern of development at current gross urban densities for each county, this translates into the need to convert an additional 7 million ac of undeveloped land into urban land uses (Zwick and Carr 2006). Over most of the range of the sand and blue-tailed mole skinks in the central region of Florida from Marion County southward to northern Polk and Osceola Counties, human population growth and the conversion of previously undeveloped lands to urban use is expected to be explosive (Zwick and Carr 2006). It is predicted that Osceola County is among the counties that will experience the greatest transformation from rural to urban land over the next 50 years (Zwick and Carr 2006). This is expected to be the result of population spillover from the build-out in Orange County (Zwick and Carr 2006).

The protection and recovery of blue-tailed mole skinks will require that habitat loss be limited to disturbed areas, and that suitable unoccupied habitat be restored. Current efforts to expand the system of protected xeric upland habitats on the LWR, in concert with implementation of aggressive land management practices, represent the most likely opportunity for securing the future of this species.

Inadequacy of Existing Regulatory Mechanisms

In addition to protections associated with the Act and existing regulations on refuges and other protected lands where skinks occur, the blue-tailed mole skink is listed by the Florida Fish and Wildlife Conservation Commission as federally-designated threatened (Chapter 39-27, Florida Administrative Code). This legislation prohibits take, except under permit, but does not provide any direct habitat protection. Wildlife habitat is protected on Florida Fish and Wildlife Conservation Commission wildlife management areas and wildlife environmental areas according to Florida Administrative Code 68A-15.004. Therefore, the Act provides additional protection for these species and their habitat through section 7 (interagency cooperation), as well as through the prohibitions of section 9(a)(l) and the provisions of section 4(d) and recovery planning. Although section 7 and 9(a)(l) provide some regulatory protection, these provisions do not adequately protect against habitat loss. In addition, existing regulations are not specific enough to guard against loss of genetic integrity of the species. Research has shown that it is important to preserve certain areas of the historic range to maintain genetic diversity.

Other Natural or Manmade Factors Affecting its Continued Existence

Improper habitat management and invasion by nonnative and invasive species threaten the existence of blue-tailed mole skinks. Active management is necessary to maintain suitable habitat for skinks. Management of scrub habitat is problematic because much of the remaining habitat occurs in small fragmented areas surrounded by residential areas where prescribed burning may not be feasible. These residential areas are also often a source of nonnative plants that invade native habitat. Many of the fragments are overgrown and in need of restoration.

Habitat degradation on protected and private sites continues to be a threat because vegetation restoration and management programs are costly and depend upon availability of funding. Where prescribed fire is not feasible as a management technique because of smoke management and other concerns, mechanical treatment is sometimes used. However, heavy machinery disturbs the soil more than prescribed burning, and it removes often limited nutrients from the soil (Mushinsky et al. 2001). This changes the nutrient levels in the topsoil, affecting the vegetative composition of the site, whereas fire releases nutrients (Mushinsky et al. 2001). Also, if logs are removed from a site after mechanical treatment, prey abundance (termites) may be lower than it would be after a fire (Mushinsky et al. 2001).

Another threat to skinks is the loss of genetic diversity. Branch et al.'s (1999; 2003) work on sand skinks identified genetic distinctions among populations from the Mt. Dora Ridge, the northern LWR, the central LWR, and the southern LWR. Because each site where more than five individuals were sampled contained unique haplotypes, populations on isolated ridges

should be protected to avoid the loss of genetic diversity. This likely applies to blue-tailed mole skinks, as well.

Climate Change and Sea Level Rise

According to the Intergovernmental Panel on Climate Change Report (IPCC) (2007), warming of the earth's climate is "unequivocal," as is now evident from observations of increases in average global air and ocean temperatures, widespread melting of snow and ice, and rising sea level. The 2007 IPCC report describes changes in natural ecosystems with potential wide-spread effects on many organisms, including marine mammals and migratory birds. The potential for rapid climate change poses a significant challenge for fish and wildlife conservation. Species' abundance and distribution are dynamic, relative to a variety of factors, including climate. As climate changes, the abundance and distribution of fish and wildlife will also change. Highly specialized or endemic species are likely to be most susceptible to the stresses of changing climate. Based on these findings and other similar studies, the Department of the Interior requires agencies under its direction to consider potential climate change effects as part of their long-range planning activities (Service 2007).

Climate change at the global level drives changes in weather at the regional level, although weather is also strongly affected by season and local effects (*e.g.*, elevation, topography, latitude, proximity to the ocean, etcetera). Temperatures are predicted to rise from 2° C to 5° C for North America by the end of this century (IPCC 2007). Other processes to be affected by this projected warming include rainfall (amount, seasonal timing and distribution), storms (frequency and intensity), and sea level rise. However, the exact magnitude, direction, and distribution of these changes at the regional level are not well understood or easy to predict. Seasonal change and local geography make prediction of the effects of climate change at any location variable. Current models offer a wide range of predicted changes.

Climatic changes in south Florida could amplify current land management challenges involving habitat fragmentation, urbanization, invasive species, disease, parasites, and water management (Pearlstine 2008). Global warming will be a particular challenge for endangered, threatened, and other "at risk" species. It is difficult to estimate, with any degree of precision, which species will be affected by climate change or exactly how they will be affected. The Service will use Strategic Habitat Conservation planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (Service 2006).

For the blue-tailed mole skink, sea level rise is likely to increase man-made effects, as the human population moves from the coast to central parts of the State. This human migration will increase the demand for development and could lead to increased loss of upland xeric habitat. In addition, the increased human population would likely increase the threats associated with human interactions, such as fire suppression, habitat degradation, and nonnative species described above.

