June 30, 2017

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE COMMISSION

In the Matter of	)	
	)	
FLORIDA POWER & LIGHT COMPANY	)	Docket Nos. M-52-040 & 52-041
	)	
(Turkey Point Units 6 and 7)	)	

NRC STAFF NOTICE TO THE COMMISSION REGARDING CONSULTATION WITH THE FISH AND WILDLIFE SERVICE UNDER SECTION 7 OF THE ENDANGERED SPECIES ACT FOR TURKEY POINT UNITS 6 & 7

Pursuant to the U.S. Nuclear Regulatory Commission Staff Update to the Status Report dated May 30, 2017,[1] the Staff hereby notifies the Commission that the U.S. Fish and Wildlife Service (FWS) has completed its Biological Opinion under Section 7 of the Endangered Species Act (ESA) regarding the Florida Power & Light Company combined license application for Turkey Point Units 6 and 7. As the Commission directed in CLI-17-1, the Staff will provide the Commission with its analysis of this Biological Opinion, including "any material developments resulting from the consultations, including measures recommended by FWS and/or NMFS for the protection of listed species and any conditions that the Staff recommends be included in the combined licenses[,]" by July 7, 2017.[2]

The Staff noted in SECY-16-0136, submitted on December 2, 2016,[3] that consultation with both the National Marine Fisheries Service (NMFS) and the FWS was in progress.[4] The

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[1] The Staff submitted the May 30 Status Update in accordance with the Staff April 20, 2017, Response (Agencywide Documents Access and Management System (ADAMS) Accession No. 17110A588) and the Commission's Memorandum and Order (CLI-17-01, dated January 4, 2017 (ADAMS Accession No. ML17004A279)).
[2] CLI-17-1 at 2-3.
[3] "Staff Statement in Support of the Uncontested Hearing for Issuance of Combined Licenses for Turkey Point Units 6 and 7 (Docket Nos. 52-040 and 52-041)," SECY-16-0136 (Dec. 2, 2016) (ML16237A433).
[4] *Id.* at 5-6.

Staff previously notified the Commission that consultation with NMFS had concluded.[5] The April 26, 2017 letter from NMFS to the NRC concluding consultation is attached to this notification.[6] The Staff does not recommend any changes to the draft license as a result of this consultation.

On June 23, 2017, FWS issued its Biological Opinion. Issuance of the Biological Opinion completes consultation with the FWS under Section 7 of the ESA and, as such, the Staff expects no further communication from the FWS regarding Section 7 consultation for Turkey Point Units 6 & 7. The Biological Opinion is attached to this notification.[7] The Staff's analysis of this Biological Opinion and recommendations for any necessary changes to the draft license will be submitted by July 7, 2017.

Respectfully submitted,
/Signed (electronically) by/
Megan A. Wright
Counsel for the NRC Staff
U.S. Nuclear Regulatory Commission
Mail Stop O14-A44
Washington, DC 20555-0001
(972) 294-5792
(301) 415-3200 (FAX)
Megan.Wright@nrc.gov

Dated at Frisco, Texas
this 30th day of June, 2017

[5] Staff May 26, 2017 Response (ADAMS Accession No. ML17146B325).
[6] ADAMS Accession No. ML17143A153 (Attachment A).
[7] ADAMS Accession No. ML17177A673 (Attachment B).

June 30, 2017

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE COMMISSION

In the Matter of	)	
	)	
FLORIDA POWER & LIGHT COMPANY	)	Docket Nos. M-52-040 & 52-041
	)	
(Turkey Point Units 6 and 7)	)	

CERTIFICATE OF SERVICE

I hereby certify that the NRC STAFF NOTICE TO THE COMMISSION REGARDING CONSULTATION WITH THE FISH AND WILDLIFE SERVICE UNDER SECTION 7 OF THE ENDANGERED SPECIES ACT FOR TURKEY POINT UNITS 6 & 7, dated June 30th, 2017, has been filed through the E-Filing system this 30th day of June, 2017.

Respectfully submitted,
/Signed (electronically) by/
Megan A. Wright
Counsel for the NRC Staff
U.S. Nuclear Regulatory Commission
Mail Stop O14-A44
Washington, DC 20555-0001
(972) 294-5792
(301) 415-3200 (FAX)
Megan.Wright@nrc.gov

Attachment A

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
http://sero.nmfs.noaa.gov

F/SER31:KBD

Jennifer Dixon-Herrity, Chief
Environmental Projects Branch
United States Nuclear Regulatory Commission
Division of New Nuclear Reactor Licensing
Mail Stop: TWFN 6C32
Washington, D.C. 20555-001

APR 26 2017

Colonel Alan Dodd, Commander
Department of the Army
Jacksonville District Corps of Engineers
9900 Southwest 107th Avenue, Suite 203
Miami, Florida 33176

Dear Ms. Dixon-Herrity and Colonel Dodd:

This letter responds to the Nuclear Regulatory Commission's request for consultation with us, the National Marine Fisheries Service (NMFS), pursuant to Section 7 of the Endangered Species Act (ESA) for the following action. The Jacksonville District of the United States Army Corps of Engineers (USACE) is a cooperating agency with the Nuclear Regulatory Commission (NRC) as the lead agency in the development of the Environmental Impact Statement for the proposed construction and operation of two new units at Turkey Point Nuclear Plant.

Applicant	SER Number	Project Type
Florida Power and Light Company (FPL)	SER-2015-16757	Expansion of Turkey Point Nuclear Plant, pile driving and dredging

Consultation History

We received NRC's letter and Biological Assessment (BA) on February 25, 2015 requesting consultation for the project referenced above. It was assigned to a Consultation Biologist on July 31, 2015. We requested additional information, and consultation was initiated on October 17, 2016, when the additional information was received.

Project Location

Address	Latitude/Longitude (North American Datum 1983)	Water body
Turkey Point Nuclear Plant, Units 6 and 7, Homestead, Miami-Dade County, Florida	25.437222°N, 80.326667°W	Biscayne Bay and Card Sound

Existing Site Conditions
The Turkey Point Nuclear Plant action area consists of 9,640 acres of land adjacent to Biscayne Bay and Card Sound with 5 existing power-generating stations comprised of pipelines, cooling towers, cooling canals, a barge slip, transmission lines, substations, heavy-haul roads, and other associated buildings and infrastructure. The project site contains dwarf mangrove islands, hypersaline mudflats, and open-water areas of Biscayne Bay Aquatic Preserve. The site for the proposed Units 6 and 7 (including associated cooling towers, a sub-station and associated facilities) is currently used to hold cooling water and is completely enclosed by earthen and concrete walls. This impounded area does not have any tidal connection to adjacent waters. According to the BA, no intertidal mangroves, corals, or ESA-listed seagrasses would be impacted or disturbed by construction or operation of the new units or any associated work. The project is not located in critical habitat.

Figure 1. Turkey Point Nuclear Plant on Biscayne Bay (©2016 Google)

Project Description
The NRC proposes to issue two combined construction permits and operating licenses to FPL for the construction and operation of Units 6 and 7 at the Turkey Point Nuclear Plant. Units 6 and 7 and associated facilities would be constructed entirely within an impounded area that does not have tidal or hydrologic connection to adjacent waters. Placement of the transmission lines and saltwater pipelines would be either in uplands or in impounded areas.

An existing equipment barge unloading area would be modified to support construction and future operations. The barge canal turning basin would be expanded to accommodate larger barges by excavating an area approximately 90 feet (ft) by 150 ft that contains very sparse non-ESA-listed seagrasses (shoal and widgeon grass). The dredging will occur using either small hydraulic or mechanical dredging methods. Dredged material would be placed in an upland disposal site. The turning basin expansion would involve temporary installation of 90 ft of 24-inch steel sheet piles with an impact hammer. Pile installation would be conducted over a 2 week period concurrently with the dredging. Work would be conducted during daylight hours only.

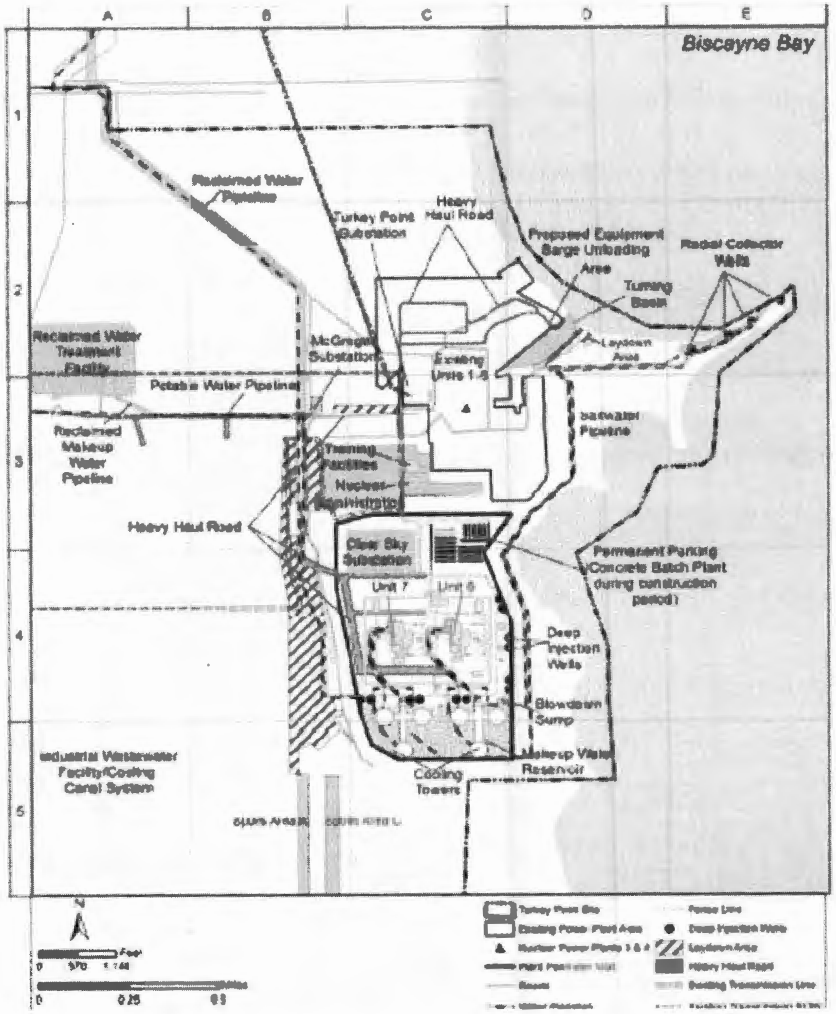

Figure 2. Site diagram of proposed location of Units 6 and 7, barge unloading area, and radial collector wells (FPL 2015).

Radial collector wells (RCWs) would be installed to augment the supply of cooling water from the Miami-Dade Water and Sewer system. The RCW will provide an alternate cooling water source when the quantity or quality of reclaimed water from the Miami-Dade system would not be available. The RCWs would be constructed of reinforced concrete caissons and installed laterally using microtunneling technology (i.e., horizontal directional drilling) approximately 25 to 40 feet (ft) below the bottom of Biscayne Bay. During the lateral drilling, best management practices would be used to reduce the potential for surface water or sediment disturbance.

Once constructed, the new units would use closed-cycle, wet-cooling towers that would primarily use reclaimed water from the Miami-Dade Water and Sewer Department. During operations, the use of the RCWs would be limited to no more than 60 days during a 12 month period. A portion of the used cooling water (i.e., blowdown water) would be discharged through deep injection wells located 2,800 to 3,500 ft underground.

Construction Conditions
Turbidity curtains would be used during dredging to contain any dredging related suspended sediments and prevent water quality degradation. FPL would follow NMFS's Sea Turtle and Smalltooth Sawfish Construction Conditions, dated March 23, 2006. They have also agreed to Florida Department of Environmental Protection's (FDEP) Conditions of Certification (State of Florida 2014-TN3637) as the preferred method for installation of the RCW in order to minimize pressure-induced fracturing and to provide South Florida Water Management District with complete drilling plans, contingencies for large storm events, and emergency response and mitigation plans in the event of a pressurized release of material. Unlike the oil and gas industry, the installation of the radial wells does not employ high pressure water injection during the construction of the well to fracture the rock and allow the escape of oil and natural gas. As a condition of FDEP's certification, a detailed monitoring plan for ecological and water quality resources in Biscayne Bay during construction of the RCWs is required for potential detection of pressure-induced fracturing. FPL does not expect pressure-induced releases of materials to occur during construction or operation of the RCWs.

Effects Determination(s) for Species the Action Agency or NMFS Believes May Be Affected by the Proposed Action

Species	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
Sea Turtles			
Green (North Atlantic and South Atlantic DPSs)	T	NLAA	NLAA
Kemp's ridley	E	NLAA	NLAA
Leatherback	E	NLAA	NLAA
Loggerhead (Northwest Atlantic Ocean distinct population segment [DPS])	T	NLAA	NLAA
Hawksbill	E	NLAA	NLAA
Fish			
Smalltooth sawfish (U.S. DPS)	E	NLAA	NLAA
Nassau grouper	T	NLAA	NE
E = endangered; T = threatened; NLAA = may affect, not likely to adversely affect			

Analysis of Potential Routes of Effects to Species
We believe that 5 species of ESA-listed sea turtles and smalltooth sawfish may be present in the action area and may be affected by the project. The majority of the construction will occur in uplands or in areas that are hydrologically isolated from tidal waters and are therefore not accessible to sea turtles and smalltooth sawfish. However, activities associated with modification of the existing barge basin and associated pile installation and RCW installation have the potential to affect ESA-listed species. We do not expect Nassau grouper to be present in the action area because the species is associated with coral reef and other hard bottom features, which are not present in the action area.

We have identified the following potential effects to these species and concluded that the species are not likely to be adversely affected:

Effects to sea turtles and smalltooth sawfish include the risk of injury from the physical action of the pile driving, dredging in the basin, and potential for interactions with construction support vessels. However, due to the species' ability to move away from the basin area to avoid these impacts and the implementation of NMFS's *Sea Turtle and Smalltooth Sawfish Construction Guidelines*, we believe these effects are extremely unlikely to occur, and are, therefore, discountable.

Additionally, dredging may temporarily result in minor and localized increases in turbidity. Given the mobility of the species and the availability of similar habitat just outside the action area, animals can easily leave the areas affected by increased turbidity and resume their normal activities in the surrounding areas. Therefore, these effects are expected to be insignificant.

Effects to listed species as a result of noise created by construction activities can also physically injure animals in the affected areas or change animal behavior in the affected areas. Injurious effects can occur in 2 ways. First, effects can result from a single noise event's exceeding the threshold for direct physical injury to animals; this constitutes an immediate adverse effect on these animals. Second, effects can result from prolonged exposure to noise levels that exceed the daily cumulative exposure threshold for the animals. If animals are exposed to these noise levels for sufficient periods, such exposure can constitute adverse effects. Behavioral effects can be adverse if such effects prevent animals from conducting biologically important activities (e.g., migrating, feeding, resting, or reproducing). Our evaluation of effects to listed species from noise created by construction activities is based on the analysis and calculations in NMFS Biological Opinion for SAJ-82[1]. The noise analysis in this consultation evaluates effects to ESA-listed fish and sea turtles identified by NMFS as potentially affected in the table above.

Installation of the RCWs has the potential to generate a maximum of 120 dB within 1 meter from the drill head; however, since the work would be occurring approximately 25 to 40 ft underground, the sound would be dampened as it moves upward through the limestone and would be below thresholds for causing auditory injury or behavioral changes to ESA-listed species.

Based on our calculations, installation of the 45 steel sheet piles could result in potential effects to ESA-listed species that may be present in the barge basin. Based on our noise calculations, installation steel sheet pile by impact hammer per day may result in single-strike or peak-pressure injury to sea turtles or ESA-listed fish at a radius of up 30 ft (Figure 3). However, the area where the sheet pile driving will occur is deeper than the surrounding waters, so the noise is expected to be concentrated within the deeper areas within the basin. Due to their expected avoidance of project noise and activity, we would not expect a sea turtle or smalltooth sawfish to remain within the project area during the pile driving. The startup of the pile driving will most likely elicit a startle reaction, resulting in a short-term disruption of activity patterns or listed species. Although the pile driving site is located within a boat basin, animals would still have an adequate avenue to escape the noise by exiting the basin entrance. Even in the unlikely event an animal does not vacate the injurious impact zone, the radius of that area is within the 50-ft radius that will be visually monitored for listed species. Construction personnel will cease construction activities if an animal is sighted per NMFS's Sea Turtle and Smalltooth Sawfish Construction Conditions. In order to lessen the potential for

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[1] NMFS. Biological Opinion on Regional General Permit SAJ-82 (SAJ-2007-01590), Florida Keys, Monroe County, Florida. June 10, 2014.

injurious noise impacts, the FPL has agreed to use a ramp-up start procedure when pile driving that will allow adequate time for animals to leave the project area.

The cumulative sound exposure level (cSEL) of multiple pile strikes over the course of a day may cause injury to ESA-listed fishes and sea turtles at a radius of up to 2,815 ft. Due to the mobility of sea turtles and ESA-listed fish species, we expect them to move away from noise disturbances. Because we anticipate the animal will move away, we believe that an animal's suffering physical injury from noise is extremely unlikely to occur. Thus, we believe the likelihood of injurious cSEL effects is discountable. An animal's movement away from the injurious impact zone is a behavioral response, with the same effects discussed below.

Based on our noise calculations, impact hammer pile installation could result in behavioral responses at radii of 2,815 ft for ESA-listed fishes and 607 ft for sea turtles. Due to the mobility of sea turtles and ESA-listed fish species, we expect them to move away from noise disturbances. If an individual chooses to remain within the behavioral response zone, it could be exposed to behavioral noise impacts during pile installation. Since installation will occur only during the day, these species will be able to resume normal activities during quiet periods between pile installations and at night. Therefore, we anticipate any behavioral effects will be insignificant.

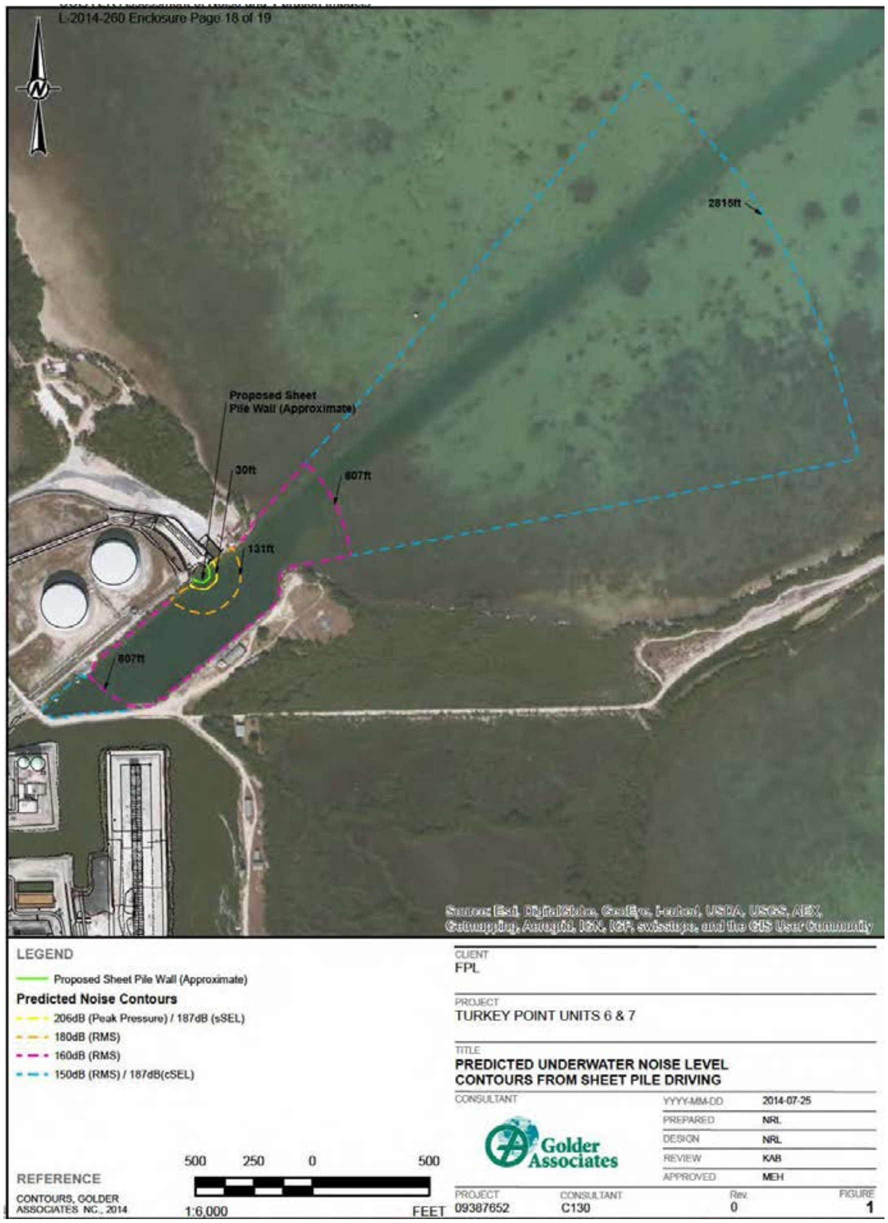


Figure 3. Predicted Underwater Noise Level Contours from Sheet Pile Driving within the Barge Basin (Golder Associates 2014).

Conclusion

Because all potential project effects to listed species were found to be discountable or insignificant, we conclude that the proposed action is not likely to adversely affect listed species under NMFS's purview. This concludes the NRC's and USACE's consultation responsibilities under the ESA for species under NMFS's purview. Consultation must be reinitiated if a take occurs or new information reveals effects of the action not previously considered, or the identified actions are subsequently modified in a manner that causes an effect to the listed species or critical habitat in a manner or to an extent not previously considered, or if a new species is listed or critical habitat designated that may be affected by the identified action. NMFS's findings on the project's potential effects are based on the project description in this response. Any changes to the proposed action may negate the findings of this consultation and may require reinitiation of consultation with NMFS.