Ongoing Conservation Efforts

Over the last 20 years, a concerted effort by public and private institutions to protect the remaining undeveloped areas of the LWR has resulted in the acquisition of 21,498 ac (8,700 ha) of scrub and sandhill habitat (Turner et al. 2006). A variety of state and federal agencies and private organizations are responsible for management of these areas. The Service has also acquired portions of several tracts totaling 1,800 ac (728.4 ha) as a component of the LWR National Wildlife Refuge (Service 1993). Private organizations, such as The Nature Conservancy and ABS, have acquired and currently manage xeric uplands within the LWR. All of these efforts have greatly contributed to the protection of imperiled species including skinks on the LWR (Turner et al. 2006).

The Service has also certified six conservation banks totaling nearly 1,500 ac for sand and blue-tailed mole skinks, two in Highlands County and four in Polk County. Conservation banking provides an avenue for collaboration of private/public partnerships to maintain and preserve habitat, providing for the conservation of endangered species. These banks conserve and manage land in perpetuity through a Conservation Easement to offset impacts occurring elsewhere to the same resource values on non-bank lands. The certification of these banks should help reduce the piece-meal approach to skink conservation that can result from separate evaluation of individual projects by establishing larger reserves and improving connectivity of habitat.

Recovery of the skink may also require rehabilitation of suitable but unoccupied habitat or restoration of potentially suitable habitat. Translocation efforts may also be needed. Although blue-tailed mole skinks have not been translocated, we may be able to infer likelihood of success based upon success of similar species. Comparisons of persistence, recruitment, and survival were used to determine translocation success of skinks on two restored scrub sites for 6 years following relocation (Mushinsky et al. 2001; Penney 2001; Penney et al. 2001). One site established a self-sustaining population, while the other did not. It was determined that site location, habitat suitability, and initial propagule size were the factors affecting success; researchers concluded the chances of long-term survival may improve when habitat is restored and skinks are introduced to sites close to intact scrub, rather than to isolated sites (Mushinsky et al. 2001; Penney 2001). In another study, Osman (2010) found that survival of sand skinks was significantly greater on translocation sites with low soil moisture and no shade-providing object, and evidence of reproduction was observed more readily on sites with lower soil compaction and light intensities over the two-year study. He concluded that sand skinks can do well in multiple microhabitat conditions and microhabitat heterogeneity in and around these sites is important. Emerick (2015) monitored and analyzed long-term translocation success of sand skinks over a total of 7 years. He confirmed survival success of the offspring of founding individuals born on the site and determined those individuals were also successfully reproducing.

References Cited

Branch, L.C., and D.G. Hokit. 2000. A comparison of scrub herpetofauna on two central Florida sand ridges. Florida Scientist 63 (2): 108- 117.

Branch, L.C., A.M. Clark, P.E. Moler, and B.W. Bowen. 2003. Fragmented landscapes, habitat specificity, and conservation genetics of three lizards in Florida scrub. Conservation Genetics 4: 199-212.

Brandley, M.C., A. Schmitz, and T.W. Reeder. 2005. Partitioned Bayesian analyses, partition choice, and the phylogenetic relationships of Scincid lizards. Systematic Biology 54(3):373-390.

Campbell, H.W. and S.P. Christman. 1982. The herpetological components of Florida sandhill and sand pine scrub associations. Pp. 163-171 In: N.J. Scott, ed. Herpetological communities: A symposium of the Society for the Study of Amphibians and Reptiles and the Herpetologist's League, August, 1977. U.S. Fish and Wildlife Service, Wildlife Research Report No. 13.

Christman, S.P. 1978. Threatened: bluetailed mole skink, Eumeces egregius lividus (Mount). Pages 38-40 *in* R.W. McDiarmid, ed. Rare and endangered biota of Florida. Volume 3: amphibians and reptiles. University Press of Florida; Gainesville, Florida.

Christman, S.P. 1988. Endemism and Florida's interior sand pine scrub. Final project report no. GFC-84-010, Florida Game and Fresh Water Fish Commission; Tallahassee, Florida.

Christman, S.P. 1992. Threatened: bluetailed mole skink, Eumeces egregius lividus (Mount). Pages 117-122 *in* P.E. Moler, ed. Rare and endangered biota of Florida. University Press of Florida; Gainesville, Florida.

Christman, S.P. 2005. Densities of Neoseps reynoldsi on the Lake Wales Ridge. Final Report, Part 1. Cooperative Agreement No. 401813J035 between U.S. Dept. of Interior, Fish and Wildlife Service and Steven P. Christman, Ph.D.Emerick, A.R. 2015. Status of a translocated Florida sand skink population after six years: Establishing and evaluating criteria for success. M.S. Thesis. University of South Florida, Tampa, Florida.

Emerick, A.R. 2015. Status of a translocated Florida sand skink population after six years: Establishing and evaluating criteria for success. M.S. Thesis. University of South Florida, Tampa, Florida.

Gianopulos, K.D. 2001. Response of the threatened sand skink (Neoseps reynoldsi) and other herpetofaunal species to burning and clearcutting in the Florida sand pine scrub habitat. M.S. Thesis, University of South Florida, Tampa, Florida.

Griffin, J.A. 2007. Personal communication. Data Services Coordinator. Email to the U.S Fish and Wildlife Service dated June 12, 2007. Florida Natural Areas Inventory; Tallahassee, Florida.

Griffith, H., A. Ngo, and R.W. Murphy. 2000. A cladistic evaluation of the cosmopolitan genus Eumeces Wiegmann (Reptilia, Squaniata, Scincidae). Russian Journal of Herpetology 7(1): 1-16.

Intergovernmental Panel on Climate Change Fourth Assessment Report. 2007. Climate Change 2007: Synthesis Report. Summary for Policy Makers. Draft.

McCoy, E.D. 2011. Personal communication. Professor and Associate Chair in the Department of Biology, University of South Florida. Sand skink scrub-jay scrub management field trip to Lake Marion. May 16.

McCoy, E.D., N. Ihasz, E.J. Britt, and H.R Mushinsky. 2010. Is the Florida sand skink (*Plestiodon reynoldsi*) a dietary specialist? Herpetologica 66(4): 432-442.

Meshaka Jr., W.E., and J.N. Layne. 2002. Herpetofauna of a long unburned sandhill in south-central Florida. Florida Scientist 65(1): 35-50.

Moler, P. 2007. Peer review comments to U.S. Fish and Wildlife Service, Vero Beach, FL. June 4.

Mount, R.H. 1963. The natural history of the red-tailed skink, Eumeces egregius (Baird). American Midland Naturalist 70: 356-385.

Mount, R.H. 1965. Variation and systemics of the scincoid lizard, Eumeces egregious(Baird) Bulletin of the Florida State Museum. University of Florida; Gainesville, Florida. Vol. 9(5): 183-213.

Mushinsky, H. 2007. Peer review comments to U.S. Fish and Wildlife Service, Vero Beach, FL. June 1.

Mushinsky, H.R. 2011. Personal communication. Professor and Graduate Director in the Department of Biology, University of South Florida. Sand skink scrub-jay scrub management field trip to Lake Marion. May 16.

Mushinsky, H.R. and E.D. McCoy. 1991. Vertebrate species compositions of selected scrub islands on the Lake Wales Ridge of central Florida. Final report no. GFC-87-149. Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program; Tallahassee, Florida.

Mushinsky, H.R. and E.D. McCoy. 1995. Vertebrate species compositions of selected scrub islands on the Lake Wales Ridge of Central Florida. Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program; Tallahassee, Florida.

Mushinsky, H.R., E.D. McCoy, K. Gianopulos, K. Penney, and C. Meyer. 2001. Biology of the threatened sand skink on restored scrub habitat and its responses to land management practices. Final report to the Disney Wildlife Conservation Fund. University of South Florida, Tampa, Florida.

Myers, R.L. 1990. Scrub and high pine. Pages 150-193 *in* R.L. Myers and J.J. Ewel, eds. Ecosystems of Florida. University Presses of Florida; Gainesville, Florida.

Osman, N.P. 2010. Experimental translocation of the Florida sand skink (Plestiodon[=Neoseps] reynoldsi): Success of a restricted species across diverse microhabitats. M.S. Thesis. University of South Florida, Tampa, Florida.

Pearlstine, L.G. 2008. Ecological consequences of climate change for the Florida Everglades: An initial summary. Technical memorandum, South Florida Natural Resources Center, Everglades National Park; Homestead, Florida.

Penney, K.M. 2001. Factors affecting translocation success and estimates of dispersal and movement patterns of the sand skink *Neoseps reynoldsi* on restored scrub. M.S. Thesis. University of South Florida, Tampa, Florida.

Penney, K.M., H.R. Mushinsky, and E.D. McCoy. 2001. Translocation success of the threatened sand skink. Proceedings from the Florida Scrub Symposium, Orlando, Florida.

Smith, C.R. 1982. Food resource partitioning of fossorial Florida reptiles. Pages 173-178 *in* N.J. Scott, ed. Herpetological communities: A symposium of the Society for the Study of Amphibians and Reptiles and the Herpetologist's League, August, 1977. U.S. Fish and Wildlife Service, Wildlife Research Report No. 13.

Smith, H.M. 2005. Plestiodon: A replacement name for most members of the genus Eumeces in North America. Journal of Kansas Herpetology 14: 15- 16.

Turner W.R., D.S. Wilcove, and H.M. Swain. 2006. State of the Scrub: Conservation progress, management responsibilities, and land acquisition priorities for imperiled species of Florida's Lake Wales Ridge [Internet]. Archbold Biological Station; Lake Placid, Florida [cited October 29, 2008]. Available from: www.archbold-station.org/ABS/publicationsPDF/Turner_etal-2006-StateotScrub.pdf

U.S. Fish and Wildlife Service. 1993. Recovery plan for the sand skink and the blue-tailed mole skink. Atlanta, Georgia.

U.S. Fish and Wildlife Service. 2006. Strategic Habitat Conservation. Final Report of the National Ecological Assessment Team to the U.S. Fish and Wildlife Service and U.S. Geologic Survey.

U.S. Fish and Wildlife Service. 2007. Bluetail mole skink (*Eumeces egregius lividus*) and sand skink (*Neoseps reynoldsi*). 5-year review: summary and evaluation. South Florida Ecological Services Office, Vero Beach, Florida.

U.S. Fish and Wildlife Service. 2007. Draft communications plan on the U.S. Fish and Wildlife Service's Role in Climate Change.

Webb, S.D. 1990. Historical biogeography. Pages 70-100 *in* Meyers, R.L. and J.J. Ewel, eds. Ecosystems of Florida. University of Central Florida Press, Orlando, Florida.

Weekley, C.W., E.S. Menges, and R.L. Pickert. 2008. An ecological map of Florida's Lake Wales Ridge: A new boundary delineation and an assessment of post-Columbian habitat loss. Florida Scientist 71(1): 45-64.

Zwick, P.D., and M.H. Carr. 2006. Florida 2060. A population distribution scenario for the State of Florida. A research project prepared for 1000 Friends of Florida. Prepared by the Geoplan Center at the University of Florida, Gainesville, Florida.

STATUS OF THE SPECIES – sand skink (*Neoseps reynoldsi*)

Legal Status

The sand skink was listed as threatened under the Endangered Species Act in 1987 (52 FR 42658), and is listed as federally-designated threatened by the state. Critical habitat has not been designated for the sand skink.