We have enclosed additional relevant information for your review. We look forward to further cooperation with you on other projects to ensure the conservation of our threatened and endangered marine species and designated critical habitat. If you have any questions on this consultation, please contact Kay Davy, Consultation Biologist, at (727) 415-9271, or by email at kay.davy@noaa.gov.

Sincerely,

Roy E. Crabtree, Ph.D.
for Regional Administrator

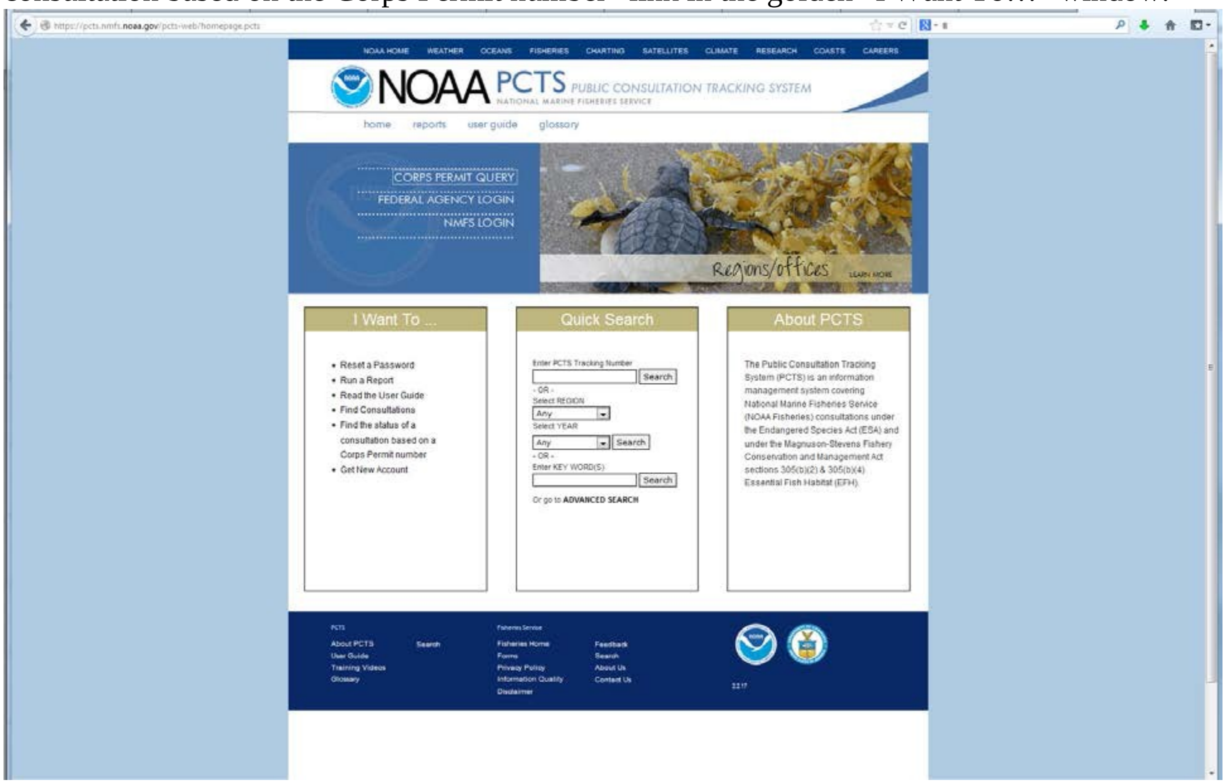
Enc.: *PCTS Access and Additional Considerations for ESA Section 7 Consultations* (Revised March 10, 2015)

File: 1514-22.4

PCTS Access and Additional Considerations for ESA Section 7 Consultations (Revised 03-10-2015)

Public Consultation Tracking System (PCTS) Guidance: PCTS is a Web-based query system at **https://pcts.nmfs.noaa.gov/** that allows all federal agencies (e.g., U.S. Army Corps of Engineers - USACE), project managers, permit applicants, consultants, and the general public to find the current status of NMFS's Endangered Species Act (ESA) and Essential Fish Habitat (EFH) consultations which are being conducted (or have been completed) pursuant to ESA Section 7 and the Magnuson-Stevens Fishery Conservation and Management Act's (MSA) Sections 305(b)2 and 305(b)(4). Basic information including access to documents is available to all.

The PCTS Home Page is shown below. For USACE-permitted projects, the easiest and quickest way to look up a project's status, or review completed ESA/EFH consultations, is to click on either the "Corps Permit Query" link (top left); or, below it, click the "Find the status of a consultation based on the Corps Permit number" link in the golden "I Want To…" window.



Then, from the "Corps District Office" list pick the appropriate USACE district. In the "Corps Permit #" box, type in the 9-digit USACE permit number identifier, with no hyphens or letters. Simply enter the year and the permit number, joined together, using preceding zeros if necessary after the year to obtain the necessary 9-digit (no more, no less) number. For example, the USACE Jacksonville District's issued permit number SAJ-2013-0235 (LP-CMW) must be typed in as 201300235 for PCTS to run a proper search and provide complete and accurate results. For querying permit applications submitted for ESA/EFH consultation by other USACE districts, the procedure is the same. For example, an inquiry on Mobile District's permit MVN201301412 is entered as 201301412 after selecting the Mobile District from the "Corps District Office" list. PCTS questions should be directed to Kelly Shotts at Kelly.Shotts@noaa.gov or (727) 551-5603.

EFH Recommendations: In addition to its protected species/critical habitat consultation requirements with NMFS' Protected Resources Division pursuant to Section 7 of the ESA, prior to proceeding with the proposed action the action agency must also consult with NMFS' Habitat Conservation Division (HCD) pursuant to the MSA requirements for EFH consultation (16 U.S.C. 1855 (b)(2) and 50 CFR 600.905-.930, subpart K). The action agency should also ensure that the applicant understands the ESA and EFH processes; that ESA and EFH consultations are separate, distinct, and guided by different statutes, goals, and time lines for responding to the action agency; and that the action agency will (and the applicant may) receive separate consultation correspondence on NMFS letterhead from HCD regarding their concerns and/or finalizing EFH consultation.

Marine Mammal Protection Act (MMPA) Recommendations: The ESA Section 7 process does not authorize incidental takes of listed or non-listed marine mammals. If such takes may occur an incidental take authorization under MMPA Section 101 (a)(5) is necessary. Please contact NMFS' Permits, Conservation, and Education Division at (301) 713-2322 for more information regarding MMPA permitting procedures.

Attachment B

United States Department of the Interior

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

June 23, 2017

Alicia Williamson
Office of New Reactors
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Service CPA Code:	04EF2000-2009-FA-0180
Service Consultation Code:	04EF2000-2009-F-0098
Date Received:	September 29, 2016
Consultation Initiation Date:	February 8, 2017
Project:	Combined License for Turkey Point Nuclear Plant, Units 6 and 7
County:	Miami-Dade

Dear Ms. Williamson:

The U.S. Fish and Wildlife Service (Service) has received the Nuclear Regulatory Commission's (NRC) letter dated September 29, 2016, requesting formal consultation for their licensing of Florida Power and Light (FPL) to construct two new nuclear power units (Units 6 and 7) and associated infrastructure at their Turkey Point Power Plant, and new transmission towers and lines located west and north of power plant site (Project). This document transmits the Service's biological opinion based on our review of the proposed Project located in Miami-Dade, Florida, and its effects on the endangered Everglade snail kite (*Rostrhamus sociabilis plumbeus*; snail kite) and Florida panther (*Puma concolor coryi*; panther), and the threatened American crocodile (*Crocodylus acutus*; crocodile) and its critical habitat, as well as the eastern indigo snake (*Drymarchon corais couperi*; indigo snake), red knot (*Dendroica kirtlandii*), and wood stork (*Mycteria americana*). It also provides the Service's concurrences for the NRC's determination that the Project may affect, but is not likely to adversely affect the federally listed species listed in Table 1. This document is submitted in accordance with section 7 of the Endangered Species Act of 1973, as amended in 1998 (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*).

This Biological Opinion is based on information provided in the NRC's biological assessment on the Project dated February 2015, the NRC's final environmental impact statement on the Project dated October 2016, correspondence, meetings, emails, and other sources of information. A complete record of this consultation is on file at the South Florida Ecological Services Office in Vero Beach, Florida.

Consultation History

In a document to the Service dated February 2015, the NRC provided their biological assessment for the Project. The biological assessment included determinations that the Project may affect, and is likely to adversely affect the crocodile, panther, snail kite, and wood stork. The NRC also determined in the biological assessment that the Project may affect, but is not likely to adversely affect the indigo snake, red knot, and the additional federally listed species in Table 1, and requested the Service's concurrence for these determinations pursuant to section 7 of the Act.

On August 20, 2015, the Service met with representatives of the NRC and the U.S. Army Corps of Engineers (Corps) to discuss the Project and the biological assessment.

In a letter to the Service dated September 28, 2016, the NRC provided additional information to the Service on the Project that had been requested at the August 20, 2015, meeting and in subsequent communications. The NRC also determined that the Project may affect but is not likely to adversely affect the endangered Miami tiger beetle (*Cicendela floridana*); the proposed rule to list the beetle under the Act was published on December 22, 2015, and the final rule was published on October 5, 2016.

In an email to the NRC dated November 3, 2016, the Service requested additional information regarding: (1) the status of the Florida bonneted bat, red knot, piping plover, and listed plants on the Project site; (2) results of a functional assessment for the wood stork foraging habitat that would be lost due to the proposed Project and associated mitigation; and (3) measures to minimize take of the crocodile.

In an email dated January 10, 2017, the NRC provided the Service a portion of the additional information requested in our November 3, 2016 email. The information included survey data collected on the proposed construction site of Units 6 and 7 during the winter of 2009 indicating that the red knot was observed on the site. Therefore, the Service finds that the red knot uses this portion of the Project site for wintering habitat, and the proposed action is likely to adversely affect the species. Therefore, the Service does not concur with the NRC's determination that the proposed Project may affect but is not likely to adversely affect the species; the Service analyzes the effects of the Project to red knots in our Biological Opinion presented below.

Similarly, the Service also notes that, based on conversations with FPL staff, the indigo snake has been observed within the Project footprint on several occasions. Therefore, the Service cannot concur with the NRC determination provided in their February 2015 biological assessment stating that the Project may affect, but is not likely to adversely affect the indigo snake. The Service finds that the proposed action is likely to adversely affect the indigo snake, and will result in incidental take of this species. As such, the effects of the Project on indigo snakes will be analyzed in this Biological Opinion.

In an email dated February 8, 2017, FPL, through the NRC, provided the Service the remainder of the additional information requested in our email on November 3, 2016.
As of February 8, 2017, the Service has received all the information necessary for initiation of formal consultation on this proposed Project as required in the regulations governing interagency consultations (50 CFR § 402.14).

BIOLOGICAL OPINION

This Biological Opinion provides the Service's opinion as to whether the proposed Project is likely to jeopardize the continued existence of the crocodile, indigo snake, panther, red knot, snail kite, and wood stork, or result in the destruction or adverse modification of designated critical habitat for the crocodile. (50 CFR § 402.02)

ANALYTICAL FRAMEWORK FOR THE JEOPARDY DETERMINATIONS

Jeopardy Determination

Section 7(a)(2) of the Act requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species. "Jeopardize the continued existence of" means 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 (50 CFR 402.02).

The jeopardy analysis in this Biological Opinion relies on four components: (1) the Status of the Species - a description of the range-wide condition of the species, the factors responsible for that condition, and its survival and recovery needs; (2) the Environmental Baseline- an analyses of the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) the Effects of the Action, including the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and (4) Cumulative Effects - an evaluation of the effects of future, non-Federal activities in the action area on the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the current status of the species, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the species in the wild.

Adverse Modification Determination

Section 7(a)(2) of the Act requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to result in the destruction or adverse modification of the critical habitat of listed species.

Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features. The destruction or adverse modification definition focuses on how Federal actions affect the quantity and quality of the physical or biological features in the designated critical habitat for a listed species and, especially in the case of unoccupied habitat, on any impacts to the critical habitat itself. The Service will generally conclude that a Federal action is likely to "destroy or adversely modify" designated critical habitat if the action results in an alteration of the quantity or quality of the essential physical or biological features of designated critical habitat, or that precludes or significantly delays the capacity of that habitat to develop those features over time, and if the effect of the alteration is to appreciably diminish the value of critical habitat for the conservation of the species. The Service may also consider other kinds of impacts to designated critical habitat as appropriate.

DESCRIPTION OF PROPOSED ACTION

The NRC is proposing to issue to FPL two combined licenses to construct and operate two new nuclear electrical generating units, electrical transmission line systems, and associated facilities (described below) at its Turkey Point power Plant (Figures 1and 2). For the purposes of our analysis we have deconstructed the proposed action into five components: power complex, muck material storage, cooling and potable water, transmission line systems, and equipment and materials access to the power complex site.

Power Complex

The proposed Project would include the construction of a new power complex that consists of two Westinghouse AP1000 reactors and steam generating units, known as Units 6 and 7, that produce a net electrical output of 1,092 megawatts per unit. The power complex would also include new cooling towers, a makeup-water reservoir, a new onsite substation (Clear Sky substation), warehouses, tunnels and pipe chases, generator buildings, a machine shop, sewage treatment facilities, a fire-protection pump house, an administration building, a concrete batch plant, and security facilities (Figure 1).

The power complex would be built within a 270-acre (ac) (109-hectare [ha]) parcel of partially disturbed, hyper-saline mud flats immediately south of the existing power units 1, 2, 3, 4, and 5 (Figure 2). Units 1 and 2 currently operate as synchronous condensers (providing voltage stability for the regional transmission system, but not power generation); Units 3 and 4 are active nuclear powered electrical generators; and Unit 5 is an active electrical generator fueled by natural gas. Initial construction activities would raise the base of the new power complex site about 25.5 feet (ft) (7.8 meters [m]) from its current elevation. The purpose of the elevated base is to protect the nuclear reactors and associated infrastructure from flooding and seismic activity. To begin construction, a mechanically stabilized earth retaining wall (20 to 21 ft [6.1 to 6.4 m] in height) with a face of concrete or modular block would be constructed around the perimeter of the power complex site. The purpose of the wall is to retain the fill material that would be used to raise the elevation to finished grade. Next, all muck soil within the power complex footprint would be excavated to a depth of approximately -4 to -6 ft (-1.2 to -1.8 m) to expose Miami limestone, and the muck removed from the site. To construct a base for the reactors and associated infrastructure, an estimated 7.8 million cubic yards (7.1 million cubic m) of suitable fill, obtained from established regional sources, would then be deposited within the power complex footprint. Outdoor lighting would also be installed concurrently with the commencement of construction to allow construction activities to occur at night within the Unit 6 and 7 Project footprint and the muck storage areas described below, and to comply with NRC and Occupational Safety and Health Administration safety regulations. Following base preparation, the nuclear power generators and the associated infrastructure described above would be constructed.

Muck material storage

The muck soil material removed from the power complex site would be deposited and stored on 212 ac (85.8 ha) of land within three designated muck storage areas, (Storage Area A = 77 ac [31.2 ha], Storage Area B = 18 ac [7.3 ha], and Storage Area C = 116 ac [46.9 ha)]), located within berms along existing roads in the 5,900-ac (2,388 ha) Cooling Canal System (CCS) (used to contain water used to cool Units 3 and 4) (Figure 1). During preparation of the muck storage areas, the center of each storage area would be excavated to construct perimeter berms that enclose the storage area, and silt fencing would be installed along the waterward edge of berms. The completed muck storage piles are estimated to be 16 to 20 ft (4.9 to 6.1 m) in height and would be constructed with a slope sufficient to prevent erosion. The purpose of the berms and silt fencing to is to prevent spoil and sediment from entering the waters of the CCS.

Cooling and potable water

Reclaimed water from the Miami-Dade Water and Sewer Department's South District Wastewater Treatment Plant (WTP) would be used to cool the new reactors. The WTP is located about 7.7 miles (mi) (12.4 kilometers [km]) north-northeast of the power complex construction footprint. A new underground pipeline (approximately 10 mi [16 km]) would be constructed, largely adjacent to the existing transmission line access road (Figure 1), and used to transport the reclaimed water from the WTP to a new treatment facility constructed on a 44-ac (18-ha) site just northeast of the existing CCS. The new water treatment facility would have its own stormwater treatment system (*i.e.* two retention ponds) and be constructed on a fill pad with a base 14 ft (4.3 m) in elevation. A new pipeline would also be constructed to transport the treated water approximately 1.1 mi (1.8 km) to the new reactors. The heated water from the operation of each nuclear unit would be cooled in three cooling towers, each approximately 67 ft (20 m) tall and 246 ft (75 m) in diameter, and heat would be dissipated to the atmosphere. A portion of the water used for cooling would also be lost to the atmosphere due to evaporation. The remainder of the used cooling water would then be transported into injection wells located immediately east of Unit 7 and discharged in the Boulder Zone at an underground depth of approximately 2,800 to 3,500 ft (853 to 1,067 m). An alternate source of cooling water would be provided through the construction of 28 radial collector wells and associated pipeline to the power complex site located on FPL's lands adjacent to Biscayne Bay, approximately 0.5 mi (0.8 km) northeast of the Project footprint. The wells would access water from the Biscayne aquifer approximately 25 to 40 ft (8 to 12 m) beneath the bottom of Biscayne Bay. This water source would only be used when reclaimed water is not available in sufficient quantity or quality, and would be limited to a maximum of 60 days per year by the State of Florida's Conditions of Certification.

Potable water would be provided to the power complex site through the construction a new potable water pipeline (Figure 2). Water would be transported from the Miami-Dade Water and Sewer Department's South District potable water facility located north about 6 mi (km) northwest of Project footprint. The potable water pipelines would be constructed within the right-of-way for other Project construction activities and would not result in additional land disturbance.

Transmission line systems

The Project also includes the construction of two new electrical transmission line systems and associated infrastructure to distribute electricity produced by Units 6 and 7 to the existing power grid. The new transmission lines would be constructed in two corridors known as the east corridor and west corridor (Figure 2).

The east corridor would begin at the new Clear Sky substation (located adjacent to Units 6 and 7) and extend approximately 19 mi (31 km) northwest from the Clear Sky substation to the existing Davis substation immediately adjacent to the existing transmission line corridor. The corridor would then proceed east and northeast approximately 18 mi to the existing Miami substation. A new 230 kilovolt (kV) electrical transmission system would be installed in the east corridor consisting of at least 112 transmission towers, each 80 to 90 ft in height and containing 4 wire conductors. A fill pad, about 100 by 100 ft, would be constructed for each transmission tower and the corridor would be approximately 150 ft (45.7 m) in width. Guy wires are needed to brace transmission towers located at turning points of the transmission system and would be installed on 19 towers within the east corridor.

The west corridor would commence at the new Clear Sky substation and extend westward immediately north of the existing CCS, and continue along SW 359th Street to a point approximately 11 mi (18 km) west. The corridor would then traverse northward approximately 17 mi (27 km) to SW 120th Street. At this location two corridors are being considered to connect to the existing Levee substation, the Preferred Corridor and the Consensus Corridor. The Preferred Corridor extends from SW 120th Street to a point about 5 mi (8 km) to the northeast, and then traverses east for about 2 mi (3 km) to the Levee substation. A portion of this segment would abut Everglades National Park (ENP). The Consensus Corridor uses the same path as the Preferred Corridor from the Clear Sky substation to SW 120th Street. The Consensus Corridor then extends about 2 mi (3 km) eastward from SW 120th before traversing northward about 5 mi (8 km) to the Levee substation. The Consensus Corridor is located farther east of ENP than the Preferred Corridor. For the Preferred Corridor, new access roads would be constructed at

Tamiami Trail and Krome Avenue. For the Consensus Corridor, new access roads would be constructed at NW 12th Street, Tamiami Trail, the L-31 Canal Levee, and SW 88th Street. The Service understands that the Consensus Corridor is now FPL's desired alternative for this portion of the transmission line system corridor. As such, the Service will only analyze the effects from the Consensus Corridor on federally listed species in this Biological Opinion.

From the existing Levee substation, the west corridor would extend about 4 mi (6 km) east and then traverse north for about 4 mi (6 km) to connect with the existing Pennsuco Substation. Two new 500 kV and one new 230 kV electrical transmission line systems would be installed in the west corridor. Each transmission line system would contain at least 264 transmission towers. Towers for the 500kV system and 230 kV systems would be 140 to 160 ft, and 80 to 90 ft in height, respectively, and each contains 4 wires. A 100 by 100-ft fill pad would be constructed for each transmission tower and have a width of approximately 330 ft from the Clear Sky substation to the Levee substation, and 150 ft (45.7 m) from the Levee substation to the Pennsuco substation. Guy wires, to brace transmission towers at turning points of the transmission system, would be installed on at least 50 towers within the east corridor.

The transmission line systems within the east and west corridors would also require additional infrastructure. FPL would construct one new substation (the Clear Sky substation, as indicated above) and expand six existing substations (Turkey Point, Miami, Levee, Davis, and Pennsuco substations; Figures 1 and 2). Construction of all substations would occur on disturbed lands and not impact habitat for wildlife. New access roads would be constructed at Tamiami Trail and Krome Avenue, NW 12th Street, the L-31 Canal Levee, and SW 88th Street. For both corridors, management of the vegetation under the transmission line system wires would require ongoing management. This management would consist of the clearing of vegetation >14 ft (4.3 m) in height and maintenance of vegetation not to exceed 14 ft (4.3 m) in height during the life of the transmission lines.

Equipment and materials access to power complex site

The Project would require the widening of existing paved roadways and the widening and paving of existing lime-rock roadways in the Project area to facilitate the movement of construction materials and fill to the power complex site. The following existing paved roadways would be widened from two to four lanes: (1) SW 328th Street/Canal Drive from SW 137th Avenue/Tallahassee Road to SW 117th Avenue; (2) SW 344th Street/Palm Drive from Speedway Boulevard to SW 137th Avenue/Tallahassee Road; and (3) SW 117th Avenue from SW 328th Street/North Canal Drive to SW 344th Street/Palm Drive. New paved roadways would be constructed within the footprint of existing lime-rock roadways at the following locations:
(1) SW 137th Avenue from SW 344th Street/Palm Drive to SW 359th Street (three lanes);
(2) SW 117th Avenue from SW 344th Street/Palm Drive to SW 359th Street (three lanes);
and (3) SW 359th Street from SW 137th Avenue/Tallahassee Road to the Turkey Point Power Plant site (three lanes from SW 137th Avenue to SW 117th Avenue and four lanes from SW 117th Avenue to the Turkey Point Power Point site, and a new bridge over the L-31E Canal). FPL has agreed to remove the new paved roadways and restore the area to its original condition as lime-

rock roadways and wetlands following completion of the Project. However, a section of new transmission lines associated with the west corridor would be located along SW 359th Street and the lime-rock roadway would provide maintenance access to this section of transmission lines.

Large components needed for construction of the power complex (*e.g.*, reactor vessels, steam generators, steam turbines *etc.*) and other construction materials would be delivered to the Project site by barges. Approximately 160 barge deliveries (80 per unit) would be needed over a 6-year period. To facilitate the movement of barges to and from the site, the existing equipment barge unloading area located at the northeastern portion of the Turkey Point Power Plant would be expanded by approximately 0.75 ac (0.30 ha), and approximately 0.1 ac (0.04 ha) of marine bottoms would be dredged. In addition, a 24-ft (7.3 m) wide by 0.9-mi (1.5 km) long heavy-haul road would be constructed along existing roads from the barge unloading area to the power complex site.

Additional information

The entire Project (power complex and transmission lines) is expected to result in permanent impacts to 706 ac (286 ha) of wetlands and temporary impacts to 47 ac (19 ha) of wetlands. To compensate for impacts to wetlands, FPL has proposed a wetland mitigation plan described below in *Minimization and Conservation Measures*. This estimate of wetland impacts is a "worst case scenario" because the final design of the transmission lines has not yet been completed. The amount of wetland impacts is expected to be smaller due to the ability to relocate pad structures and adjust span lengths associated with the transmission lines to avoid impacting wetlands during the final design process.

The purpose of the Project is to provide additional generating capacity to the existing power grid in Florida to meet the public need for electrical power. Construction of the Project would be expected to take at least 10 years to complete. The proposed Project is located at latitude 25.424966°, longitude -80.333099°, just east of Biscayne Bay and south of Palm Drive at FPL's Turkey Point Power Plant in Miami-Dade County, Florida (Figure 3).

Minimization and Conservation Measures

To minimize the Project's adverse effects to fish and wildlife, federally-listed species discussed in this Biological Opinion and wetlands, FPL has agreed to implement the following protective measures, habitat compensation, and conservation measures:

1) Wildlife fencing and underpasses - Barrier fencing will be installed in various locations within the Project site to reduce the potential for injuries and mortalities of federally listed species (*e.g.*, crocodile, indigo snake, panther) and other non-listed species of wildlife from collisions with motor vehicles associated with construction activities for the power complex. Specifically, fencing (8-ft [2.4 m] tall, chain link with fine mesh along the base, from ground level to 3 ft [0.91 m] in height, to prevent passage of small animals) will be installed along both sides of the road on: SW 137th Avenue/ Tallahassee

Road from SW 344th Street/Palm Drive to SW 359th Street, SW 117th Avenue from SW 344th Street/Palm Drive to SW 359th Street, and SW 359th Street from SW 137th Avenue/Tallahassee Road to the northeastern corner of the CCS. In addition, fencing will be installed along the entire eastern edge of the CCS from SW 359th Street southward to approximately 1,000 ft (304.8 m) south of the Land Utilization Building.

To allow safe passage of larger wildlife species (including crocodiles and panthers) under the SW 359th Street, 6-ft (1.8 m) tall box culverts will be installed on SW 359th Street in the following locations: (1) an area containing mixed hardwoods approximately 0.5 mi (0.8 km) west of the intersection of SW 117th Avenue, (2) on the west side of the L-31E Canal; and (3) at three locations along the northern boundary of CCS. A series of smaller culverts (20 to 28 inches [50.8 to 71.1 centimeters] in diameter) will also be installed along SW 359th Street to allow hydrological flow of surface waters and passage of smaller animals (*e.g.*, reptiles, amphibians, and fish etc.) under the roadway.

2) Federally listed species training program for construction site personnel – FPL will ensure that all construction personnel are educated as to the potential for the crocodile, indigo snake, red knot, and other federally listed species that could occur on the site. Educational training will consist of lectures, brochures, videos, and informational signs posted at various locations around the construction site. This media will provide a description of the species, its habitat and behavior; the protected status of the species; instructions not to kill or injure these species; and who to contact if a live, dead or injured specimen of a federally listed species is found on the Project site.

3) Federally listed species monitoring surveys – Immediately prior to and during land clearing, construction, and fill placement within the power complex, muck storage and water treatment sites, FPL's consultant will conduct daily pedestrian surveys for the crocodile and indigo snake. A sufficient number of observers shall be used to ensure adequate survey coverage of the sites. Should a crocodile or indigo snake be observed, all construction activities will be stopped. FPL biologists may safely capture a crocodile and relocate the animal to suitable habitat outside the Project footprint [as authorized by the Service's permit to FPL (TE092945-3) issued pursuant to section 10(a)(1)(B) of the Act]. If an indigo snake is observed, the animal will be allowed to leave the site under its own volition. Land clearing, muck storage, and construction activities will not commence until the surveys demonstrate that crocodiles and indigo snakes do not occur on the power complex, muck storage, and water treatment facility construction sites.

4) Sea Turtle, Manatee, and Benthic Marine Resources Protection Plan – To reduce the potential for adverse impacts to benthic marine resources in Biscayne Bay, FPL has developed a Barge Delivery Plan that provides detailed procedures that FPL will follow during deliveries of materials and equipment associated with the construction of Units 6 and 7 by tow boats and barges to minimize the potential for vessel grounding. The plan limits the maximum length of barges used in deliveries to 210 ft (64 m), and vessels may not enter the Turkey Point Entrance Channel unless winds are less than 23 mi (37 km) per

hour when winds are out of the north, west, and south, or less than 17.3 mi (27.8 km) per hour when winds are out of the east. To reduce the risk of a barge or vessel crushing a sea turtle or manatee, wharf fenders providing at least 4 ft (1.2 m) of space during maximum compression shall be installed along solid face wharfs and seawalls in the Turkey Pont barge turning basin for areas used to moor barges or vessels longer than 100 ft (30.5 m). Fenders or buoys providing at least 4 ft (1.2 m) of space will also be used when two vessels or barges are moored to each other. In addition, the Florida Fish and Wildlife Conservation Commission's (FWC) Standard Manatee Construction Conditions for In-Water Work (FWC 2011) shall be followed for all in-water activities associated with the construction of the Project that affect areas that potentially contain West Indian manatees.

5) Eastern Indigo Snake Protection Measures - To minimize adverse effects to this species during construction, FPL will follow the Service's *Standard Protection Measures for the Eastern Indigo Snake* (Service 2013) during construction of the Project.

6) Establish speed limit for motor vehicle transporting and delivering muck at muck storage areas in the CCS - A 25-mi (40.2 km) per hour speed limit will be enforced for trucks traveling on the roads to the muck storage sites.

7) Avian Protection Measures - To minimize the potential for injuries and mortalities of avian species (including the snail kite, the wood stork, and migratory birds), due to collisions with or electrocutions from the proposed transmission lines, FPL will install flight diverters and perch discouragers on all transmission lines associated with the Project. To further reduce the potential for the Project to adversely impact birds, FPL has developed an Avian Protection Plan (APP) (Appendix A) to be followed during construction and operation of the Project.

8) Habitat and wetlands compensation - To offset the loss of wildlife habitat and wetlands from the proposed action, FPL will restore or enhance, and preserve parcels of currently unprotected lands. These lands include a 238-ac (96 ha) parcel known as the Northwest Restoration Site located about 2 mi (3.2 km) north of the power complex site, a 574-ac (232 ha) parcel known as the SW 320th Restoration Site located about 4 mi (6.4 km) northwest of the Unit 6 and 7 construction site, a 170-ac (69 ha) parcel of sparsely vegetated mud flats, preserved as habitat for shorebirds, known as Assessment Area 10 located immediately southeast of the CCS, and a 6.4-ac (206 ha) parcel located southwest of the CCS near the Sea-Dade Canal that will be enhanced as nesting habitat for the crocodile. In addition, FPL will provide 1,409 credits from their Everglades Mitigation Bank (EMB) and acquire 308 credits from the Hole in the Donut Mitigation Bank (HDMB). All wetlands undergoing temporary impacts due to the Project will be restored to their original condition.

9) Surveys and monitoring for shorebirds, wood storks, and sea grasses – To assess the status of shorebirds within the power complex footprint and within the proposed habitat compensation area (Assessment Area 10), shorebird surveys will be conducted in the fall and winter at both sites prior to construction.

   To determine the relative abundance of wood storks using the nesting colonies located near the West transmission line (*i.e.*, known wood stork nesting colonies located near U.S. Highway 41 and within Water Conservation Area 3b) and their flight paths with respect to the West transmission lines, FPL will conduct pre-construction flight surveys for the wood stork during the nesting season prior to construction. A pre-clearing aerial survey for the wood stork will also be conducted by FPL to determine if active wood stork nesting colonies occur within 0.5 mi (0.8 km) of the west transmission line footprint. During the first nesting season following construction of the west transmission lines, FPL will monitor for injured or dead wood storks along the section of the West transmission line that occurs near the known wood stork nesting colonies described above. Monitoring methods will be developed in conjunction with the Service, FWC, and South Florida Water Management District. The purpose of this monitoring is to evaluate the effectiveness of the flight diverters and perch discouragers described above, and determine if additional protective or mitigation measures are needed.

   To determine the current status of seagrasses within the Project footprint, surveys will be conducted prior to dredging within all areas to be affected by the dredging of the equipment barge unloading area. If seagrasses are observed within the Project footprint, compensatory mitigation for the loss of seagrasses will be provided through an approved source.

10) Water quality and monitoring – To protect fish and wildlife and human health, FPL will be required by the Florida Department of Environmental Protection (DEP) in accordance with the State of Florida's Conditions of Certification to develop a stormwater pollution prevention plan and to monitor the surface water and ground water during construction activities. FPL has indicated that monitoring will occur in the CCS, the barge turning basin, and Biscayne Bay. The DEP will also require FPL to develop and implement an acceptable monitoring plan to determine if the water quality of Biscayne Bay and adjacent nearshore areas are being degraded from the use of reclaimed water provided by Miami-Dade County and the operation of the radial collector well system. If DEP determines that the comparison of pre-construction and post-construction monitoring data indicates statistically significant adverse impacts to the resources of Biscayne Bay resulting from the construction and operation of Units and 7, then additional measures shall be required to evaluate, abate or mitigate such impacts.

11) Restoration of Construction Access Roads – All roadways improved for construction access (as described above) will be restored to their original condition following construction of the Project. The following paved roads will reduced in size from four paved lanes to two paved lanes:

- SW 328th Street/Canal Drive from SW 137th Avenue/Tallahassee Road to SW 117th Avenue,
- SW 344th Street/Palm Drive from Speedway Boulevard to SW 137th Avenue/Tallahassee Road, and
- SW 117th Avenue from SW 328th Street/North Canal Drive to SW 344th Street/Palm Drive.

The following paved roadways will be restored to lime-rock road

- SW 137th Avenue from SW 344th Street/Palm Drive to SW 359th Street (three lanes),
- SW 117th Avenue from SW 344th Street/Palm Drive to SW 359th Street (three lanes), and
- SW 359th Street from SW 137th Avenue/Tallahassee Road to the Turkey Point Power Plant site

The bridge over the L-31E Canal will also be removed.

12) Florida panther habitat compensation – The Project will result in the permanent loss of habitat for the panther (179.72 ac [72.73 ha]; Table 2). To compensate for the loss of panther habitat resulting from the Project, the applicant has proposed to provide 2,154.4331 panther habitat units (PHUs) (rounded to 2,154 PHUs) (Table 2) from the Panther Island Mitigation Bank (PIMB). The proposed compensation plan provides habitat preservation and restoration near the Project area, and is consistent with goal 1.1.1.2.3 in the Panther Recovery Plan (Service 2008) stating that habitat preservation and restoration be provided, especially within the Primary Zone, in situations where land use intensification cannot be avoided. The applicant will provide equivalent habitat protection and restoration, to compensate for both the function and value of the lost habitat. Furthermore, FPL has agreed to not commence construction of the Project until: (1) they provide the Service with a receipt (in the form of a letter or email) from the PIMB or other Service approved conservation bank stating at least 2,154 PHUs have been reserved or acquired by the FPL; and (2) FPL and the NRC receive an email or letter from the Service indicating that we have received the receipt from the approved conservation bank(s).

13) Wood stork foraging habitat compensation – The Project will result in the loss of 238.60 ac (96.9 ha) of foraging habitat for the wood stork. To compensate for the loss of wood stork foraging habitat, FPL will acquire wetland credits from the HDMB that provide at least 32.35 kg (71.3 lb) of wood stork forage biomass from short hydroperiod wetlands and 611.12 kg (1,347.3 lb) of wood stork forage biomass from long hydroperiod wetlands.

14) Pine Rockland Plants – The proposed transmission line within the Kings Highway Pineland will be sited to avoid this area to the greatest extent practicable. The Project is anticipated to impact 0.84 ac (0.34 ha) of existing pine rockland habitat. Federally-listed plants affected by the transmission line will either be relocated, or seeds of the plants will be collected and new specimens will be cultivated and planted within lands agreed upon by the Service.

Action area

The action area is defined as all areas to be directly or indirectly affected by the Federal action and not merely the immediate area involved in the action. The Service considers the action area for this Project (Figure 1) as all lands within the Project footprint, and all lands within 25 mi (40.2 km) of the Project footprint that are located in the Service's panther Focus Area (Figure 2). The Focus Area denotes areas in Florida where development projects are most likely to affect the panther (Figure 4), and is based on the scientific information on panther habitat usage provided in Kautz *et al.* (2006) and Thatcher *et al.* (2006). The 25-mi (40.2 km) buffer around the Project footprint is based on mean dispersal distances of 23.2 mi (37.3 km) (Maehr *et al.* 2002), and 24.9 mi (40.1 km) (Comiskey *et al.* 2002) reported for subadult male panthers. The 25-mi (40.2 km) buffer distance encompasses the dispersal distance of both male and female panthers because male panther dispersal distances are known to exceed those reported for female panthers (Maehr *et al.* 2002; Comiskey *et al.* 2002). The size of the action area for this consultation is consistent with action areas defined in our recent biological opinions for the panther, and it encompasses the wide ranging movements of subadult panthers and the large home territories of adult panthers.

For purposes of our analysis of the Project's effects on the crocodile, indigo snake, snail kite, red knot, and wood stork, the area considered will be a subset of the greater action area defined for the panther and will focus on the areas where the Project has the potential to affect these specific species. These areas are identified in the *Status of the Species in the Action Area* section.

SPECIES NOT LIKELY TO BE ADVERSELY AFFECTED BY THE PROPOSED ACTION

Florida bonneted bat

The Project occurs within the geographic range of the Florida bonneted bat. The NRC has determined the Project may affect, and is not likely to adversely affect the Florida bonneted bat. The power complex footprint is mostly devoid of vegetation and does not contain suitable roosting habitat for the Florida bonneted bat; however individuals could forage over the area. Limited information on Florida bonneted bat foraging behavior is currently available. In one study using GPS-satellite tags at Babcock-Webb WMA, researchers found that most Florida bonneted bat locations were within one mile of the roost (point of capture) (Ober 2015). However, Florida bonneted bats also tended to take one longer foray, up to 7 miles, shortly after sunset each (Ober 2015, Ober 2016). Assuming a foraging area centered on a roost with a 1-mile radius, Florida bonneted bats likely forage throughout 2,010 acres, and could forage up to 98,470 acres (a 7-mi radius), on any given night. It is unknown how foraging behavior and needs differ among individuals (*e.g.*, ages, sexes), seasonally and in different habitat types. The quality of habitat and the prey availability, as well as other factors, likely greatly influence the relative importance of any particular area. Florida bonneted bat foraging areas are expected to be larger in areas with reduced prey abundance. Consequently, foraging bats in such areas would need to spend more time and effort obtaining prey to meet their biological needs. At some point this would be expected to lead to a loss in fitness. The development of the power complex will not remove all of the foraging opportunities for Florida bonneted bats in the 270-ac footprint, and bats would still be expected to forage on insects in the area even if the quality of forage has changed due to the conversion of the habitat from its current condition to the power complex.

Based on the information currently available, the footprints of the transmission lines, sub-stations, water pipelines, and water treatment plant do not contain cavity-bearing, mature trees, or other man-made structures that would provide roosting habitat for the bat. Furthermore, the footprint of these areas will be small relative to the expected size of the foraging area around a roost (2,010 - 98,470 ac).

Therefore, based on the fact that no roosts are expected to be removed as a result of the Project and effects to foraging habitat will be minimal based on the expected foraging range of the species, and because foraging opportunities will still be available on the Project site following development, the Service concurs with NRC's determination that the Project may affect, but is not likely to adversely affect the Florida bonneted bat.

The Service understands that FPL plans to wait several years to begin construction of the Project. Therefore, to ensure that the Service's analysis has the most recent information available to determine the status of this species on the Project site prior to construction, FPL has agreed to:

1) Conduct a survey to determine the status of the Florida bonneted bat within all suitable habitats located in the Project footprint. The survey will: (1) be conducted before construction commences, and no earlier than 1 year before commencement of construction is scheduled; (2) include both roosting and acoustic surveys; and (3) follow the most current guidance on Florida bonneted bat surveys provided by the Service.

2) Provide the results of the survey to the Service and the NRC in the form of a report. If the results of the survey indicate that the Florida bonneted bat occurs on the Project site, the NRC must re-initiate consultation with the Service before construction of the Project can commence.

Bartram's scrub-hairstreak butterfly, Florida leafwing butterfly, Miami tiger beetle, and Schaus swallowtail butterfly

The Project occurs within the geographic range of the Bartram's scrub-hairstreak butterfly, Florida leafwing butterfly, Miami tiger beetle, and Schaus swallowtail butterfly. The NRC determined the Project may affect, and is not likely adversely affect these species. The Bartram's scrub-hairstreak butterfly, Florida leafwing butterfly, and Miami tiger beetle all occur exclusively in pine rockland habitat. The butterflies are both further limited in their distribution based on their host plant pineland croton (*Croton linearis*). The Miami tiger beetle is currently only known to occur on two localities. Small parcels of pine rockland habitat occur within or near the footprint of the west transmission line. Based on the limited distribution of these species and the small sizes of the parcels of pine rockland habitat that overlap the proposed Project footprint, it is likely that FPL will be able to modify the final design of the west transmission lines to avoid areas where the species are documented.

The Schaus swallowtail butterfly is only known to occur within tropical hardwood hammocks located in the Florida Keys, several small islands within Biscayne National Park, and a few small localities in peninsular Florida in Miami-Dade County. Tropical hardwood hammock vegetation does not occur on or near the Project footprint, and the Project footprint does not occur within the Service's consultation area for the Schaus swallowtail butterfly.

Based on the reasoning described, the Service concurs with the NRC's determination for the Bartram's scrub-hairstreak butterfly, Florida leafwing butterfly, Miami tiger beetle, and Schaus swallowtail butterfly. The Service understands that FPL will not begin construction for several years and the final location of the components of the transmission line in the pine rockland habitat could still be adjusted. Therefore, to ensure that the Service's analysis has the most recent information available to determine the status of the Bartram's scrub-hairstreak butterfly, the Florida leafwing butterfly, and the Miami tiger beetle on the Project site prior to construction, FPL has agreed to:

1) Conduct surveys to determine the status of the Bartram's scrub-hairstreak butterfly, Florida leafwing butterfly, and the Miami tiger beetle, within all suitable habitats located in the Project footprint. The Service considers suitable habitat for these species as any pine rockland habitat located in or near the Project footprint. For Bartram's scrub-hairstreak butterfly and the Florida leafwing butterfly, the surveys: (1) will be conducted before construction commences, and no earlier than 1 year before commencement of construction is scheduled; and (2) follow the Service's most current survey guidance for Bartram's scrub-hairstreak butterfly and the Florida leafwing butterfly. For the Miami tiger beetle, the Service survey protocol currently recommends 2 years of surveys within suitable habitat. Therefore, the surveys for this species: (1) will be conducted before construction commences and no earlier than 2 years before construction is scheduled to commence; and (2) follow the Service's most current guidance for the Miami tiger beetle.

2) Provide the results of the survey to the Service and the NRC in the form of a report. If the results of the survey indicate that either the Bartram's scrub-hairstreak butterfly, the Florida leafwing butterfly, or Miami tiger beetle occur on the Project site, the NRC must re-initiate consultation with the Service before construction of the Project can commence.