Species Description

Appearance/Morphology

The sand skink is a small, fossorial lizard that reaches a maximum length of about 5 inches (in) (12.7 centimeters [cm]). The tail makes up about half the total body length. The body is shiny and usually gray to grayish-white in color, although the body color may occasionally be light tan. Hatchlings have a wide black band located along each side from the tip of the tail to the snout. This band is reduced in adults and may only occur from the eye to snout on some individuals (Telford 1959). Sand skinks contain a variety of morphological adaptations for a fossorial lifestyle. The legs are vestigial and practically nonfunctional, the eyes are greatly reduced, the external ear openings are reduced or absent (Greer 2002), the snout is wedge-shaped, and the lower jaw is countersunk.

Taxonomy

The taxonomic classification of the sand skink has been reevaluated since it was listed as *Neoseps reynoldsi* in 1987 (52 FR 42658), and the commonly accepted scientific name for the sand skink is now *Plestiodon reynoldsi* (Brandley et al. 2005; Smith 2005). A detailed description of the recent taxonomic review can be found in Service (2007). We continue to use the scientific name as published in the final listing rule (52 FR 42658).

The sand skink is believed to have evolved on the central Lake Wales Ridge (LWR) and radiated from there (Branch et al. 2003). Analysis of mitochondrial DNA indicates populations of the sand skink are highly structured with most of the genetic variation partitioned among four lineages: three subpopulations on the LWR characterized by high haplotype diversity and a single, unique haplotype detected only on the Mount Dora Ridge (MDR) (Branch et al. 2003). Under the conventional molecular clock, the 4.5 percent divergence in sand skinks from these two ridges would represent about a 2-million year separation. The absence of haplotype diversity on the MDR would suggest this population was founded by only a few individuals or severely reduced by genetic drift of a small population (Branch et al. 2003).

Life History

The sand skink is usually found below the soil surface burrowing through loose sand in search of food, shelter, and mates. Sand skinks feed on a variety of hard and soft-bodied arthropods that occur below the ground surface. The diet consists largely of beetle larvae and termites (*Prorhinotermes* spp.). Spiders, larval ant lions, lepidopteran larvae, roaches, and adult beetles are also eaten (Myers and Telford 1965; Smith 1982).

Sand skinks are most active during the morning and evening in spring and at mid-day in winter, the times when body temperatures can easily be maintained at a preferred level between 82 and 88 degrees Fahrenheit in open sand (Andrews 1994). During the hottest parts of the day, sand skinks move under shrubs to maintain their preferred body temperatures in order to remain active near the surface. With respect to season, Telford (1959) reported skinks most active from early March through early May, whereas Sutton (1996) found skinks most active from mid-February to late April. Based on monthly sampling of pitfall traps, Ashton and Telford (2006) found captures peaked in March at Archbold Biological Station (ABS), but in May at the Ocala National Forest (ONF). All of these authors suggested the spring activity peak was associated with mating. At ABS, Ashton and Telford (2006) noted a secondary peak in August that corresponded with the emergence of hatchling sand skinks.

Telford (1959) assumed sand skinks become sexually mature during the first year following hatching, at a size of 1.78 in (4.52 cm) snout-vent length. He suspected most of the breeders in his study were in their second year and measured between 1.78 and 2.24 in (4.52 and 5.69 cm) snout-vent length. However, Ashton (2005) determined sand skinks become sexually mature between 19 and 23 months of age and have a single mating period each year from February through May. Sand skinks first reproduce at 2 years of age and females produce a single clutch in a season, although some individuals reproduce biennially or less frequently (Ashton 2005). Sand skinks lay between two and four eggs, typically under logs or debris, in May or early June (Ashton 2005; Mushinsky in Service 2007), approximately 55 days after mating (Telford 1959). The eggs hatch from June through July. Sand skinks can live at least to 10 years of age (Meneken et al. 2005). Gianopulos (2001) found the sex ratio of sand skinks did not differ significantly from 1:1, which is consistent with the findings of Sutton (1996).

Most sand skinks move less than 130 feet (ft) (39.6 meters [m]) between captures, but some have been found to move over 460 ft (140.2 m) in 2 weeks (Mushinsky et al. 2001). Limited dispersal ability has been suggested to explain the relatively high degree of genetic structure within and among sand skink populations (Branch et al. 2003; Reid et al. 2004). Analysis of blood and fecal samples obtained from 20 sand skinks in ONF demonstrated that no blood parasites were present and only normal protistan and helminth symbiotes were observed, with no evidence of effect on survival of individuals or the population (Telford 1998). Similarly, a species of nematode (*Parapharyngodon ocalaensis*) was collected from the intestinal tracts of 22 sand skinks (Bursey

and Telford 2002). It is not known to be a threat to the species. In a subsequent paper, Telford and Bursey (2003) found 3 species of endoparasites in 45 sand skinks from ONF.

Habitat

The sand skink is widespread in native xeric uplands with excessively well-drained soils (Service 2012), principally on the ridges listed above at elevations greater than 80 ft (24.4 m) above mean sea level. Commonly occupied native habitats include Florida scrub variously described as sand pine scrub, xeric oak scrub, rosemary scrub and scrubby flatwoods, as well as high pine communities that include sandhill, longleaf pine/turkey oak, turkey oak barrens and xeric hammock (see habitat descriptions in Myers 1990 and Service 1999). Coverboard transects extended from scrub or high pine (sandhill) through scrubby flatwoods to pine flatwoods revealed that sand skinks left more tracks in scrub than the other three habitats and did not penetrate further than 130 ft (39.6 m) into scrubby flatwoods or 65 ft (19.8 m) into pine flatwoods (Sutton et al. 1999). Sand skinks also use disturbed habitats such as citrus groves, pine plantations, and old fields, especially when adjacent to existing scrub (Pike et al. 2007; 2008).