Beach jacquemontia, Carter's small-flowered flax, crenulate lead plant, deltoid spurge, Florida brickell-bush, Garber's spurge, Small's milkpea, and tiny polygala

The Project occurs within the geographic range of: beach jacquemontia, Carter's small-flowered flax, crenulate lead plant, deltoid spurge, Florida brickell-bush, Garber's spurge, Small's milkpea, and tiny polygala, collectively referred to here as "listed plants". The NRC has determined the Project may affect, and is not likely adversely listed plants. The listed plants are only known to occur within pine rockland habitat; and a few small parcels of pine rockland habitat occur within or near the footprint of the west transmission line. Based on the small sizes of the parcels of pine rockland habitat and the ability of FPL to modify the final design of the west transmission lines to avoid these areas, the Service finds that the Project is unlikely to adversely affect listed plants. Thus, we concur with NRC's determination for the listed plants. The Service understands that construction of the proposed Project will not commence for several years. Therefore, to ensure that the Service's analysis has the most recent information available to determine the status of listed plants on the Project site prior to construction, FPL has agreed to:

1) Conduct botanical surveys to determine the status of the listed plants within all suitable pine rockland habitat located in the Project footprint. The survey: (1) will be conducted before construction commences, and no earlier than 1 year before commencement of construction is scheduled; (2) follow the Service's most current survey guidance for listed plants.

2) Provide the results of the survey to the Service and the NRC in the form of a report. If the results of the survey indicate that any of the listed plant species listed above occur on the Project site, the NRC must re-initiate consultation with the Service before construction of the Project can commence.

3) Listed plants affected by the transmission line will either be relocated, or seeds of the plants will be collected and new specimens will be cultivated and planted within lands agreed upon by the Service.

Piping plover

The Project occurs within the geographic range of the piping plover. The NRC determined the Project may affect, and is not likely to adversely affect the piping plover. The Service does not have any records of the piping plover occurring on suitable habitat within the Project site (*i.e.*, the mudflats associated with the power complex). Furthermore, piping plover were not observed during past surveys of the power complex site conducted by FPL's consultants. Consequently, the Service finds it unlikely that the piping plover occurs on the Project site, and we thus concur with this determination. The Service understands that FPL will not commence construction of the proposed Project for several years. Therefore, to ensure that the Service's analysis has the most recent information available to determine the status of this species on the Project site prior to construction, FPL has agreed to:

1) Conduct a survey to determine the status of the piping plover within all suitable habitat located in the Project footprint. The Service considers suitable habitat on the Project site as the construction footprint for Units 6 and 7. The survey: (1) will be conducted before construction commences, and no earlier than 1 year before commencement of construction is scheduled; and (2) will follow the most current guidance on piping plover surveys provided by the Service.

2) Provide the results of the survey to the Service and the NRC in the form of a report. If the results of the survey indicate that the piping plover occurs on the Project site, the NRC must re-initiate consultation with the Service before construction of the Project can commence.

West Indian manatee

The Project occurs within the geographic range of the West Indian manatee. The NRC determined that the Project may affect, but is not likely to adversely affect the West Indian manatee. The proposed expansion and dredging of the existing equipment barge unloading area and the transporting and delivering of materials and equipment by barges to the Project site have to potential to adversely affect the West Indian manatee. Manatees could be injured or killed by equipment used during expansion and dredging activities or collisions with barges. To protect the manatee during expansion and dredging of equipment barge unloading area and barge deliveries to the site, FPL has agreed to follow the Service's *Standard Manatee Conditions for In-Water Work* (Service 2011) during these activities. Based on the protective measures instituted, the Service concurs with NRC's determination that the proposed Project may affect, but is not likely to adversely affect the West Indian manatee.

STATUS OF THE SPECIES/CRITICAL HABITAT

Please see Appendix B for the Status of the Species for the crocodile, indigo snake, snail kite, panther, red knot, and wood stork.

Critical habitat has not been designated for the indigo snake, panther, red knot, and wood stork; therefore, it will not be discussed further in this Biological Opinion.

Summary of threats to the species/critical habitat

American crocodile

Modification and destruction of nesting habitat has been, and remains, the primary threat to the crocodile in South Florida. Much of the crocodile's coastal nesting habitat has been transformed to commercial and residential development and related infrastructure (*i.e.*, stores, hotels, houses, buildings, roads, and parking areas). The majority or remaining nesting habitat, and the species designated critical habitat, occurs within protected conservation areas (*e.g.*, Everglades National Park). Sea level rise associated with climate change also has the potential to result in significant habitat loss through inundation of existing coastal areas used by crocodiles. Coastal areas within the southern tip of peninsular Florida have been designated as critical habitat for the crocodile (see discussion in Appendix B: Status of the Species/Critical Habitat – American crocodile [*Crocodylus acutus*]).

Other threats to the crocodile include: human disturbance, road-related injuries and mortalities, and natural climatic events. Human disturbance due to human encroachment into crocodile habitat may alter normal behavioral patterns of crocodiles and may cause females to abandon nest sites. The level of disturbance is expected to increase as the population of South Florida grows and more people engage in recreational activities within conservation lands. The extensive roadway system in South Florida also poses a threat to the crocodile. As the crocodile population has increased over the past decades, the number of injuries and mortalities of crocodiles resulting from motor vehicle collisions has increased. Finally, natural climatic events such as tropical storms, hurricanes, and cold fronts during winter have the potential to result in crocodile mortalities, as demonstrated in the winter of 2010 when a prolonged cold spell resulted in the death of at least 125 crocodiles.

Eastern indigo snake

The primary threats to this species include habitat loss and fragmentation from ongoing commercial and residential development throughout the state of Florida. Collisions with motor vehicles on Florida's extensive roadway system may be a significant source of indigo snake injury and mortality.

Everglade snail kite and wood stork

The principal threats to the survival and recovery of the snail kite and the wood stork are the loss, fragmentation, alteration, and degradation of its wetland habitat. Impacts to the habitat of these bird species have resulted from residential and commercial development, agricultural activities, and activities related to flood control (*i.e.*, the drainage of wetlands facilitated by the construction of ditches, canals and impoundments), and water supply. In addition, the degradation of the water quality of wetland habitats, caused by the runoff of phosphorus and nitrogen from agricultural and urban sources, has altered the composition and structure of wetland plant communities used by the snail kite and wood stork. These threats have resulted in reduced foraging and nesting opportunities for these species.

Florida panther

Habitat loss and fragmentation due to commercial and residential development and other anthropogenic activities is the greatest threat to the survival and recovery of the panther throughout its range. The panther is a wide-ranging carnivore that requires large areas of continuous habitat for its survival. As discussed in the Status of the Species, the average home range of female and male panther is 29,059 ac (11,760 ha) and 62,542 ac (25,310 ha), respectively. Therefore, the maintenance of large parcels of continuous suitable habitat is vital to the persistence of this species.

Other significant threats to the panther include injuries and mortalities to panthers due to collisions with motor vehicles and intraspecific aggression. The FWC documented 287 vehicle-related panther deaths and 13 vehicle-related panther injuries from 1972 to the present on highways in South Florida, including 34 panther deaths in 2016 and 4 so far in 2017. Panther mortalities resulting from attacks of con-specifics are also known to occur in the panther population (*e.g.*, males may kill rival males when defending a territory). A total of 82 panther deaths due to intraspecific aggression were documented by the FWC from 1984 to the present, including 3 in 2016 and 1 in 2017. Habitat loss of sufficient magnitude may increase the potential for intraspecific aggression by reducing the amount of habitat available for a panther to establish a territory

Red knot

A variety of threats affect red knots wintering in South Florida. Significant threats to this species include the loss and degradation of their coastal habitat due to ongoing residential and commercial development. Sea level rise associated with climate change is also expected to result in the loss or red knot wintering habitat through inundation of existing habitat. Disturbance related to human presence (*e.g.*, recreational users at beaches) or human-related activities within red knot habitat may also cause the species to abandon wintering habitat (either temporarily or permanently). As such, disturbance may result in reduced time available for foraging, and ultimately reduce the species' fitness. Finally, the occurrence of invasive exotic plant species, specifically the Australian pine (*Casuarina equisetifolia*), within coastal wintering habitat can also affect red knots by providing roosts for avian predators and increasing the risk of predation.

ENVIRONMENTAL BASELINE

Status of the species/critical habitat within the action area

American crocodile

As previously stated, the effects of the proposed action on the crocodile do not extend across the entire action area. For the purposes of our analysis we will focus on the 270-ac (109 ha) power complex footprint, the 212-ac (85.8 ha) muck storage sites and existing access roadway; the Turkey Point peninsula (approximately 8 ac [3.2 ha]) proposed for the radial well collection system; the 44-ac (18 ha) reclaimed water treatment facility site; the 5,900-ac (2,388 ha) CCS for existing power generation Units 3 and 4, located immediately adjacent to the Project in the Turkey Point Power Plant; and the footprints of the paved roadways that will be built or widened to provide access to the power complex (SW 137th Avenue from SW 344th Street/Palm Drive to SW 359th Street, SW 117th Avenue from SW 344th Street/Palm Drive to SW 359th Street, SW 359th Street from SW 137th Avenue to the Turkey Point Power Plant site, SW 328th Street from SW 137th Avenue Road to SW 117th Avenue, SW 344th Street/Palm Drive from Speedway

Boulevard to SW 137th Avenue, and SW 117th Avenue from SW 328th Street to SW 344th Street). Also, the Service includes SW 344th Street from Speedway Boulevard to the Turkey Point Power Plant entrance because this roadway provides an entrance to the Project site for construction workers and motor vehicle traffic is expected to increase during construction of the Project. The exact numbers of crocodiles that inhabit the effected area are not known because extensive mark-recapture surveys have not been conducted to ascertain this information. However, crocodile nests are commonly observed in the CCS.

Nesting activity occurs within the CCS for Units 3 and 4 adjacent to the Project site at the Turkey Point Power Plant. As discussed in the Status of the Species-American Crocodile, the number of nests at the CCS increased from 2 nests in the late 1970s to a maximum of 25 nests in both 2013 and 2014. However, during the past two years (2015 and 2016), surveys conducted by FPL's staff and consultant suggest that there has been a reduction in the number of crocodile nests produced within the CCS. A total of 9 nests were observed in 2015 and 8 in 2016. The decrease in nesting in the CCS has occurred with a concomitant decrease in the number of crocodiles observed within the CCS during spotlight surveys (Mazzotti 2015). In addition, the body condition of many of the crocodiles observed within the CCS has decreased (*i.e.*, animals appear emaciated and much thinner than healthy animals of the same total length). Moreover, anecdotal evidence suggests that a majority of the fish and invertebrate species that used to provide prey for the crocodile in the waters of the CCS no longer occur or are greatly diminished in numbers. The reduction in crocodile nesting, individual numbers, and body condition, and the reduction in crocodile prey are thought to be the result of the recent increase in water temperature and salinity, and decrease in water quality within the waters of CCS observed during the past few years, beginning in 2013. Temperatures have increased by up to 4° C during certain times of the year, salinities of over 90 parts per thousand have been recorded, and an outbreak of cyanobacteria (blue-green algae) has greatly increased turbidity. The cause of the temperature increase and decrease in CCS water quality is unclear. Suspected contributing factors include FPL's recent increase in power production from nuclear Units 3 and 4, the discharge of vegetative cuttings within the CCS and/or the lower than average precipitation in the area. FPL is currently taking steps to improve water quality and habitat for crocodiles in the CCS, which appears to be working to some extent; the Service is awaiting an official report.

Critical habitat

Physical and biological features for crocodile critical habitat were not described when it was designated. The Service considers nesting substrate and foraging habitat to be essential habitat features for the species. Nesting habitat is characterized as sparsely vegetated sandy and marl soils adjacent to open water. Sites optimal for nesting provide appropriate soils for incubation, are generally protected from wind and wave action, and have access to deeper water (Service 1999). Crocodiles feed opportunistically and foraging habitat includes aquatic and upland areas.

Portions of the Project footprint are located within critical habitat designated for the crocodile. These areas include: (1) the majority of the 5,900-ac (2,388 ha) CCS; (2) the 270-ac (109 ha) parcel of partially disturbed, hypersaline mud flats proposed for construction of the power complex; (3) the haul road and storage areas proposed for muck material removed from the Units 6 and 7 site; and (4) the majority of the Turkey Point peninsula (roughly 8 ac [3.2 ha]) proposed to contain the radial collector well system and transport pipeline.

The CCS provides important habitat for the crocodile in the Project area. FPL has conducted habitat enhancement on the banks of the CCS to improve the opportunities for nesting and actively manages the waters to improve their quality and foraging opportunities.

The habitat within the power complex footprint is relatively poor quality crocodile habitat. This parcel is connected to hypersaline waters of the CCS, but water management of the site associated with the operation of Units 3 and 4 and the seasonality of precipitation result in the area being completely dry during certain times of the year. Moreover, vegetation and aquatic prey species for the crocodile do not occur on the site. Observations made by FPL indicate that crocodiles normally do not occur within the power complex footprint, although solitary basking crocodiles are observed from time to time. In addition, nesting has never been documented to occur within the power complex footprint.

Although the muck storage areas do provide some habitat, they are not currently used by crocodiles. The sites do not contain aquatic habitat for the crocodile, although aquatic habitat for the crocodile occurs immediately adjacent to the site within the waters of the CCS. The muck storage sites do provide potential nesting habitat for the crocodile, but nesting has never been recorded in these areas. This may be due to disturbance from occasional motor vehicles using the adjacent roads, or the steep slopes of berms making access by crocodiles more difficult.

Finally, the site of the proposed radial well collector system on the Turkey Point peninsula contains poor quality nesting habitat for the crocodile. The shorelines of the peninsula are heavily vegetated with mangroves and other woody vegetation, and open sandy areas favored as nesting sites are generally lacking. Crocodile nests have not been documented within this area.

Eastern indigo snake

As previously stated, the effects of the proposed action on the indigo snake do not extend across the entire action area. For the purposes of our analysis we will focus on spoils area B in the 212-ac (85.8 ha) muck storage sites and existing access roadway; the footprints of the 44-ac (18 ha) reclaimed water treatment facility site and the pipeline used to transport reclaimed water from the WTP; the Turkey Point peninsula (approximately 8 ac [3.2 ha]) proposed for the radial well collection system; the footprints of the roadways that will be widened and paved to provide access to the power complex south of SW 344th Street/Palm Drive (SW 137th Avenue from SW 344th Street to SW 359th Street, SW 117th Avenue from SW 344th Street to SW 359th Street, and SW 359th Street from SW 137th Avenue to the Turkey Point Power Plant site); and the east and west corridors proposed for the transmission line systems. The 270-ac (109 ha) power complex site is largely disturbed and inundated with hypersaline water from the CCS as is not considered to be suitable habitat for the indigo snake because of the hypersaline water.

FPL biologists have observed the indigo snake outside of the Project footprint in the test canals north of the CCS and within lands immediately south of the CCS with the EMB. Due to the indigo snake's habit of spending much of its time inactive and hidden underground, and the lack of a reliable and easily applied survey method, the exact number of indigo snakes within the affected area is difficult to estimate. Therefore, information from a study on indigo snakes conducted by Layne and Steiner (1996) at Archbold Biological Station in Lake Placid was used to estimate the number of indigo snakes occurring on the Project site. Layne and Steiner (1996) determined that the mean home range of a male and female indigo snake is approximately 184 ac (74.4 ha) and 46 ac (18.6 ha), respectively. The Service has determined that cumulatively approximately 233.8 ac (94.6 ha) of indigo snake habitat will be effected by the proposed Project (see Effects of the Action listed below). This includes: (1) 44 ac (17.8 ha) of habitat in the footprint of the water treatment facility; (2) 68.4 ac (27.7 ha) of habitat in the new access roadways located south of SW 344 Street/Palm Drive; and (3) 60.72 ac (24.6 ha) each in the east and west transmission line system corridors (based on the impacts of 264 transmission lines tower each requiring a 0.23-ac [0.09 ha] fill pad, 264 towers x 0.23 ac [0.09] = 60.72 ac [24.6 ha]). Based on the home range sizes listed in Layne and Steiner (1996), and expecting overlap of male and female home ranges, we expect that the water treatment facility supports one female and part of a male's home range. Because one female indigo snake is expected to occur, we also estimate that one nest with eggs would occur within the footprint of the water treatment facility during the breeding season. The habitat disturbance along the access roadways and transmission lines will be linear and/or with a relatively small footprint (*i.e.*, tower pads), therefore, we will not use the total acreage of disturbance to estimate the number of indigo snakes that could occur within these features, and expect that each individual area where habitat will be removed would be a small portion of any individual's home range.

Everglade snail kite

Current surveys for snail kites and their nests within the action area have not been conducted. However, as previously stated, the effects of the proposed action on the snail kite are not expected to extend across the entire action area. For the purposes of our analysis we will focus on the west corridor proposed for a new electrical transmission line system, where the species is reasonably certain to occur.

Snail kites are expected to occur within the northern segment of the west transmission line corridor of the Project footprint from approximately the Clear Sky substation to the Pennsuco substation (Figure 2). The exact number of snail kites that occur within this portion of the Project footprint is not known because extensive repeated surveys have not been conducted to ascertain this information. However, the range wide population of this species was estimated at 2,127 birds in 2015 (Fletcher *et al.* 2016a) and 2,056 birds in 2016 (Fletcher, 2016b). Records in the Service's database indicate the closest documented snail kite nest to the Project was recorded in 2012 approximately 1 mi (1.6 km) northwest of the proposed west transmission line corridor.

Critical habitat has been designated for the snail kite. However, the nearest critical habitat for this species is located approximately 9 mi west of the Project footprint. Consequently, the Project is not anticipated to affect critical habitat for the snail kite, and it will not be discussed further in this Biological Opinion.

Florida panther

The Service used current and historical radio-telemetry data, information on habitat quality, prey base, and evidence of uncollared panthers to evaluate panther use in the action area. Panther telemetry data are collected 3 days per week from fixed-wing aircraft, usually in early to midmorning. Studies indicate panthers are most active between dusk and dawn (Maehr *et al.* 1990, Beier 1995) and are typically at rest in dense ground cover during daytime monitoring flights (Land 1994). Therefore, telemetry locations may present an incomplete picture of panther activity patterns and habitat use (Comiskey *et al.* 2002). However, this potential bias was not detected in a recent analysis by Land *et al.* (2008) using GPS location data collected throughout a 24-hour day. This study revealed panther habitat selection patterns are similar when using either aerial telemetry data or GPS location data, and upland and wetland forests were the habitats most selected by panthers. There was also an indication grassland-dry prairie habitats were used more at night than during daytime hours.

Only a subset of the panther population has been radio-collared. However, the large database of telemetry locations taken from radio-collared panthers south of the Caloosahatchee River can be used to estimate the size and number of home ranges and travel corridors south of the Caloosahatchee River. The FWC also uses observational data collected during telemetry flights to assess the yearly breeding activity of radio-collared panthers.

Because of the factors described above, the exact population of panthers in the action area is not known. Although, data made available to the Service from the FWC indicate that the panther population in South Florida has increased in recent years from a net population of 49 individuals in 2000 to 107 in 2015 (Table 3). As of February 2017, 3,400 telemetry observations from 8 radio-collared panthers, whose current status is alive or unknown, have been documented within the action area. Panthers greater than 12 years of age are not likely to still be alive based on the known longevity of panthers in the wild of 10 to 12 years (Belden 1988). The most recent telemetry point in the action area was recorded on May 11, 2011, for panther FP192. Uncollared panthers are also presumed to occur in the action area.

Motor vehicles have affected panthers in the action area. There have been 6 documented panther deaths and 1 injury resulting from vehicle collisions (Table 4). The most recent vehicle-related panther mortality in the action area occurred April 30, 2011, on U.S. Highway 41 in Miami-Dade County, Florida.

The Service used our panther Habitat Assessment Methodology (see attachment entitled Status of the Species –Florida panther) to evaluate the panther habitat that would be lost in the Primary Zone due to the Project, the number of PHUs needed to compensate for the loss, and the habitat provided as compensation by the applicant (Table 2). The Project would result in a loss of 179.72 ac (72.73 ha) of panther habitat providing 913.79 PHUs. To compensate for the PHUs lost due to the Project, FPL will acquire at least 2,154 PHUs from the PIMB or other Service-approved conservation or mitigation bank. The habitat compensation proposed by the FPL is consistent with the Service's panther goal to strategically locate, preserve, and restore lands containing sufficient area and appropriate land cover types to ensure the long-term survival of the panther population south of the Caloosahatchee River.

Red knot

As previously stated, the effects of the proposed action on the red knot do not extend across the entire action area. For the purposes of our analysis we will focus on the 270-ac (109-ha) power complex footprint composed of occasionally inundated mudflats. The red knot has been documented within the mud flat habitat in the power complex footprint. Information provided by FPL, through the NRC, indicates that less than 10 individuals of the red knot were observed during surveys of power complex site in the winter of 2009. A more current survey of the Project footprint for the red knot has not been conducted. The exact number of birds that inhabit this portion of the Project is not known and would be expected to vary annually because the number of birds stopping in the mud flats during migration to winter at any given time and in any given year would be dependent on numerous factors. Extensive surveys conducted throughout the winter over multiple years would be needed to provide an average of the number of birds expected to occur. In the absence of this information, we expect any of the 270-ac (109 ha) of mud flat habitat would be occupied annually during the winter.

Wood stork

As previously stated, the effects of the proposed action on the wood stork do not extend across the entire action area. For the purposes of our analysis we will focus on the 44-ac (18 ha) reclaimed water treatment facility site, the east and west corridors proposed for the new electrical transmission line systems, and the wetlands/ditches along the access roads to the power complex site including a portion of SW 344th Street/Palm Drive and roads located north and south of SW 344th Street/Palm Drive. Observations by FPL and records in the Service's database indicate the wood stork occurs and nests within the affected area. The Project footprint is located within the Core Foraging Areas (CFAs) of 7 of these active nesting colonies and the nearest active wood stork nesting colonies are located roughly from 1 to 3 mi (1.6 to 4.8 km) west of the west corridor transmission line. The CFA is defined as all lands within 18.6 mi of an active nesting colony. NRC's Biological Assessment states that wood storks are not known to nest on the Project site, but have been observed foraging on the site.

Factors affecting the species environment within the action area

Factors that affect the species environment within the action area, and result in habitat loss and other effects to the species considered in this Biological Opinion include, but are not limited to: construction of highways and commercial and residential development, agriculture operations, resource extraction, public lands management (prescribed fire, public use, exotic plant eradication, *etc.*), hydrological restoration projects, and public and private land protection efforts.

Past and ongoing Federal and State actions that could affect the crocodile, indigo snake, snail kite, panther, red knot, and wood stork, in the action area include the issuance of Corps' permits and State of Florida Environmental Resource Permits authorizing the filling of wetlands for development projects and other purposes. Since 1982, the Corps and the State have had a joint wetland permit application process, where all permit applications submitted are distributed to both agencies. Upon review of our records, the Service has consulted on 11 projects, affecting approximately 2,129 ac (861.6 ha) of indigo snake and panther habitat, in the action area. These projects also resulted in the loss of habitat that could affect the baseline habitat available for the crocodile, snail kite, and wood stork. Furthermore, sand placement and restoration projects along the coast as well as Hurricane Matthew in 2017 have affected the habitat available to the red knot. However, a total of 2,005 ac (811.4 ha) of habitat was restored or preserved in association with these projects.

Roads and highways facilitate the movement of people and goods by cars and trucks, and may adversely affect the crocodile, indigo snake, and panther. The construction of new roads and the widening of existing roads can result in the direct loss of wildlife habitat (Forman *et al.* 2003). These species can also be injured or killed due to collisions with motorized vehicles when attempting to cross roads or feed in canals, ditches or swales adjacent to existing highways. The action area contains paved roadways used by motor vehicles, and injuries and deaths of crocodiles and panthers due to motor vehicle collisions have been recorded (as discussed above). It is likely that injuries and mortalities to indigo snakes occur as well, although they are much more difficult to document. The amount of motor vehicle traffic on these roadways is likely to increase in the future due to expected population growth and development in the region and the potential for injuries and mortalities of these species is expected to increase.

Conservation lands acquired through the land acquisition programs of Federal, State and County resource agencies within the action area have benefited the crocodile, indigo snake, snail kite, panther, red knot, and wood stork by preserving and maintaining habitat in perpetuity.

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 sea level rise, altered weather patterns, and 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 the ability to effectively use prescribed burning to manage habitat in optimal conditions for indigo snakes, panthers, and their prey. Increased rainfall could also reduce the amount of area suitable for panther denning or indigo snake sheltering by increasing the area covered with standing water or the duration of inundation of seasonally wet areas. In addition, an increase or decrease in precipitation could affect water levels in wetlands, ditches, swales and canals. This, in turn, could affect prey densities and ultimately affect productivity and survivorship of the snail kite and the wood stork. Increased precipitation would likely increase the availability of prey species, whereas increased periods of drought could reduce wetland prey habitat and the amount of prey available to the snail kite and the wood stork. It is also possible the intensity or frequency of thunderstorms or hurricanes may increase. Winds associated with these events could adversely affect the snail kite and the wood stork by increasing the number of nests damaged or destroyed. Finally, sea level rise associated with climate change could result in inundation and destruction of swallow water and mud flat habitats used by the red knot during wintering and nesting habitat currently used by the crocodile. Moreover, sea level rise will increase the salinity of coastal freshwater and brackish water habitats currently used by crocodiles.

It is difficult to determine if 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

Accidental release of radiation into environment due to operation of the new reactors

Our analyses of the Project under the Act includes consideration of the likelihood that an accident during operation of the nuclear reactors would occur resulting in accidental release of radiation or radioactive materials into the environment, above what is currently deemed safe by

NRC during normal operation of the reactors. The NRC indicates that the design, construction, and operation of nuclear power plants include many safety features that are intended to prevent the release unsafe levels of radiation or radioactive materials into the environment [NRC 2016a; see 10 CFR Part 50 (TN249), Appendix 1], and mitigate the consequences of failures [10 CFR Part 100 (TN282)]. Licensees of nuclear power reactors must also have emergency preparedness plans and protective action measures for the site and environs [see 10 CFR 50.47 (TN249), 10 CFR Part 50 (TN249), Appendix E, and NUREG-0654/FEMA-REP-1 (NRC1980-TN512)]. Based on the safety measures required by the NRC, the Service finds it unlikely that the construction and ongoing operation of Units 6 and 7 will result in an accidental release of radiation or radioactive materials that will result in harm to the environment, or threatened and endangered species listed under the Act.

Electromagnetic fields resulting from transmission lines

The transmission lines proposed for the Project generate low frequency electric and magnetic fields referred to collectively as electromagnetic fields (EMFs). The effect of exposure to EMFs to vertebrate animals is unclear. Past studies have not provided consistent evidence that exposure to EMFs from transmission lines adversely affect human heath (NRC 2016b), and the studies that have shown an increased risk to life-threating illnesses (*e.g.*, cancer *etc.*) are the subject of debate in the scientific community (Fernie and Reynolds 2005). Studies have shown that EMFs can have some influence on the development, reproduction, and physiology of honey bees (Greenberg *et al.* 1981) and have minor effects on the physiology of milk production in dairy cows (Burchard *et al.* 1996). Fernie and Reynolds (2005) reviewed past studies of EMFs on wild birds and birds in aviaries and found that EMF affected the behavior, reproductive success, growth and development, physiology, endocrinology and oxidative stress, but the effects were not always adverse and consistent patterns were not observed. Based on the variable results reported by Fernie and Reynolds (2005) and lack of studies on the effects of EMFs on other wild vertebrates, it appears that more research is needed to determine the long term effects of EMFs on the fitness and survival of vertebrate wildlife species

Based on our knowledge of the life histories and behavior of the crocodile, indigo snake, snail kite, panther, red knot, and wood stork, the Service expects that these species will not spend a significant amount of time under or near the transmission lines proposed for the Project. We don't expect this level of exposure to EMFs from the transmission lines to result in adverse effects to these species.

Effects by Species

American crocodile

Power complex: Land clearing and construction activities associated with the power complex would result in the loss of habitat for the crocodile. The poor quality crocodile habitat within the 270-ac (109 ha) parcel of partially disturbed, hyper-saline mud flat habitat identified as the construction footprint of the power complex would be transformed into two new nuclear reactors and associated infrastructure. Crocodiles are occasionally observed basking in the footprint of the proposed power complex. However, the site is dry during parts of the year, devoid of terrestrial and aquatic vegetation, and does not contain an adequate prey base for the crocodile. Moreover, nesting has not been observed in this area. Regardless, given that crocodiles have been observed in the area and suitable nesting opportunities exists, the Service finds that the loss of this habitat would adversely affect the crocodile through a reduction in habitat available to the species.

Lighting, noise and human activity from activities at the muck storage sites would result in an increase in disturbance to crocodiles occurring in adjacent waters of the CCS. Crocodiles commonly occur within canals and nest within berms of the adjacent CCS. The Service finds that crocodiles would likely initially respond to the disturbance by temporarily avoiding areas of the CCS immediately adjacent to the power complex site (estimated to be all portions of the CCS within 500 ft [152.4 m]). Over time (in a period of months), we expect crocodiles to acclimate to the disturbance and re-occupy habitat within the CCS adjacent to the power complex site. As such we find that disturbance from the Project due to activities at the power complex may affect, but would not adversely affect the crocodile.

Motorized vehicles operating in the power complex site during construction have the potential to injure or kill crocodiles that may enter the site. FPL would install chain link exclusion fencing along the eastern boarder of the CCS from SW 359th Street southward to approximately 1,000 ft (304.8 m) south of the Land Utilization Building, which would act as barrier to crocodiles attempting to enter the power complex site from the northern portion of the CCS. In addition, FPL would educate all construction personnel regarding the potential for the crocodile occurring on the site and instruct them not to kill or injure the species. Also, immediately prior to and during land clearing, and fill placement within the power complex, FPL's consultants would conduct daily pedestrian surveys for the crocodile within and immediately adjacent to, the power complex site. A sufficient number of observers shall be used to ensure adequate survey coverage of the sites. Should a crocodile or indigo snake be observed, all construction activities would be stopped. FPL biologists may safely capture a crocodile and relocate the animal to suitable habitat outside the Project footprint, as authorized by the Service's 10(a)(1)(B) permit to FPL (TE092945-3). Construction activities would not commence until the surveys demonstrate that crocodiles do not occur on the power complex site. Work at the power complex would begin with construction of a mechanically stabilized earth retaining wall (20 to 21 ft [6.1 to 6.4 m] in height) with a face of concrete or modular block around the perimeter of the power complex site. The purpose of the wall would be to retain the fill material that would be used to raise the elevation to finished grade. We expect that the retaining wall, in concert with the exclusion fencing along the eastern boundary of the CCS, would prevent crocodiles from entering the power complex site. Based on these protective measures, the Service finds that motorized vehicle operation within the power complex site would not be likely to result in injuries or mortalities of crocodile and would not adversely affect the species.

Muck material storage: Storage of muck material removed from the power complex site would affect 212 ac (85.8 ha) of berms within three designated muck storage areas located within and adjacent to the CCS. The muck storage areas and associated access road do not contain aquatic habitat for the crocodile, although aquatic habitat for the crocodile occurs immediately adjacent within the waters of the CCS. The sites provide moderate to poor quality potential nesting habitat for the crocodile, but nesting has never been recorded in these areas. This may be due to disturbance from occasional motor vehicle use on the adjacent roads, and the steep slopes of berms making them more difficult for crocodiles to access. This area would be available for crocodile nesting and basking following the deposition of the muck material at the site. However, it would be unlikely that crocodiles would use the deposited muck material for nesting following completion of muck deposition. The height of the muck storage piles (16 to 20 ft [4.9 to 6.1 m]) is expected to be an impediment to nesting. The Service finds that the storage of muck material at the storage sites would result in the functional loss of the nesting habitat, and would adversely affect the species.

Lighting, noise and human activity from construction activities at the muck deposition sites and the existing access roadway would result in an increase in disturbance to crocodiles occurring in adjacent habitats. Crocodiles commonly occur within canals and nest within berms of the adjacent CCS. The Service finds that crocodiles would be likely to initially respond to the disturbance by temporarily avoiding areas of the CCS immediately adjacent to the muck storage sites. Over time (in a period of months), we expect crocodiles to acclimate to the disturbance and re-occupy habitat within the CCS adjacent to the muck storage sites. As such we find that disturbance from the project due to activities at the muck storage sites may affect, but would not adversely affect the crocodile.

Trucks hauling muck from the power complex site to the muck storage sites have the potential to injure or kill crocodiles that may enter the access roadway and muck storage areas. To minimize the potential for crocodiles to be struck by trucks or other vehicles travelling in this area, FPL's consultant would conduct daily pedestrian surveys for the crocodile. A sufficient number of observers shall be used to ensure adequate survey coverage of the sites. Should a crocodile be observed, all construction activities would be stopped. FPL biologists may safely capture a crocodile and relocate the animal to suitable habitat outside the Project footprint. FPL would also establish speed limit of 25 mi per hour along the muck storage access roadway for trucks transporting and delivering muck. The Service finds that these protective measures would help minimize the potential for injuries and deaths of crocodiles due to collisions with trucks. However, there have been 15 documented crocodile deaths from vehicle collisions in the action area during the last 4 years (4 in 2013, 5 in 2014, 2 in 2015, and 4 in 2016). In addition, at Turkey Point Unit 5, two crocodile deaths have been documented from vehicles, one during construction and one during operation. Therefore, due to the difficulty of drivers spotting small crocodiles, and based our knowledge of past crocodile mortalities from vehicles collisions in the area and at Unit 5, the Service finds that an occasional injury or death of a crocodile from a vehicle associated with muck storage would be likely. Based on the number and frequency of vehicle and crocodile collisions in the area, we expect the number of crocodiles that would be injured or killed trucks during muck hauling activities would be small.

The muck storage areas are proposed immediately adjacent to the waters of the CCS, and have the potential to adversely affect the water quality in the CCS. The runoff of muck material from the storage areas during precipitation events could promote eutrophication in the waters of the CCS, and ultimately reduce the quality of aquatic habitat for crocodile prey and crocodile feeding. To minimize the potential for muck runoff, each muck storage area would be constructed with perimeter berms that enclose the storage area. In addition, silt fencing would be installed along the waterward edge of berms, and the completed muck storage piles would be constructed with a slope sufficient to prevent erosion. Moreover, to protect fish and wildlife and human health, FPL would be required by the DEP, in accordance with the State of Florida's Conditions of Certification, to develop a storm water pollution prevention plan and to monitor the surface water and ground water during construction activities. FPL has indicated that monitoring would also occur in the CCS. If monitoring indicates that statistically significant adverse impacts to the waters of the CCS are occurring, additional measures shall be required to evaluate, abate or mitigate such impacts. Based on these minimization measures, the Service finds that runoff from the storage of muck material would not be likely to adversely affect the water quality of the CCS or the crocodile.

Cooling and potable water: The Unit 6 and 7 reactors would require water for cooling during electrical power production. FPL's primary source of cooling water would be reclaimed water from the Miami-Dade Water and Sewer Department's South District WTP, located about 7.7 mi (12.4 km) north-northeast of the power complex construction footprint. Reclaimed water would be transported by a new underground pipeline (approximately10 mi [16 km] in length) from the WTP to the new water treatment facility located on a 44-ac (18 ha) site just northeast of the existing CCS (Figure 1). A new pipeline would also be constructed to transport the treated water approximately 1.1 mi (1.8 km) to the new reactors. Construction of the pipelines would occur within disturbed lands and other lands that do not provide habitat for the crocodile. Therefore, the construction of the cooling water pipelines would not be expected to adversely affect the species. However, the reclaimed water treatment facility site currently contains good quality habitat for crocodiles and their prey consisting of open water canals. The site also contains berms that currently provide poor quality crocodile nesting habitat because they are heavily vegetated with exotic trees (*i.e.*, *Casuarina* spp.) and other woody plant species. Crocodile nesting has not been documented within the water treatment facility site. The Service finds that the loss of this 44-ac (18 ha) of good to poor quality habitat would adversely affect the crocodile reducing the amount of feeding and basking habitat available to the species

An alternate source of cooling water would be provided through the construction of 28 radial collector wells located approximately 0.5 mi (0.8 km) northeast of the Project footprint on the Turkey Point peninsula adjacent to Biscayne Bay. A water pipeline from the collector wells to the power complex site would also be constructed from the radial well collector system to the power complex site. Water from these wells would be used for cooling the Unit 6 and 7 reactors if, for any reason, reclaimed water from the Miami-Dade Water and Sewer Department's South District WTP was not available. In general, the construction of the radial collector well system and associated pipeline would occur in the existing roadways; therefore, although this area is within designated critical habitat, the habitat features will not be changed, and the basking opportunities that currently exist would not be substantially affected. Specifically, the four central caissons of the well system and the water transport pipeline would be constructed within an existing dirt roadway and disturbed storage area on Turkey Point and adjacent lands, and the construction of the 28-well radial collector system would not disturb any potential crocodile shoreline habitats at Turkey point. The shoreline of the Turkey Point peninsula is largely vegetated with woody vegetation, such as mangroves, and provides only a small amount of potential habitat for crocodile nesting. Crocodile nesting has not been documented along the shorelines of the Turkey Point peninsula, and the project would not affect shoreline areas that might be used by crocodiles for nesting. The collector wells would access water from the Biscayne aquifer approximately 25 to 40 ft (8 to 12 m) beneath the bottom of Biscayne Bay, and use of the radial collector well system would be infrequent (no more than 60 days per year). Consequently, use of the radial collector system would not be expected to significantly affect benthic communities or aquatic crocodile habitat in Biscayne Bay. In addition, FPL would be required by the DEP, in accordance with the State of Florida's Conditions of Certification to develop a stormwater pollution prevention plan and to monitor the surface water and ground water during construction activities. FPL has indicated that monitoring would occur in Biscayne Bay. If the DEP determines that the comparison of pre-construction and post-construction monitoring data indicates statistically significant adverse impacts to the waters of Biscayne Bay resulting from the construction and operation of Project, then additional measures shall be required to evaluate, abate or mitigate such impacts. The Service finds that the construction and operation of the radial well collector system and water pipeline may affect, but would not adversely affect the crocodile or its habitat.

Potable water would be provided to the power complex site through the construction a new potable water pipeline (Figure 2). The footprint of potable water pipeline would not occur within crocodile habitat, and construction of the potable water pipeline would not adversely affect the crocodile.

<u>Transmission line systems</u>: The footprints of the proposed east and west transmission line systems do no occur within occupied crocodile habitat. No effect to crocodiles would be expected from these portions of the development.

<u>Equipment and materials access to power complex site</u>: The Project would require the widening of existing paved roadways and the widening and paving of existing lime-rock roadways in the Project area to facilitate the movement of trucks carrying equipment, construction materials and fill to the power complex site. The increase in truck traffic along these roadways would increase the likelihood that crocodiles trying to cross these roadways would be struck by vehicles and either injured or killed. To minimize the likelihood that trucks would collide with crocodiles, FPL would install chain-link exclusion fencing along various locations within the Project site. The fencing would be as follows: 8-ft (2.4 m) tall, chain link with fine mesh along the base, from ground level to 3 ft (0.91 m) in height, and installed along both sides of the road on. Locations include: (1) SW 137th Avenue/ Tallahassee Road from SW 344th Street/Palm Drive to SW 359th Street; (2) SW 117th Avenue from SW 344th Street/Palm Drive to SW 359th Street; and (3) SW 359th Street from SW 137th Avenue/Tallahassee Road to the northeastern corner of the CCS.

In addition, fencing would be installed along the entire eastern edge of the CCS from SW 359th Street southward to approximately 1,000 ft (304.8 m) south of the Land Utilization Building. To allow safe passage and movement of crocodiles under the SW 359th Street, 6-ft (1.8 m) tall box culverts would be installed on SW 359th Street in the following locations: (1) an area containing mixed hardwoods approximately 0.5 mi (0.8 km) west of the intersection of SW 117th Avenue; (2) on the west side of the L-31E Canal; and (3) at three locations along the northern boundary of CCS. These protective measures would promote safe movement of crocodiles and help reduce the likelihood that crocodiles are struck by trucks along the access roads located south of SW 344th Street/Palm Drive. However, the Service notes that the access roadways including SW 344th Street/Palm Drive and roads north of SW 344th Street/Palm Drive would not contain exclusion fencing, and crocodiles occur within canals adjacent to these roadways. In addition, the segment of SW 328th Street/Palm Drive from SW 137th Avenue to the entrance of the Turkey Point Power Plant also warrants consideration of potential risk to crocodiles from vehicles. Although this section of road would not be widened or used for delivery of materials, fill, or equipment, it would be expected to provide the main access to the Project site for construction workers. As such, traffic on this portion of the roadway would be expected to increase. Moreover, crocodiles occur in the adjacent canal next to the roadway and crocodile deaths from vehicle collisions have been documented in this section of roadway. Therefore, the Service finds that the widening of the existing paved access roadways including a section of SW 344th Street/Palm Drive and roads north of SW 344th Street/Palm Drive and increased vehicle traffic on SW 344th Street/Palm Drive resulting from the Project would adversely affect the crocodile by increasing the likelihood that crocodiles would be injured or killed by motor vehicles attempting to cross these roadways. As described above, the number and frequency of crocodile mortalities in the area (4 in 2013, 5 in 2014, 2 in 2015, 4 in 2016 and 2 at Turkey Point Unit 5) has been low. Therefore, we would expect the number of injuries and/or mortalities along the roadway associated with the proposed Project to be small.

Large components needed for construction of the power complex (*e.g.*, reactor vessels, steam generators, steam turbines etc.) and other construction materials would be delivered to the Project site by barges. Approximately 160 barge deliveries (80 per unit) would be needed over a 6-year period. To facilitate the movement of barges to and from the site, the existing equipment barge unloading area located at the northeastern portion of the Turkey Point Power Plant would be expanded by approximately 0.75 ac (0.30 ha), and approximately 0.1 ac (0.04 ha) of marine bottoms would be dredged. Crocodiles are known to occur in Biscayne Bay. However, due to wariness and vagility of the species, the Service finds it would be unlikely that crocodiles would loiter in the areas where these activities are occurring. Consequently, it would be unlikely that a crocodile would be injured and/or killed from barge strikes or dredging equipment during dredging activities. FPL would follow the Service's *Standard Manatee Conditions for In-Water Work* (Service 2011) during the dredging work. These conditions would require the use of observers that would likely spot any crocodiles that may enter the dredging footprint and could stop the works until the crocodile was relocated or left the area under its own volition. Consequently, we find that barge deliveries of materials and equipment and the dredging at the equipment barge unloading area may affect, but would not adversely affect crocodiles.

Critical habitat – American crocodile

As previously stated, when critical habitat was designated for the crocodile it did not describe the important features within the habitat to the species. However, the Service considers nesting substrate and foraging habitat to be essential habitat features for the species. Portions of the Project development areas overlap designated critical habitat for the crocodile. These lands total 483 ac (195.2 ha) and include: (1) the 270-ac (109 ha) power complex construction footprint; (2) the 212- ac (85.8 ha) muck storage areas located within and adjacent to the CCS; and (3) a small portion (less than 1 ac [0.4 ha]) of the Turkey Point peninsula proposed to contain the radial collector well system.

As described above in the effects to the species section, the proposed action would permanently remove the 270-ac (109 ha) of habitat in the power complex footprint, and functionally remove the 212-ac in the muck storage areas. These areas do not exhibit the characteristics of high quality nesting or foraging habitat and neither area is currently known to be used for nesting. The construction of the radial collector well system and associated pipeline would occur in the existing roadways; therefore, the habitat suitability for crocodiles would not be changed from its current condition. The CCS is also designated critical habitat, and the muck storage areas proposed immediately adjacent to the waters of the CCS have the potential to adversely affect the water quality in the CCS, thus one of its important features. As discussed above in greater detail, FPL has designed the muck storage areas to minimize the likelihood that the water quality in the CCS would be degraded by the muck storage, and monitoring would occur to evaluate the effectiveness of the design features. Therefore, the muck storage may affect, but would not be expected to adversely affect the water quality in the CCS.