Various authors have attempted to characterize optimal sand skink habitat (Telford 1959; 1962; Christman 1978; 1992; Campbell and Christman 1982). Literature descriptions of scrub characteristics have not proven very useful to predict sand skink abundance, but expert opinion was more successful (McCoy et al. 1999). McCoy et al. (1999) used trap-out enclosures to measure sand skink densities at seven scrub sites and attempted to rank each area individually based on eight visual characteristics to identify good habitat: (1) root-free, (2) grass-free, (3) patchy bare areas, (4) bare areas with lichens, (5) bare areas with litter, (6) scattered scrubs, (7) open canopy, and (8) sunny exposure. None of the individual literature descriptions of optimal habitat (or any combination thereof) accurately predicted the rank order of actual sand skink abundance at these sites, which ranged in density from 52 to 270 individuals per acre (ac) (Sutton 1996). However, knowledgeable researchers, especially as a group, appear to be able to visually sort out the environmental variables important to sand skinks, but had difficulty translating their perceptions into a set of rules that others could use to identify optimal sand skink habitat (McCoy et al. 1999).

Multiple studies (Collazos 1998; Hill 1999; Mushinsky and McCoy 1999; Gianopulos 2001; Mushinsky et al. 2001) have determined the relationship between sand skink density and a suite of environmental variables. These studies have found sand skink relative density was positively correlated with low canopy cover, percent bare ground, amount of loose sand and large sand particle size, but negatively correlated with understory vegetation height, litter cover, small sand particle size, soil moisture, soil temperature, and soil composition. In an unburned sandhill site at ABS, Meshaka and Lane (2002) captured significantly more sand skinks in pitfall traps set in openings without shrubs than at sites with moderate to heavy shrub density. Telford (1959) suggested scattered debris and litter provided moisture that was important to support an abundant

food supply and nesting sites for sand skinks. Cooper (1953) noted the species was most commonly collected under rotting logs, and Christman (1992) suggested they nest in these locations. Christman (2005) found skinks continue to occupy scrub with a closed canopy and thick humus layer, although at lower densities. Recent surveys have also shown sand skinks may occupy both actively managed lands, such as citrus groves and pine plantations, and old-field communities (Pike et al. 2007), particularly if these sites are adjacent to patches of native habitat that can serve as a source population for recolonization.

Experimental studies have been conducted to investigate the effects of management techniques, such as mechanical treatment and prescribed burning, on sand skink abundance. Several studies found a decrease in relative abundance of skinks immediately following both mechanical and burning treatments (Mushinsky and McCoy 1999; Gianopulos 2001; Gianopulos et al. 2001; Mushinsky et al. 2001; Sutton et al. 1999). Gianopulos (2001) and Gianopulos et al. (2001) reported a significant increase in skink captures in mechanical treatment plots over the 5-year period following the treatment. However, a clear increase in skink numbers following a burn was not observed (Navratil 1999; Gianopulos et al. 2001; Mushinsky et al. 2001). Christman (2005) conducted trap surveys at sites with a known burn history on the LWR in Polk and Highlands Counties and did not observe a strong correlation between skink density and number of years since the site was burned. Mushinsky et al. (2001) noted significantly larger skinks were captured in burned plots, indicating more insect prey may have been available from decaying logs or older skinks inhabited these sites.

Habitat size may be a factor in maintaining viable skink populations. Pike et al. (2006) monitored sand skinks and quantified vegetation change in six areas from 5 to 69 ac (2 to 27.9 hectare [ha]) that were restored to a more natural state using fire and canopy thinning, and set aside for conservation in residential areas. Pike et al. (2006) documented a severe decline in occupancy and relative density of sand skinks, and hypothesized indirect impacts from surrounding development, such as changes in soil hydrology, may have caused the decline. Hydrologic changes in the soil may have occurred as a result of construction of retention ponds or run-off from neighborhoods that caused a rise in the groundwater level (Pike et al. 2006). The population decline of skinks noted may also have been caused by prescribed burning used to restore these sites (Mushinsky in Service 2007).

Distribution

The sand skink occurs on the sandy ridges of interior central Florida from Marion County south to Highlands County. The extant range of the sand skink includes Highlands, Lake, Marion, Orange, Osceola, Polk, and Putnam Counties (Christman 1988; Telford 1998). Principal populations occur on the LWR and Winter Haven Ridges (WHR) in Highlands, Lake, and Polk Counties (Christman 1992; Mushinsky and McCoy 1991). The sand skink is uncommon on the MDR, including sites within the ONF (Christman 1970; 1992). Despite intensive sampling

efforts in scrub habitat with similar herpetofauna, the sand skink has not been recorded at Avon Park Air Force Range on the Bombing Range Ridge (Branch and Hokit 2000). Although we do not have estimates of acreage for all of the ridges, we do know the largest of these, the LWR, encompasses approximately 517,303 ac (209,300 ha) (Weekley et al. 2008). According to the Florida Natural Areas Inventory (FNAI) database, updated as of September 2006, there were 132 locality records for the sand skink, including 115 localities on the LWR, 7 on the MDR, and 4 on the WHR (Griffin 2007). FNAI also reports four localities for this species west of the MDR in Lake County and two localities between the LWR and the Lake Hendry Ridge.