Habitat management along the banks of the CCS and within EMB (south of the CCS) is currently conducted by FPL to enhance the nesting opportunities for crocodiles within these areas of critical habitat. In addition, fresh water canals adjacent to the CCS and water within Biscayne Bay provide foraging opportunities for crocodiles residing in the area. These areas of critical habitat would remain available to crocodiles following development and are mostly protected areas. The 483 ac (195.2 ha) of critical habitat that would be affected in the Project footprint represents 0.06 percent of approximately 768,000 ac (310,799 ha) of lands and waters included in the critical habitat designation for the crocodile.

Eastern indigo snake

Power complex: The 270-ac (109 ha) footprint of the power complex is partially disturbed and the hyper-saline mud flat is not expected to be suitable habitat for the indigo snake because of its highly saline environment. No effect to indigo snakes would be expected from this portion of the development.

Muck material storage: The 212 ac (85.8 ha) of berms designated for the three muck storage areas and existing access roadway located in the CCS contains disturbed and lower quality habitat for the indigo snake. Indigo snakes are not likely to occur within the spoils area A and C because they are contained within the CCS and the hypersaline water is anticipated to function as a barrier to indigo snakes entering the area (Figure 1). However, indigo snakes are known to occur within suitable habitat in FPL's EMB located immediately south and contiguous with spoils area B (Figure 1) and the southern boundary of the CCS. Disturbance from lighting, noise and human activity during the muck storage activities at spoils area B would not be expected to affect indigo snakes occurring near the site. However, because these reptiles are actively searching predators and are known to have large home ranges, the Service finds that indigo snakes may occasionally enter spoils area B for foraging. Thus, trucks operating in spoils area B, hauling and unloading muck material from the power complex site could run over and either injure or kill indigo snakes. To minimize the likelihood that indigo snakes would be injured or killed due to collisions with trucks, FPL would educate all construction staff that indigo snakes my occur on the site, their protective status, and what to do if an indigo snake is observed. FPL has also agreed to follow the Service's *Standard Protection Measures for the Eastern Indigo Snake* (Service 2013) during the muck storage activities. These protective measures would include daily pedestrian surveys for the indigo snake conducted by FPL's consultants. Should an indigo snake be observed, all construction activities would be stopped and the animal would be allowed to leave the site under its own volition. In addition, FPL would also establish a speed limit of 25 mi (40.2 km) per hour along the muck storage access roadway for trucks transporting and delivering muck that would be strictly enforced. The Service finds that these protective measures would help minimize the potential for injuries and deaths of indigo snakes due to collisions with trucks, and such incidents would be unlikely to occur. Consequently, we find that the muck storage activities may affect, but would not adversely affect the indigo snake.

<u>Cooling and potable water</u>: Construction of the reclaimed water pipeline and the potable water pipeline would occur largely within the rights-of-way of transmission lines and roadways. Although these areas could be traversed by indigo snakes moving from one area to the next indigo snakes would not be expected to reside in the construction area. As a protective measure, FPL would follow the Service's *Standard Protection Measures for the Eastern Indigo Snake* (Service 2013) during construction. Therefore, installation of the pipelines may affect, but would not be expected to adversely affect the indigo snake.

The 44-ac (18 ha) water treatment facility site contains suitable habitat for the indigo snake. Indigo snakes have been documented in the Test Canal System located approximately 0.3 mi (0.5 km) east of the water treatment facility site, and indigo snakes are expected to occur within the proposed water treatment facility footprint. Construction of the water treatment facility would result in the permanent loss of 44 ac (18 ha) of indigo snake habitat. As previously described in the *Status of the species/critical habitat within the action area* the Service expects that the water treatment facility supports one female and part of a male's home range as well as 1 nest with eggs during the breeding season.

Habitat clearing, earth moving, scraping, and piling during construction have the potential to crush indigo snakes, their nests, and eggs. Snakes can also be buried in their burrows and other refugia during construction, leading to mortality. The proposed Project would clear the 44-ac (18 ha) within the water treatment facility. FPL would implement the Service's *Standard*

Protection Measures for the Indigo Snake, which would require the development of an education plan for all construction personnel. Therefore, on-site personnel should be familiar with the physical description of the indigo snake and know what to do if it was observed during any phase of construction activities. Based on the proper implementation of these protection measures, the number of snakes injured and/or killed during construction should be reduced to some degree. However, the female that is expected to have her entire home range within the project footprint would be forced to leave the area and establish a new home range. This individual would be more vulnerable to predation and intraspecific aggression as it attempted to establish new home range, and this loss of habitat (home range) would be expected to impair her ability to feed, breed, and shelter until a new home range was established. The male expected to have an overlapping home range would not be anticipated to be adversely affected in the same manner because the habitat removed would be a small portion of his expected 184 ac (74.4 ha) home range. Should the construction take place while a nest is present, the construction would also be expected to destroy or kill the estimated 1 nest with eggs.

To compensate for the loss of indigo snake habitat, FPL has proposed to restore, preserve and manage in perpetuity the 238-ac (96 ha) Northwest Restoration Site and the 574-ac (232 ha) SW 320th Restoration Site. These sites contain habitat types suitable for the indigo snake.

Transmission line systems: The corridors of the east and west transmission line systems provide suitable habitat for the indigo snake and the species is likely to occur within the corridors. We estimate that 121.4 ac (49.2 ha) of lands within the transmission line system footprint would be transformed to fill pads and transmission line towers. Although this habitat would be permanently lost to the indigo snake, it would be distributed in a linear fashion and each individual footprint would be relatively small (23-ac [0.09 ha] fill pad) in comparison to an indigo snake home range (46 ac [18.6 ha] female and 184 ac [74.4 ha] male). Therefore, we do not anticipate that the transmission line system would remove enough habitat within any individual indigo snake's home range that would result in the inability of the indigo snake to feed, breed, or shelter. Furthermore, as previously stated, FPL would implement the Service's *Standard Protection Measures for the Indigo Snake*; therefore, on-site personnel should be familiar with the physical description of the indigo snake and know the proper way to avoid any harm if one was observed during any phase of construction activities.

Equipment and materials access to power complex site: Lands within the footprints of the existing access roadways to the power complex site, proposed to be widened and located north of SW 344 Street/Palm Drive, have been altered by agriculture. The Service finds that these lands provide lower quality habitat for the indigo snake in this area. Although snakes may occur in this area, the habitat lost would be distributed in a linear fashion, with a small footprint (approximately 100 ft wide). Therefore, this loss of habitat would not be expected to remove enough habitat within any individual indigo snake's home range that it would result in the inability of the indigo snake to feed, breed, or shelter. Given the lower quality of habitat, the abundance of snakes in the area is also expected to be low; consequently, the likelihood that a snake would be injured and/or killed while crossing the roadway, once widened, would be expected to be de minimis. Therefore, widening of the access roads located north of SW 344 Street/Palm Drive may affect, but would not be expected to adversely affect indigo snakes.

Lands within the footprints of the access roadways to the power complex site, proposed to be paved and widened and located south of SW 344 Street/Palm Drive, provide suitable habitat for the indigo snake. Moreover, the Service is aware that indigo snakes have been observed near the footprints of these roadways. Consequently, we expect the indigo snake occurs within this portion of the Project footprint. We estimate that 68.4 ac (27.7 ha) of the habitat within the footprints of the new paved access roads located south of SW 344th Street/Pam Drive would be transformed to paved roadways, and permanently lost to the indigo snake. As discussed above, the habitat lost would be distributed in a linear fashion and would not be expected to remove enough habitat within any individual indigo snake's home range that it would result in the inability of the indigo snake to feed, breed, or shelter. Furthermore, the roadways in this area would be fenced, therefore, snakes would not be expected to be at risk to being injured or killed in the roadways.

Activities at the barge unloading area would not affect upland habitat for the indigo snake.

Everglade snail kite

<u>Power complex, Muck material storage, Cooling and potable water, and Equipment and materials access to power complex site</u>: These portions of the proposed Project do not provide suitable habitat for the snail kite and snail kites are not known to occur in these areas. No effect to snail kites would be expected from these portions of the development.

<u>Transmission line systems</u>: The footprint for the west transmission line system occurs within suitable habitat for the snail kite. Snail kites are likely to occur within the northern segment of the west transmission corridor, roughly from the footprint of the Clear Sky substation to the footprint of the Pennsuco substation (Figure 2). Snail kites have not been documented to nest in this portion of the Project footprint, but nesting has been recorded approximately 1 mi (1.6 km) northwest. The Service estimates that 30 ac (12.1 ha) of lands (roughly half of the lands estimated to be impacted by the transmission towers and fill pads) that have the potential to provide foraging habitat for the snail kite in the west transmission line system corridor would be permanently lost to the snail kite from conversion into pads and transmission line features. However, in South Florida cattails have rendered much of the foraging habitat unavailable to snail kites and without management of the habitat it is considered unsuitable for snail kite foraging. In addition, the 30 ac (12.1 ha) of habitat would be distributed along the transmission route, further reducing the potential impact of the habitat loss. Therefore, we anticipate the habitat lost from the construction of the west transmission line system may affect, but would not adversely affect snail kites.

Following construction, the presence and "operation" of the west transmission line system represents a potential threat to the snail kite. These structures would create new flight path obstacles within areas known to contain snail kites. Snail kites may collide with these structures when flying, resulting in injury and/or death of the bird. In addition to collision, snail kites that perch on the electrical transmission structures could be killed by electrocution. To reduce the potential for collisions and electrocutions, FPL would install flight diverters and perch discouragers on all new transmission lines. The purpose of the flight diverters would be to make the transmission lines more visible to snail kites and other birds when flying. Perch discouragers reduce the ability of snail kites and other bird species to perch on transmission towers, and in turn reduce the potential for electrocution. To further reduce the potential for the Project to adversely impact birds, FPL has developed an APP (Appendix A), that would be followed during construction and operation of the Project. The Service expects that the installation of flight diverters and perch discouragers, and the implementation of the APP would help reduce the potential for collisions with transmission lines and electrocutions. However, injuries and/or mortalities of snail kites due to collisions with the new transmission lines or electrocutions (from streamers while perched) may still occur.

There is limited information on mortality of snail kites at transmission lines, in part due to limited monitoring and the potential of scavenging on any dead birds prior to observations; however raptors are known to be killed from collision and electrocution at power lines and FPL's APP identifies that based on the biological characteristics and past FPL records snail kites have a higher susceptibility to collision and/or electrocutions in FPL's service area (Pandion Systems, Inc. 2007). Based on our knowledge of the flight habits of snail kite (low during foraging and high while dispersing), their small size (limiting the potential for electrocution), the abundance of birds in the area of the west transmission line, and the minimization measures implemented by FPL (diverters and APP); we anticipate that the likelihood of injury and mortality would be low, and no more than one snail kite every 5 years.

The footprint of the east transmission line system does not provide suitable habitat for the snail kite and snail kites are not known to occur on the site.

Florida panther

Power complex, Muck material storage, Cooling and potable water: These portions of the proposed Project do not provide suitable habitat for the panther and are not located within the Service's Focus Area for the panther. No effect to panthers would be expected from these portions of the development.

Transmission line systems and Equipment and materials access to power complex site: The construction of the transmission line system and the access roads to the power complex site would result in the loss of panther habitat within the primary zone and secondary zone of the Service's panther Focus Area. These lands include: (1) a 6.8-mi (10.9 km) segment of the west transmission line system corridor located south of SW 344 Street/Palm Drive from east of SW 117th Avenue to west of Krome Avenue in Florida City; (2) a 1-mile (1.6 km) segment of the west transmission line system located just west of the intersection of U.S. Highway 41 and U.S. Highway 27; and (3) nearly all of the footprints for the access roadways located north and south of SW 344th Street/Palm Drive. As discussed, the Focus Area denotes areas in Florida where development projects could potentially affect the panther (Figure 4) and is based on the scientific information on panther habitat usage provided in Kautz *et al.* (2006) and Thatcher *et al.* (2006). The primary zone is defined as the most important area in South Florida needed to support a self-sustaining panther population, and the secondary zone is defined as lands within South Florida that could support resident panthers with sufficient restoration, and are currently used by dispersing subadult panthers (Kautz *et al.* 2006).

The suitable habitat that would be lost is approximately 179.73 ac (72.73 ha) that provide 921.686 PHUs (Table 2) based on the Service's panther habitat methodology (Service 2012a). Roughly half of the 179.73 ac (72.73 ha) impacted by the Project would be permanently lost through conversion to the west transmission line system. The remainder of the impacts would result in temporary loss of panther habitat associated with the paved access roads proposed north and south of SW 344th Street/Palm Drive. This habitat loss from the roads would be considered temporary because following construction of the Project, the pavement and fill associated with these sections of roadway would be removed; and the road footprints would be return to their original condition, as two lane unpaved lime rock roads and native upland and wetlands habitat types. However, panther habitat in these areas would not be completely restored because a section of the west transmission line would remain within SW 359th Street from east of SW 117th Street to SW 137th Avenue. Moreover, there would be a substantial time delay associated with the restoration of panther habitat in these areas because restoration would not begin until the Project is completed, a period of at least 10 years. Furthermore, following removal of road material, it would take several more years for the plant communities at the site to become fully reestablished.

As discussed in the *Status of the Species* for the panther, panther mortalities resulting from attacks of con-specifics are known to occur in the panther population (*e.g.*, males may kill other rival males when defending a territory). Habitat loss may increase the potential for intraspecific aggression among panthers in the action area. Panther deaths due to intraspecific aggression have not been documented within the action area. The Project would result in the loss of 179.73 ac (72.73 ha) of panther habitat. Based on the minor amount of panther habitat lost (179.73 ac [72.73 ha]), the Service expects that the Project would not significantly increase the potential for intraspecific aggression and result in additional injuries and mortalities of panthers.

The new paved roadways proposed for the Project would not result in new access to undeveloped lands adjacent to the Project footprint that could induce development in the area. As discussed, FPL has agreed to restore the new paved roads south of Palm Drive back to their original condition as unpaved lime rock roads. The Service finds it would be unlikely that the existing access would promote habitat loss due to new development, or increase the potential for panther injuries or deaths due to any new motor vehicle traffic associated with such development, beyond what is already proposed for the Project. We have reached this conclusion because the lands adjacent to the new paved roadways are primarily owned by FPL, act as a buffer to the Turkey Point Power Plant, and are largely wetlands, increasing the challenges for development.

Habitat loss associated within the transmission line systems and equipment and materials access to power complex site would adversely affect the panther due to a net loss of habitat currently available for hunting/foraging, breeding, and cover in the Project area, and the reduction in the size of any panther territories established in the Project area. Of the 179.73 ac (72.73 ha) of panther habitat that would be lost due to the Project 143.64 ac (58.13 ha) is located in the Primary Zone and 36.08 ac (14.60 ha) is located in the Secondary Zone of the Service's Panther Focus Area. Collectively this represents 0.62 percent of a female panther's average home range (29,059 ac [11,760 ha]), 0.29 percent of a male panther's average home range (62,542 ac [25,310 ha]), and 0.01percent of the 1,202,699 ac (486,800 ha) of non-urban private lands available to the panther. Because the amount of habitat that would be removed would be such a small portion of the home range, and would be distributed across the road and transmission features in even smaller parcels, we expect that any panther with a home range in or near the Project footprint would adjust their territories in association with the habitat lost.

The construction of the new access roads south of SW 344th Street/Palm Drive would introduce new motor vehicle traffic in areas where it previously did not occur and increase motor vehicle traffic on existing roadways (*i.e.*, the new roadways to be widened south of SW 3444th Street/Palm Drive and connecting roadways). Trucks would be needed to deliver fill, construction materials and equipment to the power complex construction site, and a significant increase in truck traffic would occur on these roadways during the 10 years expected to complete the Project. Consequently, the increase in truck traffic would increase noise and disturbance to the panther in these areas. Panthers may initially avoid the new access roads due to the introduction of motor vehicle traffic in an area where it previously did not occur. However, based on our knowledge of panther behavior in other parts of their range, we find that panthers would eventually acclimate to the disturbance and use the culvert underpasses that would be installed on SW 359th Street. Furthermore, panthers are mostly active between dusk and dawn (Maehr *et al.* 1990, Beier 1995) limiting the interaction that would be expected to occur with the construction activities. Therefore, the Service finds that increase in disturbance resulting from truck traffic associated with the Project would not be expected to adversely affect panther movements or the important biological functions of the panther (*e.g.*, feeding and breeding *etc.*).

The increase in motor vehicle use in or near the Project footprint could increase the likelihood that panthers would be injured or killed due to collisions with motor vehicles. Heavy truck traffic would be expected to occur on the newly paved and widened access roads used to deliver fill, construction materials and equipment during the 10 year period of construction for the Project. As discussed in the Project Description, to accommodate the increase in truck traffic, FPL would pave the existing lime-rock roadways at south of SW 344th Street/Palm Drive and widen existing paved roadways including a portion of SW 344th Street/Palm Drive and roads north of SW 344th Street/Palm Drive from two to four lanes. As a protective measure to reduce the likelihood that panthers would be injured and/or killed due to collisions with trucks or other motor vehicles on the new access roadways South of Palm Drive, FPL would install exclusion fencing along both sides of the pavement on SW 359th Street from SW 137th Avenue/Tallahassee Road to the Turkey Point Power Plant site, SW 117th Avenue from SW 359th Street to Palm Drive, and SW137th Avenue from SW 359th Street to Palm Drive. Culvert underpasses would also be installed to allow panthers and other wildlife species safely cross under SW 137th Avenue. The fencing and underpasses would be installed within lands that contain the most suitable panther habitat and where panther are most likely to occur in the Project footprint. Therefore, we find that these protection measures would help minimize the potential for injuries and mortalities of panthers from motor vehicle collisions due to the Project.

Truck traffic would also increase on the existing access roads to be widened north of Palm Drive and connecting roadways in the action area, and these roadways would not contain barrier fencing to prevent panthers and other wildlife from entering the roadways. This area is located outside of the Service's panther Focus Area, contains mostly agricultural and urban lands, and is less likely to be inhabited by panthers. Moreover, the Service does not have any records of panther injuries or mortalities due to collisions with motor vehicles occurring in this area. Therefore, the Service finds it would be unlikely that injuries and deaths of panthers would result from this portion of the Project.

The new paved roadways proposed for the Project would not result in new access to undeveloped lands adjacent to the Project footprint that could induce development in the area. As discussed, FPL has agreed to restore the new paved roads south of Palm Drive back to their original condition as unpaved lime rock roads. Because the lands adjacent to the new paved roadways are primarily owned by FPL, act as a buffer to the Turkey Point Power Plant, and consists largely of wetlands (which make these areas more difficult to develop), the Service finds it would be unlikely that the existing access would promote habitat loss due to new development, or any new motor vehicle traffic associated with such development, beyond what is already proposed for the Project.

The barge unloading area site does not provide habitat for the panther and is not located in the Service's Focus Area for the panther. No effect to panthers is expected from this portion of the development.

As a conservation measure to compensate for the loss of panther habitat due to the Project, FPL has proposed to provide at least 2,154 PHUs of panther habitat for preservation and management in perpetuity at a Service approved conservation bank. The lands proposed for compensation are consistent with our current panther Habitat Assessment Methodology and the Service's panther conservation strategy to locate, preserve, and restore lands containing sufficient area, access, and appropriate cover types to ensure the long-term survival of the panther south of the Caloosahatchee River.

Red knot

<u>Power complex</u>: The Project would result in the permanent loss of coastal wintering habitat for the red knot. The Service considers this area to include the 270-ac (109 ha) parcel of occasionally inundated, hyper-saline mud flat habitat located in footprint of power complex where the species has been observed. Red knots and other species of shore birds use this area for foraging and resting during the dry season (*i.e.,* from roughly November through March) when

the site contains little standing water and the species is wintering in South Florida. Habitat loss from this portion of the Project would be an adverse effect to the species because it would be expected to reduce the ability of individuals to feed and/or shelter in this area during the winter. Furthermore, this loss of habitat could reduce the fitness of an individual because of missed feeding and resting opportunities, which in turn would reduce the likelihood of successfully breeding in the subsequent spring, and could ultimately affect the survival of the individual red knot.

As a conservation measure to compensate for the loss of red knot wintering habitat, FPL has proposed to preserve and manage in perpetuity a 170-acre (69 ha) parcel of sparsely vegetated mud flats as habitat for shorebirds, known as Assessment Area 10 located immediately southeast of the CCS. In addition, the restoration, preservation, and long-term management of the 238-ac (96 ha) Northwest Restoration Site and the 574-ac (232 ha) SW 320th Restoration Site may provide some habitat types suitable for wintering red knots.

Muck material storage, Cooling and potable water, Transmission line systems, and Equipment and materials access to power complex site: These Project areas do not provide wintering habitat for red knot, and the species is unlikely to occur within these areas during construction of the Project. No effects to red knots would be expected from this portion of the development.

Wood stork

Power complex: The disturbed mudflats within the proposed 270-ac (109 ha) power complex site provide very little to no habitat for the wood stork. The site is dry for many months out of the year, and when inundated, contains hypersaline water from the CCS. Moreover, a significant fish population that would provide feeding opportunities for the wood stork is not known to occur at the site. Therefore, the Service finds that the construction of the power complex site would not adversely affect the wood stork.

Muck material storage: The muck material storage sites and access roadway do not provide suitable habitat for the wood stork and wood storks are not known to occur on these sites. No effects to wood storks are expected from this portion of the development.

Cooling and potable water, Transmission line systems, and Equipment and materials access to power complex site: The Service defines foraging habitat for wood storks as all wetlands and ditches (except for reservoirs, lakes, deep water canals and other similar surface waters) within the CFA (*i.e.*, 18.6 mi [29.9 km]) of an active wood stork nesting colony. A portion of the corridor for the west transmission line system is located in the CFAs of 7 active wood stork nesting colonies. These CFAs would be negatively affected by the loss of habitat associated with the west transmission line construction. As indicated previously, the exact acreage of wetlands that would be lost will not be determined until the final route and design of the transmission lines is complete. Because this information is not yet available, FPL's consultant used the best available information and estimated that 238.69 ac (96.6 ha), of potential wood stork foraging habitat occurring within the 7 CFAs would be permanently removed during construction.

FPL's consultant applied the Service's Wood Stork Forage Methodology (Service 2012b) to this wetland acreage and determined that the wetlands are comprised of 27.76 ac (11.2 ha) of short hydroperiod wetlands (<180 days inundated annually) and 210.93 ac (85.4 ha) of long hydroperiod wetlands ($\geq$ 180 days inundated annually), and provide 32.35 and 611.12 kg (71.3 and 1,347.3 lb) of wood stork forage biomass, respectively. The habitat lost due to the Project would adversely affect the wood stork by reducing foraging opportunities for the species, which could subsequently reduce the health and fitness of the birds in the 7 nesting colonies and lead to a reduction in breeding success, and/or a reduction in the survival of individuals.

Additional Project components would impact foraging habitat for wood storks, however, these areas are outside of CFAs. Suitable wetlands located outside of the CFA are less likely to be used by wood storks, but still provide occasional foraging opportunities. The footprints of the 44-ac (18 ha) water treatment facility, the east transmission line, and the access roads to the power complex site including a portion of SW 344th Street/Palm Drive and roads located north and south of SW 344th Street/Palm Drive contain wetlands or ditches that can be used by wood storks for foraging. The permanent loss of this foraging habitat has the potential to adversely affect wood storks from additional losses in foraging opportunities. However, given that these areas are outside of any CFA for an active colony, the Service finds that these additional wetland impacts, may affect, but would not be likely to adversely affect wood storks.

The footprints of the reclaimed water and potable water pipelines, the radial collector well system, and barge unloading area do not provide suitable habitat for the wood stork and wood storks are not known to occur there. No effects to wood storks would be expected from this portion of the development.

The Corps determined that 706 ac (286 ha) of wetlands would be permanently impacted and 47 ac (19 ha) of wetlands would be temporarily impacted by the proposed action. As discussed above, not all of these wetlands fall within a CFA for wood storks. As a conservation measure to mitigate for the loss of wetlands and to benefit the wood stork, FPL would acquire wetland credits from the HDMB that provide at least 32.35 kg (71.3 lb) of wood stork forage biomass from short hydroperiod wetlands and 611.12 kg (1,347.3 lb) of wood stork forage biomass from long hydroperiod wetlands. This proposed mitigation would sufficiently offset the expected adverse effects to the wood stork from the loss of wetland habitat in the west transmission line 927.76 ac (11.2 ha) of short hydroperiod wetlands and 210.93 ac (85.4 ha) of long hydroperiod wetlands, 32.35 and 611.12 kg (71.3 and 1,347.3 lb) of wood stork forage biomass, respectively.

Following construction, the presence and "operation" of the west transmission line system would be a potential threat to wood storks. This structure would create a new obstacle in the flight path of wood storks and would present the potential for injury and/or mortality if individuals collide with the transmission line. This threat is increased because an active nesting colony is located 1 to 2 mi (1.6 to 3.2 km) east of the west transmission line corridor, which increases the bird activity in the area; and young birds dispersing would be more vulnerable to collision because they are still not skillful fliers. In addition to collision, wood storks could perch on the electrical transmission structures and be killed by electrocution. As discussed above for the snail kite, to reduce the potential for collisions and electrocutions, FPL would install flight diverters and perch discouragers on all new transmission lines and they have developed an APP (Appendix A), that would be followed during construction and operation of the Project. The Service expects that the installation of flight diverters and perch discouragers, and the APP would help reduce the potential for collisions and electrocutions along the west transmission line. However, injuries and/or mortalities of wood storks due to collisions with the new transmission lines or electrocutions may still occur.

There is limited information on mortality of wood storks at transmission lines due to limited monitoring and the potential of scavenging any dead birds prior to observations. However, wood stork collisions and electrocutions have been reported with electric utility structures in Florida and FPL's APP identifies that based on the biological characteristics and past FPL records, wood storks have a higher susceptibility to collision and/or electrocutions in FPL's service area (Pandion Systems, Inc. 2007). Based on the abundance of birds in the area (7 overlapping CFAs), the proximity of the west transmission line to the active colony (1 mi [1.6 km]), the increased risk of collision to dispersing juveniles who are less adept at flying, and the minimization measures implemented by FPL (diverters and APP); we anticipate that the likelihood of injury and/or mortality would two wood storks annually. This rate in mortality could decrease over time as birds acclimate to having the obstacle in the flight path and adjust their routes accordingly.

During the first nesting season following construction of the west transmission lines, FPL would monitor for injured and/or dead wood storks along the section of the west transmission line that occurs near the known wood stork nesting colonies described above. Monitoring methods would be developed in conjunction with the Service, FWC, and South Florida Water Management District. The purpose of this monitoring would be to evaluate the effectiveness of the flight diverters and perch discouragers described above, and determine if additional protective or mitigation measures would be needed.

Interrelated and interdependent actions

Interrelated or interdependent actions are not expected to result from the Project or affect the crocodile, indigo snake, snail kite, panther, red knot, or wood stork.

CUMULATIVE EFFECTS

The Service defines "cumulative effects" considered in this Biological Opinion as the effects of future State, Tribal, local, or private actions (*i.e.*, non-Federal actions) reasonably certain to occur in the action area. Our definition of cumulative effects does not include future Federal actions unrelated to the proposed action because these actions require separate consultation pursuant to section 7 of the Act. Within the action area, past and ongoing State and County actions (non-

Federal) affecting panther habitat include: (1) State of Florida Development of Regional Impact (DRI) Orders; (2) County Comprehensive Plan Amendments; (3) County Zoning Amendments; (4) County Planned Unit Developments (PUDs); and (5) South Florida Water Management District's Environmental Resource Permits (ERPs). To estimate future non-Federal actions, the Service chose to identify and tabulate recent non-Federal actions and forecast this level of development as representative of future non-Federal actions.

Our estimate of non-Federal actions (*i.e.*, cumulative effects) in the action area incorporates Florida Land Use Cover and Forms Classification System (FLUCCS) mapping to determine if a property may be exempt from Federal Clean Water Act, section 404 wetland regulatory review by the Corps. To determine if a development project would likely be exempt from regulatory review, we identified the percentage of the Project site that was classified as wetland habitat based on FLUCCS 600 series (wetland), and the 411 and 419 (hydric pine flatwood) mapping unit classifications. Projects on properties with less than 5 percent wetlands were considered to be exempt from the Corps' regulatory review because impacts to wetlands could likely be avoided by project design.

Based on this approach, and information provided by the applicant's consultant, the Service finds that from 2014 through 2016, 15 projects in the action area affecting 3,088.48 ac (1,249.9 ha) of lands were exempt from regulatory review. Therefore, the Service estimates approximately 1,029.5 ac (416.6 ha) per year (3,088.48 ac /3 years = 2,033.7 ac per year) in the action area would be exempt from regulatory review in the action area. These actions are comprised of commercial and residential development projects and infrastructure projects (*e.g.*, the construction or widening of roads *etc.*). The adverse effects of these actions to the crocodile, indigo snake, snail kite, panther, red knot, and wood stork, include: the loss, degradation and fragmentation of habitat; increased disturbance to the species from construction activities; and an increase in potential for injuries and deaths of these species due to collisions with motor vehicles. We find this value is representative of future yearly development likely to occur in the action area that would not be reviewed by the Service pursuant to section 7 of the Act. The Service notes many unforeseen factors can affect development in the action area. Therefore, we acknowledge it is difficult to forecast development related to non-Federal actions in the action area with great certainly. However, the Service asserts that this estimate provides the best approximation available of future, non-Federal actions reasonably certain to occur and meets our definition of cumulative effects. With respect to the panther, this level of development represents 3.5 percent of a female panther's average home range (29,059 ac [11,760 ha]) and 1.6 percent of a male panther's average home range (62,542 ac [26,520 ha]). These cumulative effects would also result in reduction of habitat available to the crocodile, indigo snake, snail kite, red knot, and wood stork. Although, the amount of habitat lost for the crocodile, snail kite, red knot, and wood stork would be expected to be less because these species have more specific habitat requirements and their habitat is less abundant within the action area. In the short term, this loss of habitat would not be significant, but over the long term (*i.e.*, two or three decades), this amount of cumulative habitat loss has the potential to affect the survival of these species. The Service will continue to monitor the cumulative effects of development and other effects to these species in the action area and throughout their range. We have accounted for some habitat loss and changes in habitat quality through its habitat assessment methodology for the panther, and we are encouraging State and County environmental staff to develop Habitat Conservation Plans and seek Incidental Take Permits under section 10 of the Act to receive take coverage and compensate for adverse effects to the these species resulting from non-Federal actions.

CONCLUSION

After reviewing the current status of the crocodile and its critical habitat, the indigo snake, the snail kite, the panther, the red knot, and the wood stork, 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 crocodile, indigo snake, snail kite, panther, red knot, or wood stork, and it will not adversely modify the critical habitat of the crocodile. We have reached this conclusion for the following reasons:

American crocodile

1) The habitat that would be permanent lost is poor quality and is only infrequently used by the species; 2) the amount of habitat lost permanently and/or functionally (526 ac [231 ha]) including the power plant site (270 ac), muck storage area (212 ac), and water treatment facility (44 ac) would be a relatively small amount considering the overall range of the species, and this amount would only represents a small reduction in the geographic range of these species; 3) disturbance from construction activities at the power complex, reclaimed water and potable water pipelines, the radial collector wells, the east and west transmission line systems, and barge areas would not be expected to adversely affect the species; 4) runoff from the muck storage areas would be expected to be avoided and therefore, would not be anticipated to adversely affect the water quality of the CCS and subsequently crocodiles; 5) injury and/or mortality along the roadways would be minimized through fencing, and would be expected to be low and infrequent in number (1 every 5 years) during construction in the areas where there would be no fencing (muck storage activities and where there would be increases in traffic on existing roadways used for access to the power complex site); and 6) injury and mortality along the roadways following construction would also be expected to be low (1 every 10 years) over the life of the Project. This combined rate of injury and mortality would not be expected to reduce the population of this species.

Critical habitat – American crocodile

The small amount of construction in critical habitat within the footprint of the radial collector wells and pipeline [less than 1 ac (0.4 ha) in size] would not affect potential crocodile nesting habitat and would not be expected to affect aquatic habitat for the crocodile in Biscayne Bay. This section of critical habitat characterized as a dirt roadway and disturbed storage area on the Turkey Point Peninsula. Consequently, this development element would not be expected to result any functional loss of this portion of critical habitat.

The 270-ac (109 ha) footprint of the power complex currently provides poor quality habitat for the crocodile as this area is almost completely barren of vegetation, devoid of water during certain times of the year, does not provide a sufficient prey base for the crocodile, and does not provide suitable habitat for crocodile nesting. The 212 ac (85.8 ha) of critical habitat within the construction footprint of the muck storage areas consists of berms and a dirt roadway that currently provide poor quality nesting habitat for the crocodile, and nesting has not been previously documented. Although this muck area would remain available to crocodiles, it would be expected to be functionally lost because of the design of the area with the expected height of the muck deposition piles (16 to 20 ft [4.9 to 6.1 m]). Therefore, although the proposed Project would alter the characteristics of this critical habitat and preclude the 482 ac (195.1 ha) from developing suitable features important to the crocodile, this area currently does not provide this function for the species. Furthermore, the CCS, EMB, and Biscayne Bay, within and adjacent to the proposed Project provide suitable habitat for nesting and foraging for the crocodiles that reside in the area. Finally, this 482 ac (195.1 ha) of habitat represents only a small amount [0.06 percent of approximately 768,000 ac (310,799 ha)] of the lands and waters included in the critical habitat designation for the crocodile.

Eastern indigo snake

1) Construction activities at the power complex site and barge area would not adversely affect the indigo snake; 2) FPL would implement the Service's *Standard Protection Measures for the Eastern Indigo Snake* (Service 2013), which would avoid and minimize the likelihood of take at the muck storage areas, and the linear features of the Project which include the reclaimed and potable water pipeline, and the transmission lines; 3) the small amounts of habitat that would be removed along the linear features of the Project (road widening and transmission lines) would not significantly impair the ability of any individual snake to feed, breed, or shelter because the loss of habitat would be a small portion of their individual territory; 4) snakes would be unlikely to be killed on roadways north of SW 344 Street/Palm Drive due to low densities and south of SW 344 Street/Palm Drive due to fencing in place during construction; and 5) Only 1 snake would be expected to be taken in the form of harm and 1 nest with eggs would be expected to be destroyed/killed when the 44 ac (18 ha) of habitat is developed into the water treatment facility. This number and acreage would represents a small fraction of the number of individuals and habitat that is available locally and range wide, and would not be expected to reduce the population or geographic range of the species.

Everglade snail kite

1) Construction of the power complex site, muck storage areas, and cooling water pipeline and treatment facility, potable water pipeline site, radial collector wells site, power complex associated roadways, and activities associated with barge activities would not be expected to affect the snail kite; 2) only a small amount of foraging habitat considered occupied by the snail kite (30 ac [12.1 ha)]) would be permanently lost through the construction of the west transmission line system, and this habitat is not considered to be suitable foraging habitat in its current condition; and 3) only a small number of snail kites (1 every 5 years) would be expected

to be injured and/or killed due to collisions and electrocutions associated with the transmission lines, and this rate of injury and mortality would not be expected to significantly reduce the population of this species locally or range wide.

Florida panther

1) Construction of the power complex site, muck storage sites and cooling water pipeline and treatment facility, potable water pipeline site, radial collector wells site, east transmission line system corridor, and activities associated with barge activities would not be expected to affect the panther; 2) only a small amount of habitat considered occupied by the panthers, (179.73 ac [72.73 ha]), associated with the access roads to the power complex site and a section of the west transmission line system, would be permanently or temporarily lost, and this amount represents 0.62 percent of a female panther's average home range and 0.29 percent of a male panther's average home range; 3) this habitat loss would be a very small reduction in the geographic range of the species, and there are estimated to be 118 to 228 panthers that would not be affected by the proposed action (FWC estimates the panther population to be 120 to 230 individuals); 4) the small reduction in panther habitat from the Project would not be expected to result in increased potential for intraspecific aggression among panthers in the action area; 5) the loss of panther habitat due to the Project would be offset through the FPL's acquisition of 2,154 PHUs from PIMB; 6) improvements to the access roads associated with the Project would not be expected to provide new access to undeveloped lands and induce additional loss of panther habitat or increases in motor vehicle traffic, which could lead to additional injury or mortality; 7) construction activities associated with the Project would not be expected to adversely affect the panther; and 8) the fencing and underpasses constructed would be expected to minimize the likelihood that any panther would be injured or killed from collisions with motor vehicles using the roads providing access to the power complex site.

Red knot

1) Construction and activities at the muck storage sites, cooling water pipeline and treatment facility, potable water pipeline site, radial collector wells site, east and west transmission line system corridors, the sites of the access roadways to power complex, and activities associated with barge activities would not be expected to affect the red knot; 2) although the permanent loss of 270-ac [109 ha]) of wintering habitat associated with the construction of the power complex would be expected to adversely affect individuals through a reduction in individual fitness, breeding success, and survival, these birds would have the opportunity to seek alternative wintering habitat along the coast because this habitat represents a small reduction in the wintering habitat along the Atlantic coast available to the species; and 3) the number of red knots that would be adversely affected by the loss in habitat would be expected to be relatively small given the number of birds observed on-site and the mobility of the species to seek alternative opportunities for wintering along the coast.

Wood stork

1) Construction of the power complex, muck storage area, reclaimed water and potable water pipelines, the radial collector well system, and the barge unloading area would not adversely affect the wood stork; 2) although construction of the west transmission line would be expected to permanently remove up to 27.76 ac (11.2 ha) of short hydroperiod wetlands and 210.93 ac (85.4 ha) of long hydroperiod wetlands, adversely affecting the seven nesting colonies that have CFAs overlapping this Project feature, this adverse effect would be mitigated by FPL's purchase of wetland habitat that would replace the foraging value to wood storks lost by the transmission line; 3) FPL would purchase additional wetland mitigation credits to offset wetland impacts that would occur on the other elements of the Project that are outside the CFA of any active wood stork colonies; 4) the amount of wetlands lost within the CFA of the seven colonies would be a small portion of the available wetland habitat locally and range wide, and would only be a small decrease in the geographic range for the species; 5) although wood storks injury and/or mortality would be expected because of collision or electrocution with the west transmission line, the number of individuals that would be expected to be effected would be small, only two annually, and this rate of injury/mortality would not be expected to significantly contribute to a decline in the population of this species or reduce the likelihood of recovery.

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.

The terms and conditions described below are nondiscretionary and must be undertaken by the NRC so they become binding conditions of any grant or permit issued to FPL, as appropriate, for the exemption in section 7(o)(2) to apply. The NRC has a continuing duty to regulate the activity covered by this incidental take statement. If the NRC: (1) fails to assume and implement the terms and conditions; or (2) fails to require FPL to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protection coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the FPL must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR § 402.14(i)(3)].

Sections 7(b)(4) and 7 (o)(2) of the Act generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act prohibits the removal and reduction to possession of Federally listed endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law.

AMOUNT OR EXTENT OF TAKE

American crocodile

The proposed Project would be expected to result in the incidental take of crocodiles in the form of harm from the habitat loss and injuries and/or mortalities from vehicle collisions. All crocodiles using the 526 ac (212.9 ha) of habitat would be adversely affected by significantly impairing their ability to feed, breed, and shelter within this habitat. The adverse effects of this habitat loss on the fitness and survival of individual crocodiles is difficult to quantify because the number is expected to vary over time depending on the suitability of the habitat for nesting and foraging, the fact that not all crocodiles nest in any given year, and the density of crocodile nesting is highly variable (at times communally nesting). Therefore, the Service will express the amount of take in terms of the acres of habitat that would be lost or 526 ac (212.9 ha). Injuries and/or mortalities of crocodiles would be expected to occur from collisions with motorized vehicles operating in the muck storage areas and paved access roads to the power complex site. The Service anticipates one crocodile will be taken every 5 years, or at total of two crocodiles for the duration of construction (estimated to be 10 years). Following construction, the Service estimates that one crocodile will be taken every 10 years for the life of Project operation. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures.

Eastern indigo snake

The proposed Project would be expected to result in the incidental take of indigo snakes in the form of harm and mortality from habitat loss due to land clearing and construction activities associated with the proposed action. Based on Layne and Steiner's (1996) estimates of home range, we anticipate that only one snake (female) would be taken in the form of harm and one nest with eggs would be expected to be destroyed/killed when 44 ac (18 ha) of habitat is developed into the water treatment facility. Indigo snakes are difficult to detect and observe because their cryptic and secretive nature and we do not anticipate that FPL would be able to detect and determine whether the number of individuals taken has exceeded 1 individual and 1 nest with eggs. Therefore, we will use the amount of habitat lost as a surrogate for this take, and if the amount of habitat permanently removed exceeds 44 ac (18 ha), this would be considered exceedance of take requiring reinitiation of consultation and review of the reasonable and prudent measures.

Everglade snail kite

The proposed Project would be expected to result in the incidental take of snail kites in the form injuries and/or mortalities. Injuries and mortalities of this species would be expected to occur from collisions and/or electrocutions from the west transmission line system. The Service anticipates one snail kite would be taken every 5 years for the life of the Project. Monitoring conducted for the wood stork and associated with the APP will be used to identify if this level of take is exceeded. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures.

Florida panther

The proposed Project would be expected to result in the incidental take of the panther in the form of harm due to habitat loss from land clearing and construction activities associated with the Project. The Service anticipates that all panthers using the 173.12 ac (70.06 ha) could be taken as a result of the proposed action. Incidental take of panthers is difficult to detect and quantify because it is difficult to document the adverse effects of habitat lost from the Project on survival and reproduction of panthers, and because monitoring panthers in their large territories is difficult, especially when they are un-collared. Therefore, the Service will use habitat as a surrogate to the number of individuals taken; and the Service finds that no more than 173.12 ac (70.06 ha) of habitat will be incidentally taken as a result of the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures.

Red knot

The proposed Project would be expected to result in the incidental take of red knots in the form of harm from the wintering habitat that would be permanently lost. It is difficult to quantify the exact number of individuals that could be affected from this habitat lost because the number of red knots that may use the area for wintering during any given year would be expected to fluctuate based on a number of factors (*e.g.* annual breeding success, weather) that are not associated with the proposed action. Therefore, the Service will use acres of wintering habitat lost as a surrogate for the number of individuals taken. The Service finds that no more than 270 ac (109 ha) of wintering habitat will be incidentally taken as a result of the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures.

Wood stork

The proposed Project would be expected to result in the incidental take of wood storks in the form of harm from the habitat loss and from injuries and/or mortalities. All wood storks using the 238.69 ac (96.6 ha) of wetland habitat (27.76 ac [11.2 ha] of short hydroperiod wetlands and 210.93 ac [85.4 ha] of long hydroperiod wetlands) would be adversely affected by significantly impairing their ability to feed and potentially breed and survive. The adverse effect of this habitat loss on the fitness and survival of individual wood storks is difficult to quantify because the number of woods storks that may rely on that foraging habitat over time is expected to vary depending on the other foraging opportunities available in the CFA and the number of birds in the colonies. Therefore, the Service will express the amount of take in terms of the acres of habitat lost or 27.76 ac (11.2 ha) of short hydroperiod wetlands and 210.93 ac (85.4 ha) of long hydroperiod wetlands. Injuries and mortalities would also be expected to occur from collisions and/or electrocutions from the west transmission line system. The Service anticipates two wood storks could be killed annually. Therefore, take for wood storks will be considered exceed if more than 27.76 ac (11.2 ha) of short hydroperiod wetlands and 210.93 ac (85.4 ha) of long hydroperiod wetlands are removed from the CFAs or more than two wood storks are injured/killed annually from the transmission lines. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures.