Population Dynamics

Abundance (historical and current), population estimates, stability/viability

The current status of the sand skink throughout its geographic range is unclear because recent comprehensive, rangewide surveys have not been conducted. At the time of Federal listing in 1987, FNAI had recorded 31 known sites for the sand skink. By September 2006, 132 localities were known by FNAI (Griffin 2007). This increase is largely the result of more intensive sampling of scrub habitats in recent years and does not imply this species is more widespread than originally supposed. Nonetheless, except for a few locations where intensive research has been conducted, limited information about the presence or abundance of sand skinks exists. Reptile surveys in a variety of scrub habitats in the ONF did not detect sand skinks (Greenberg et al. 1994). Telford (1998) cited the ephemeral nature of early successional scrub habitats due to dynamic changes as an important confounding factor in the evaluation of the sand skink's present status in the ONF. At least two persistent populations are known from the ONF (Telford 1998), where sand skinks have been collected for genetic analysis (Branch et al. 2003) and population studies (Ashton and Telford 2006). Additional studies have provided presence/absence information that has been used to determine the extant range of the species (Mushinsky and McCoy 1991; Stout and Corey 1995). However, few long-term monitoring efforts have been undertaken to evaluate the population size, or population trends, of sand skinks at these sites, on remaining scrub habitat on private lands, or rangewide.

The population dynamics of sand skinks within their extant ranges are not well known because the skinks' small size and secretive habits make their study difficult. Sand skinks are known to exhibit life-history traits that are also found in a number of other fossorial lizard species, such as: delayed maturity, a small clutch size of relatively large eggs, low frequency of reproduction, and a long lifespan (Ashton 2005). Such character traits may have resulted from, and be indicative of, high intraspecific competition or predation.

Threats

Present or Threatened Destruction, Modification or Curtailment of its Habitat or Range

The modification and destruction of xeric upland communities in central Florida were a primary consideration in listing the sand skink as threatened. By some estimates, as much as 90 percent of the scrub ecosystem has already been lost to residential development and conversion to agriculture, primarily citrus groves (Kautz 1993; Turner et al. 2006a). Xeric uplands remaining on private lands are especially vulnerable to destruction because of increasing residential and agricultural pressures.

Approximately 85 percent of xeric upland communities historically used by sand skinks on the LWR are estimated to have been lost due to development (Turner et al. 2006b). It is likely continued residential and agricultural development of xeric upland habitat in central Florida has destroyed or degraded habitat containing sand skinks. Protection of the sand skink from further habitat loss and degradation provides the most important means of ensuring its continued existence. Of the 73 locations examined by Turner et al. (2006a) on which sand skinks were reported, 39 are protected and, as of 2004, 27 were managed. Current efforts to expand the system of protected xeric upland communities on the LWR, coupled with implementation of effective land management practices, represent the most likely opportunity for assuring the sand skink's survival.

The 5-year review found no justification for change in the threatened status (Service 2007).

Ongoing Conservation Efforts

Over the last 20 years, a concerted effort by public and private institutions to protect the remaining undeveloped areas of the LWR has resulted in the acquisition of 21,498 ac (8,700 ha) of scrub and sandhill habitat (Turner et al. 2006). A variety of state and federal agencies and private organizations are responsible for management of these areas. The Service has also acquired portions of several tracts totaling 1,800 ac (728.4 ha) as a component of the LWR National Wildlife Refuge (Service 1993). Private organizations, such as The Nature Conservancy and ABS, have acquired and currently manage xeric uplands within the LWR. All of these efforts have greatly contributed to the protection of imperiled species including skinks on the LWR (Turner et al. 2006).

The Service has also certified six conservation banks totaling nearly 1,500 ac for sand and blue-tailed mole skinks, two in Highlands County and four in Polk County. Conservation banking provides an avenue for collaboration of private/public partnerships to maintain and preserve habitat, providing for the conservation of endangered species. These banks conserve and manage land in perpetuity through a Conservation Easement to offset impacts occurring elsewhere to the same resource values on non-bank lands. The certification of these banks should help reduce the piece-meal approach to skink conservation that can result from separate evaluation of individual projects by establishing larger reserves and improving connectivity of habitat.

Recovery of the skink may also require rehabilitation of suitable but unoccupied habitat or restoration of potentially suitable habitat. Translocation efforts may also be needed. Comparisons of persistence, recruitment, and survival were used to determine translocation success of sand skinks on two restored scrub sites for 6 years following relocation (Mushinsky et al. 2001; Penney 2001; Penney et al. 2001). One site established a self-sustaining population, while the other did not. It was determined that site location, habitat suitability, and initial propagule size were the factors affecting success; researchers concluded the chances of long-term survival may improve when habitat is restored and skinks are introduced to sites close to intact scrub, rather than to isolated sites (Mushinsky et al. 2001; Penney 2001). In another study, Osman (2010) found that survival of sand skinks was significantly greater on translocation sites with low soil moisture and no shade-providing object, and evidence of reproduction was observed more readily on sites with lower soil compaction and light intensities over the two-year study. He concluded that sand skinks can do well in multiple microhabitat conditions and microhabitat heterogeneity in and around these sites is important. Emerick (2015) monitored and analyzed long-term translocation success of sand skinks over a total of 7 years. He confirmed survival success of the offspring of founding individuals born on the site and determined those individuals were also successfully reproducing.

References Cited

Andrews R.M. 1994. Activity and thermal biology of the sand-swimming skink Neoseps reynoldsi: Diel and seasonal patterns. Copeia 1: 91-99.

Ashton, K.G. 2005. Life history of a fossorial lizard, Neoseps reynoldsi. Journal of Herpetology 39(3): 389-395.

Ashton, K.G. and S.R. Telford, Jr. 2006. Monthly and daily activity of a fossorial lizard, Neoseps reynoldsi. Southeastern Naturalist 5(1): 175-183.

Branch, L.C., and D.G. Hokit. 2000. A comparison of scrub herpetofauna on two central Florida sand ridges. Florida Scientist 63(2):108-117.

Branch, L.C., A.M. Clark, P.E. Moler, and B.W. Bowen. 2003. Fragmented landscapes, habitat specificity, and conservation genetics of three lizards in Florida scrub. Conservation Genetics 4: 199-212.

Brandley, M.C., A. Schmitz, and T.W. Reeder. 2005. Partitioned Bayesian analysis, partition choice and phylogenetic relationships of scincid lizards. Systemic Biology 54(3):373-390.

Bursey, C.R., and S.R. Telford, Jr. 2002. *Parapharyngodon ocalaensis* n. sp. (Nematoda: Pharyngodonidae) from the sand skink, *Neoseps reynoldsi* (Scincidae), of Florida. The Journal of Parasitology 88(5):929-931.

Campbell, H.W. and S.P. Christman. 1982. The herpetological components of Florida sandhill and sand pine scrub associations. Pp. 163-171 In: N.J. Scott, ed. Herpetological communities: A symposium of the Society for the Study of Amphibians and Reptiles and the Herpetologist's League, August, 1977. U.S. Fish and Wildlife Service, Wildlife Research Report No. 13.

Christman, S.P. 1970. The possible evolutionary history of two Florida skinks. Quarterly Journal of the Florida Academy of Science 33(4): 291-293.

Christman, S.P. 1978. Threatened: sand skink, Neoseps reynoldsi (Stejneger). Pages 40-41 *in* R.W. McDiarmid, ed. Rare and endangered biota of Florida. Volume 3: amphibians and reptiles. University Press of Florida; Gainesville, Florida.

Christman, S.P. 1988. Endemism and Florida's interior sand pine scrub. Final project report no. GFC-84-010, Florida Game and Fresh Water Fish Commission; Tallahassee, Florida.

Christman, S.P. 1992. Threatened: sand skink, Neoseps reynoldsi (Stejneger). Pages 135-140 *in* P.E. Moler, ed. Rare and endangered biota of Florida. University Press of Florida; Gainesville, Florida.

Christman, S.P. 2005. Densities of Neoseps reynoldsi on the Lake Wales Ridge. Final Report, Part 1. Cooperative Agreement No. 401813J035 between U.S. Dept. of Interior, Fish and Wildlife Service and Steven P. Christman, Ph.D.

Collazos, A. 1998. Microhabitat selection in Neoseps reynoldsi: The Florida sand swimming skink. Master's Thesis. University of South Florida, Tampa.

Cooper, B.W. 1953. Notes on the life history of the lizard, *Neoseps reynoldsi* Stejneger. Quarterly Journal of the Florida Academy of Sciences. 16(4):235-238.

Emerick, A.R. 2015. Status of a translocated Florida sand skink population after six years: Establishing and evaluating criteria for success. M.S. Thesis. University of South Florida, Tampa, Florida.

Gianopulos, K.D. 2001. Response of the threatened sand skink (*Neoseps reynoldsi*) and other herpetofaunal species to burning and clearcutting in the Florida sand pine scrub habitat. M.S. Thesis, University of South Florida; Tampa, Florida.

Gianopulos, K.D., H.R. Mushinsky, and E.D. McCoy. 2001. Response of the threatened sand skink (*Neoseps reynoldsi*) to controlled burning and clear-cutting in Florida sand pine scrub habitat. Proceedings from the Florida Scrub Symposium; Orlando, Florida.

Greenberg, C.H., D.G. Neary, and L.D. Harris. 1994. Effect of high-intensity wildfire and silvicultural treatments on reptile communities in sand-pine scrub. Conservation Biology 8:1047-1057.

Greer, A.E. 2002. The loss of the external ear opening in scincid lizards. Journal of Herpetology 36(4):544-555.

Griffin, J.A. 2007. Personal communication. Data Services Coordinator. Email to the U.S Fish and Wildlife Service dated June 12, 2007. Florida Natural Areas Inventory; Tallahassee, Florida.

Hill, K. 1999. Responses of released populations of the sand skink, Neoseps reynoldsi, to scrub habitat translocation in Central Florida. Master's Thesis. University of South Florida, Tampa.

Kautz, R.S. 1993. Trends in Florida wildlife habitat 1936-1987. Florida Scientist 56(1): 7-24.

McCoy, E.D., P.E. Sutton, and H.R. Mushinsky. 1999. The role of guesswork in conserving the threatened sand skink. Conservation Biology 13(1):190-194.

Meneken, B.M., A.C.S. Knipps, J.N. Layne, and K.G. Ashton. 2005. Neoseps reynoldsi. Longevity. Herpetological Review 36: 180-181.

Meshaka Jr., W.E., and J.N. Layne. 2002. Herpetofauna of a long unburned sandhill in south-central Florida. Florida Scientist 65(1): 35-50.

Mushinsky, H.R. and E.D. McCoy. 1991. Vertebrate species compositions of selected scrub islands on the Lake Wales Ridge of central Florida. Final report no. GFC-87-149. Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program; Tallahassee, Florida.

Mushinky, H.R. and E.D. McCoy. 1999. Studies of the sand skink (Neoseps reynoldsi) in Central Florida. Final Report, prepared for: Walt Disney Imagineering, Kissimmee, Florida.

Mushinsky, H.R., E.D. McCoy, K. Gianopulos, K. Penney, and C. Meyer. 2001. Biology of the threatened sand skink of restored scrub habitat and their responses to land management practices. Final report to the Disney Wildlife Conservation Fund.

Myers, R.L. 1990. Scrub and high pine. Pages 150-193 *in* R.L. Myers and J.J. Ewel, eds. Ecosystems of Florida. University Presses of Florida; Gainesville, Florida.

Myers, C.W. and S.R. Telford, Jr. 1965. Food of Neoseps, the Florida sand skink. Quarterly Journal of the Florida Academy of Science. 28: 190-194.

Navratil, G. 1999. A study of selected land management practices on the sand pine scrub habitat of Florida: A measure of the effects of land management on the sand skink, *Neoseps reynoldsi*. M.S. Thesis, University of South Florida, Tampa, Florida.

Osman, N.P. 2010. Experimental translocation of the Florida sand skink (Plestiodon[=Neoseps] reynoldsi): Success of a restricted species across diverse microhabitats. M.S. Thesis. University of South Florida, Tampa, Florida.

Penney, K.M. 2001. Factors affecting translocation success and estimates of dispersal and movement patterns of the sand skink *Neoseps reynoldsi* on restored scrub. M.S. Thesis. University of South Florida, Tampa, Florida.

Penney, K.M., H.R. Mushinsky, and E.D. McCoy. 2001. Translocation success of the threatened sand skink [Internet]. Pages 26-28 *in* D. Zattau, editor. Proceedings of the Florida Scrub Symposium 2001; Orlando Florida [cited October 29, 2008]. Available from: http://www.fws.gov/northflorida/Scrub-Jays/Docs/Proceedings-07-2001.pdf

Pike, D.A., R.S. Mejeur, W.D. Lites, and J.H. Exum. 2006. Do neighborhood conservation areas work? A drastic reduction in lizard occupancy coinciding with improved habitat quality and surrounding development. Abstract in Joint Meeting of the 22nd Annual Meeting of the American Elasmobranch Society, 86th Annual Meeting of the American

Society of Ichthyologists and Herpetologists, 64th Annual Meeting of the Herpetologists' League, and the 49th Annual Meeting of the Society for the Study of Amphibians and Reptiles; 12–17 July 2006; New Orleans, Louisiana.

Pike, D.A., K.S. Peterman, and J.H. Exum. 2007. Use of altered habitats by the endemic *Plestiodon reynoldsi* Stejneger (sand skink). Southeastern Naturalist 6:715–726.

Pike, D.A, K.S. Peterman, and J.H. Exum. 2008. Habitat structure influences the presence of sand skinks (*Plestiodon reynoldsi*) in altered habitats. Wildlife Research 35:120–127.

Reid, D.T., K.G. Ashton, and K.R. Zamudio. 2004. Characterization of microsatellite markers in the threatened sand skink (Neoseps reynoldsi). Molecular Ecology Notes 4: 691-693.

Smith, C.R. 1982. Food resource partitioning of fossorial Florida reptiles. Pages 173-178 *in* N.J. Scott, ed. Herpetological communities: A symposium of the Society for the Study of Amphibians and Reptiles and the Herpetologist's League, August, 1977. U.S. Fish and Wildlife Service, Wildlife Research Report No. 13.

Smith, H.M. 2005. Plestiodon: A replacement name for most members of the genus Eumeces in North America. Journal of Kansas Herpetology 14: 15-16.

Stout, I.J. and D.T. Corey. 1995. Effects of patch-corridor configurations on nongame birds, mammals, and herptiles in longleaf pine-turkey oak sandhill communities. Nongame Project Report No. RFP-86-003, Florida Game and Fresh Water Fish Commission; Tallahassee, Florida.

Sutton, P.E. 1996. A mark and recapture study of the Florida Sand skink Neoseps reynoldsi and a comparison of sand skink sampling methods. Master's thesis, University of South Florida; Tampa, Florida.

Sutton, P.E., H.R. Mushinsky, and E.D. McCoy. 1999. Comparing the use of pitfall drift fences and cover boards for sampling the threatened sand skink (Neoseps reynoldsi). Herpetological Review 30(3): 149-151.

Telford, S.R., Jr. 1959. A study of the sand skink, Neoseps reynoldsi. Copeia 1959 (2):100-119.

Telford, S.R. 1962. New locality records for the sand skink, Neoseps reynoldsi Stejneger. Copeia 1959: 110-119.

Telford, S.R., Jr. 1998. Monitoring of the sand skink (*Neoseps reynoldsi*) in Ocala National Forest. Final report submitted to U.S. Forest Service, Ocala National Forest, Silver Springs, Florida.

Telford, S.R., Jr., and C.R. Bursey. 2003. Comparative parasitology of squamate reptiles endemic to scrub and sandhills communities of north-central Florida, U.S.A. Comparative Parasitology 70:172–181.

Turner W.R., D.S. Wilcove, and H.M. Swain. 2006a. State of the Scrub: Conservation progress, management responsibilities, and land acquisition priorities for imperiled species of Florida's Lake Wales Ridge [Internet]. Archbold Biological Station; Lake Placid, Florida [cited October 29, 2008]. Available from: www.archbold-station.org/ABS/publicationsPDF/Turner_etal-2006-StateotScrub.pdf

Turner, W. R., D. S. Wilcove, and H. M. Swain. 2006b. Assessing the effectiveness of reserve acquisition programs in protecting rare and threatened species. Conservation Biology 20(6):1657-1669.

U.S. Fish and Wildlife Service. 1993. Recovery plan for the sand skink and the blue-tailed mole skink. Atlanta, Georgia.

U.S. Fish and Wildlife Service. 1999. South Florida multi-species recovery plan. Atlanta, Georgia.

U.S. Fish and Wildlife Service. 2007. Blue-tailed mole skink (*Eumeces egregius lividus*) and sand skink (*Neoseps reynoldsi*) [Internet]. 5-year review: summary and evaluation. South Florida Ecological Services Office, Vero Beach, Florida [cited October 29, 2008]. Available from: http://ecos.fws.gov/docs/five_year_review /doc1071.pdf

U.S. Fish and Wildlife Service. 2012. Draft Species Conservation Guidelines, South Florida – Sand Skink and Blue-tailed Mole Skink [Internet]. U.S. Fish and Wildlife, South Florida Ecological Services Office; Vero Beach, Florida [cited October 29, 2008]. Available from: http://www.fws.gov/verobeach/ReptilesPDFs/20120206_Skink%_Final.pdf