EFFECT OF TAKE

In the accompanying Biological Opinion, the Service determined this level of anticipated take is not likely to result in jeopardy to the crocodile, indigo snake, snail kite, panther, red knot or wood stork, and/or the destruction or adverse modification of critical habitat designated for the crocodile. Critical habitat has been designated for the snail kite but is not anticipated to be affected. Critical habitat has not been designated for the indigo snake, panther, red knot, and wood stork and will not be affected.

REASONABLE AND PRUDENT MEASURES

When providing an incidental take statement, the Service is required to provide: (1) reasonable and prudent measures it considers necessary or appropriate to minimize the take; (2) terms and conditions that must be complied with to implement the reasonable and prudent measures; and (3) procedures to be used to handle or dispose of any individuals taken. The Service finds the NRC and FPL have already designed the Project to minimize take resulting from the action as described in the "Description of the Proposed Action" section of this Biological Opinion. Therefore, additional reasonable and prudent measures and their implementing terms and conditions are not necessary to reduce take of the crocodile, indigo snake, snail kite, panther, red knot, and wood stork resulting from the action and will not be provided.

MONITORING AND REPORTING REQUIREMENTS

Pursuant to 50 Code of Federal Regulations 402.14(i)(3), the NRC and FPL must provide adequate monitoring and reporting to determine if the amount or extent of take is approached or exceeded. Following commencement of construction, FPL must provide an annual report notifying the Service as to: (1) the acreage of each habitat type cleared by the Project, this report should clearly outline the amount of habitat taken associated with each Project feature and the habitat type (*e.g.* suitable crocodile, wetland, suitable red knot *etc.*); and (2) any observations of injured or dead crocodiles, indigo snakes, snail kites, and wood storks within the Project footprint, including the paved access roads and transmission lines made during routine inspection or maintenance activities conducted by FPL employees. Once construction is complete and operations have commenced, FPL must notify the Service whenever a dead and/or injured crocodile is observed within the power complex or along an access road. Finally, FPL must provide reports as described in the APP, as well as the monitoring results on the west transmission line associated with wood storks within 6 months of completing that monitoring.

DISPOSITION OF DEAD OR INJURED SPECIMENS

Upon locating a dead, injured, or sick threatened or endangered species, initial notification must be made to the nearest Service Law Enforcement Office; Fish and Wildlife Service; 20501 Independence Boulevard; Groveland, Florida 34736-8573; 352-429-1064. Secondary notification should be made to the Florida Fish and Wildlife Conservation Commission; South Region; 3900 Drane Field Road; Lakeland, Florida; 33811-1299; 1-800-282-8002. Care should be taken in handling sick or injured specimens to ensure effective treatment and care or in the handling of dead specimens to preserve biological material in the best possible state for later analysis as to the cause of death. In conjunction with the care of sick or injured wildlife, or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure evidence intrinsic to the specimen is not unnecessarily disturbed.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service recommends that FPL contribute to the monitoring of crocodiles at a broader scale in Biscayne Bay to improve the understanding of how crocodiles are moving between Turkey Point and other portions of the range. A contribution could include monetary funds to the greater monitoring efforts or purchase of satellite transmitters to be used on crocodiles specifically captured within the CCS. We also recommend that the right of way for the transmission line is managed to control invasive exotic species, specifically plants. FPL is encouraged to continue to work with the Service on avian and powerline interaction issues and develop regular monitoring to evaluate avian mortality within their service area.

REINITIATION NOTICE

This concludes formal consultation on the actions outlined in the Project consultation request. As written in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary NRC involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of NRC's and FPL's action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the NRC or FPL's action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Biological Opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease until reinitiation.

Thank you for your cooperation and effort in protecting federally listed species and fish and wildlife resources. If you have any questions regarding this Project, please contact John Wrublik at 772-469-4282.

Sincerely yours,

for Ashleigh Blackford

Roxanna Hinzman
Field Supervisor
South Florida Ecological Services Office

cc: electronic only
Corps, Miami, Florida (Megan Clouser)
EPA, West Palm Beach, Florida (Ron Miedema)
FWC, Naples, Florida (Darrell Land)
FWC, Tallahassee, Florida (FWC-CPS)
NOAA Fisheries, West Palm Beach, Florida (Brandon Howard)

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Table 1. Species the Nuclear Regulatory Commission determined the Project may affect, but are not likely to adversely affect.

Species	**Listing Status**
Bartram's scrub-hairstreak butterfly (*Strymon acis bartrami*)	endangered
beach jacquemontia (*Jacquemontia reclinata*)	endangered
Carter's small-flowered flax (*Linum carteri* variety *carteri*)	endangered
crenulate lead plant (*Amorpha crenulata*)	endangered
deltoid spurge (*Chamaesyce deltoidea*)	endangered
Florida bonneted bat (*Eumops floridanus*)	endangered
Florida brickell-bush (*Brickellia eupatorioides* variety *floridana*)	endangered
Florida leafwing butterfly (*Anaea troglodyta floridalis*)	endangered
Garber's spurge (*Chamaesyce garberi*)	threatened
Miami tiger beetle (*Cicendela floridana*)	endangered
piping plover (*Charadrius melodus*)	threatened
Schaus swallowtail butterfly (*Heracides aristodemus ponceanus*)	endangered
Small's milkpea (*Galactia smallii*)	endangered
tiny polygala (*Polygala smallii*)	endangered
West Indian manatee (*Trichechus manatus*)	endangered

Table 2. Panther Habitat Units (PHUs) impacted by the Project and PHUs needed as compensation.*

Land Cover Type	Habitat Score	Acres in Panther Primary Zone (Transmission Lines –preferred corridor)	PHUs Provided In Primary Zone (Transmission Lines – preferred corridor)	Acres in Panther Secondary Zone (Transmission Lines –preferred corridor)	PHUs Provided In Secondary Zone (Transmission Lines – preferred corridor)	Acres in Panther Primary Zone (Units 6 and 7 access roads)	PHUs Provided (Units 6 and 7 access roads)
Hardwood Swamp	9.2	8.63	79.396	1.21	11.132	13.89	127.788
Improved Pasture	5.2	1.46	7.592	-	-	-	-
Cropland	4.8	12.16	58.368	-	-	4.61	22.128
Orchards/ Groves	4.7	-	-	-	-	1.59	7.473
Marsh/ Wet Prairie	4.7	53.54	251.638	30.62	143.914	28.43	133.621
Exotic Plants	3.0	17.23	51.69	4.25	12.75	2.10	6.300
Surface Waters	0	5.50	0	8.14	0	2.97	-
Urban Lands	0	8.19	0	6.59	0	15.49	-
	Total	106.71	448.684	50.81	167.796	69.08	297.31

*Total acreage of habitat suitable for the panther (habitat types with Habitat Scores > 0) = 93.02 ac in transmission line west corridor in Primary Zone + 36.08 ac in transmission line west corridor in Secondary Zone + 50.62 ac in Unit 6 and 7 access roads footprint in Primary Zone = 179.72 ac).

Total PHUs provided by in Primary Zone =total PHUs provided in transmission line west corridor in the Primary Zone (448.684 PHUs) + total PHUs provided in Units 6 and 7 access roads in the Primary Zone (297.31 PHUs) = 745.994 PHUs.

Total PHUs provided in transmission line west corridor in the Secondary Zone = 167.796

Total PHUs provided by Project = total PHUs provided in Primary Zone (745.994 PHUs) + total PHUs provided in Secondary Zone (167.796) = 913.79 PHUs

PHUs needed to compensate for impacts of Project in Primary Zone = Total PHUs lost in Primary Zone (913.79 PHUs) x Base Ratio for Primary Zone (2.5) x Landscape Multiplier for Primary Zone (1.0) = 1,864.985

PHUs needed to compensate for impacts of Project in Secondary Zone = Total PHUs lost in Secondary Zone (167.796 PHUs) x Base Ratio for Primary Zone (2.5) x Landscape Multiplier for Primary Zone (0.69) =289.4481 PHUs

Total PHUs needed to compensate for impacts to Project = PHUs needed to compensate for impacts in Primary Zone (1,864.985 PHUs) + PHUs needed to compensate for impacts Secondary Zone (289.4481 PHUs) = 2,154.4431 (rounded to 2,154).

Table 3. Reported minimum panther population counts

Year	Total	Mortality	Net
2000	62	13	49
2001	78	11	67
2002	80	14	66
2003	87	24	63
2004	78	20	58
2005	82	12	70
2006	97	19	78
2007	117	25	92
2008	104	23	81
2009	113	24	89
2010	115	24	91
2011	111	24	87
2012	123	29	94
2013	133	29	104
2014	138	24	114
2015	149	41	108
2016	*	*	*

*Data not yet available

Table 4. Panther-Vehicle Collisions within Action Area as of September 2016.

Panther ID	Location	Year	Sex	Result
FP21	Palm Drive	1988	Female	Injury
UCFP62	U.S. Highway 41	2004	Female	Death
UCFP80	Card Sound Road	2006	Female	Death
UCFP96	U.S. Highway 1	2007	Female	Death
UCFP101	U.S. Highway 41	2007	Male	Death
UCFP110	Ingraham Highway	2008	Female	Death
UCFP160	U.S. Highway 41	2011	Male	Death

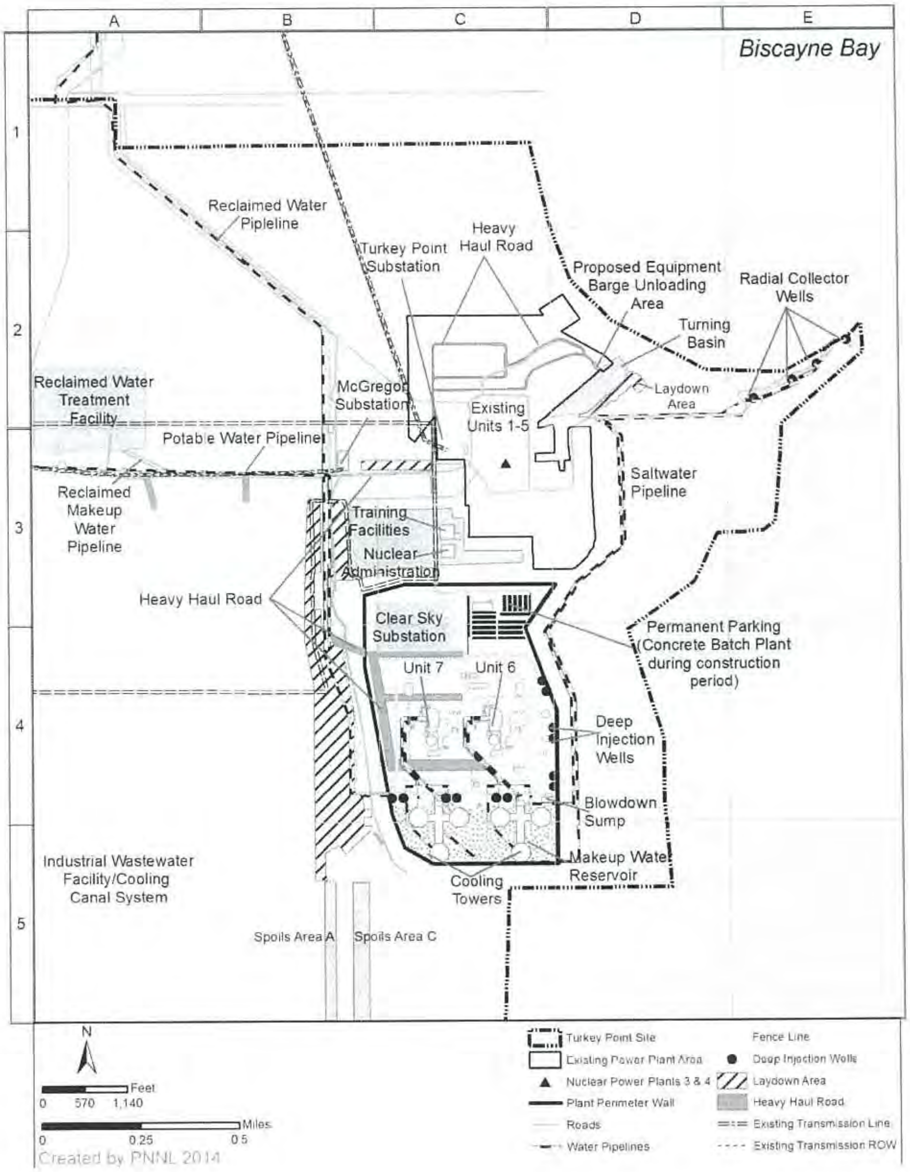

Figure 1. Site layout for Units 6 and 7 and associated facilities.

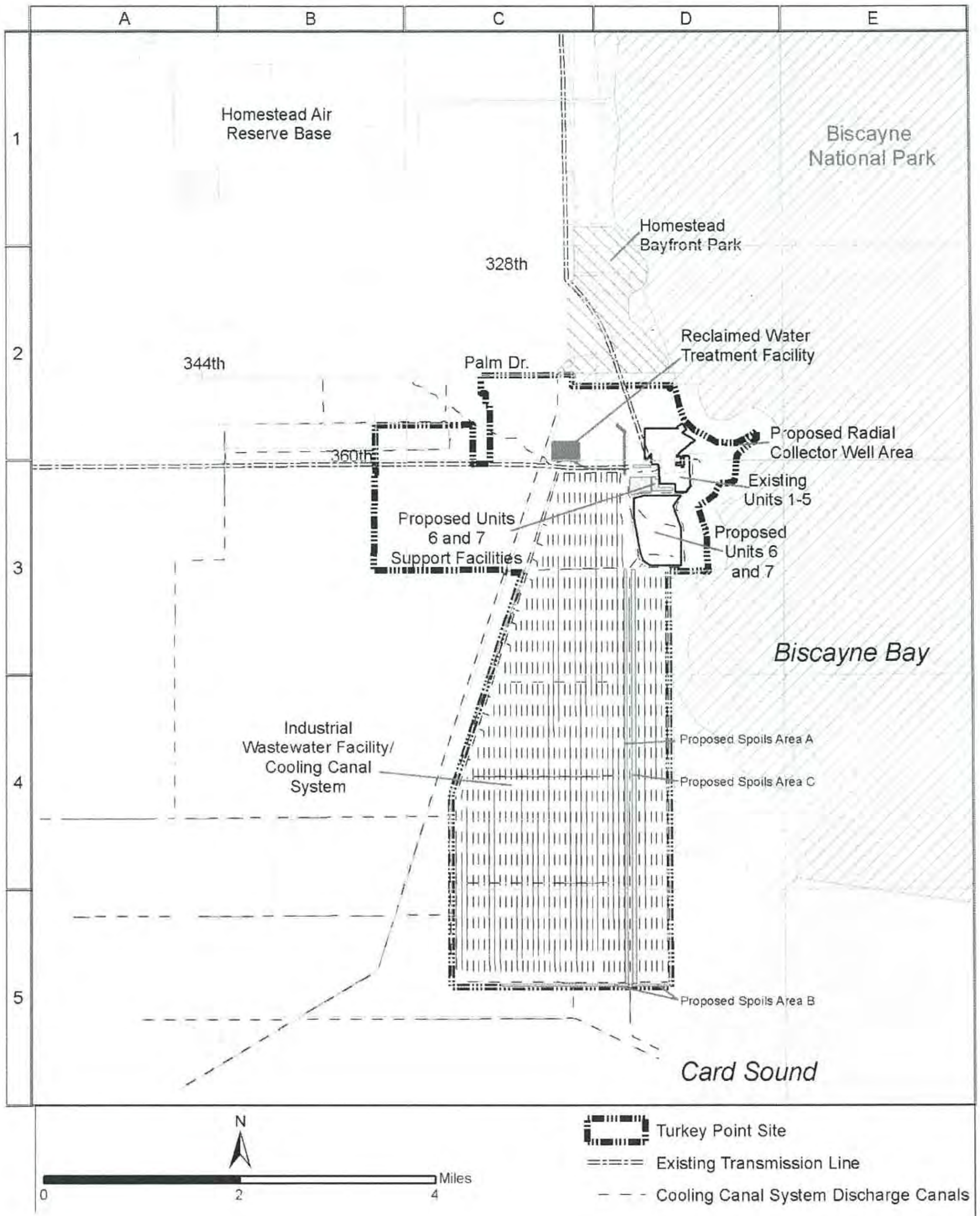

Figure 1 Continued. Site layout for Units 6 and 7 and associated facilities.

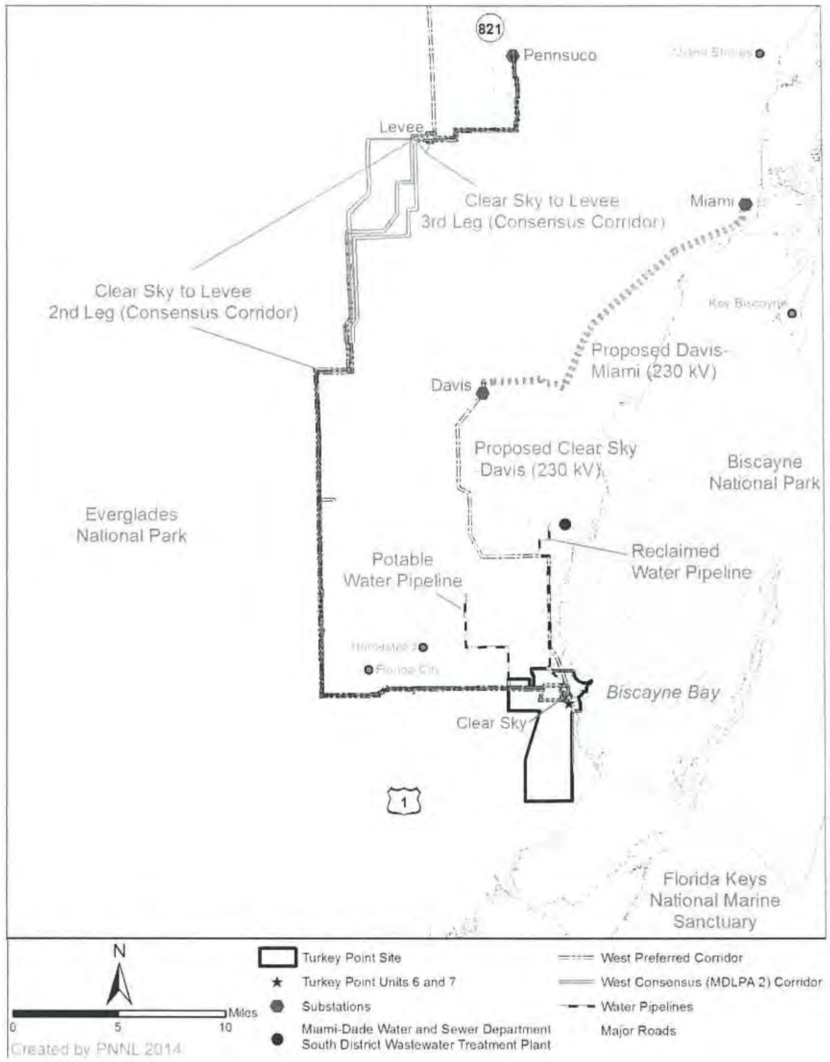

Figure 2. Location map of proposed transmission line corridors.

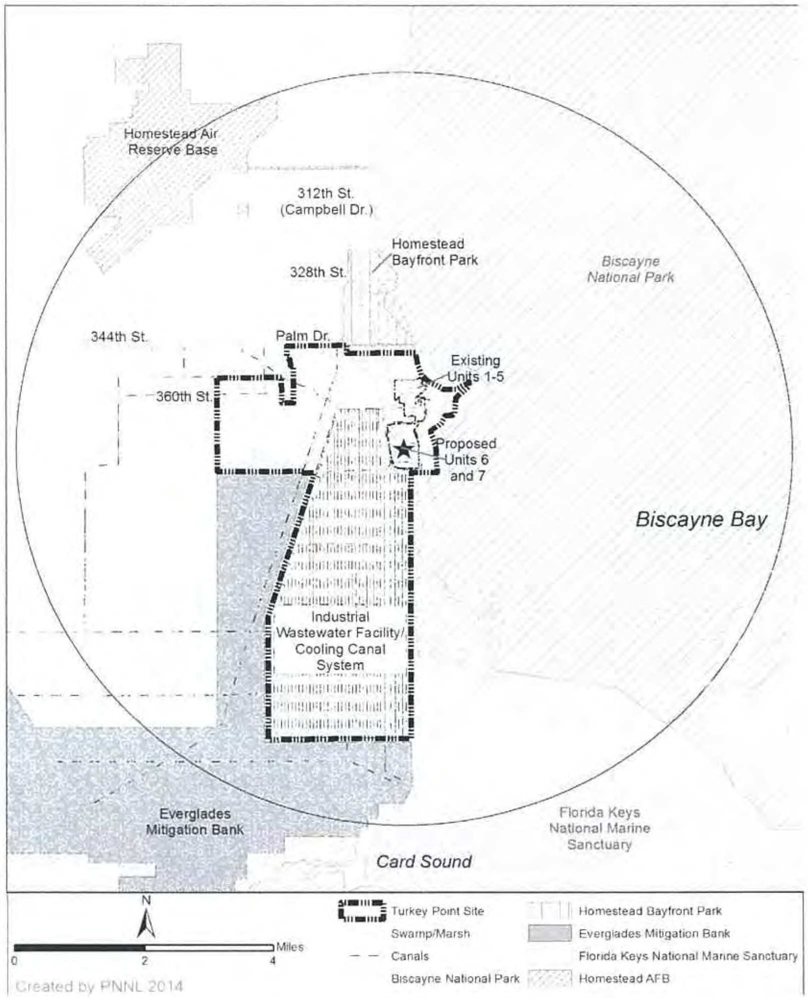

Figure 3. Location map for Project in Miami-Dade County, Florida.

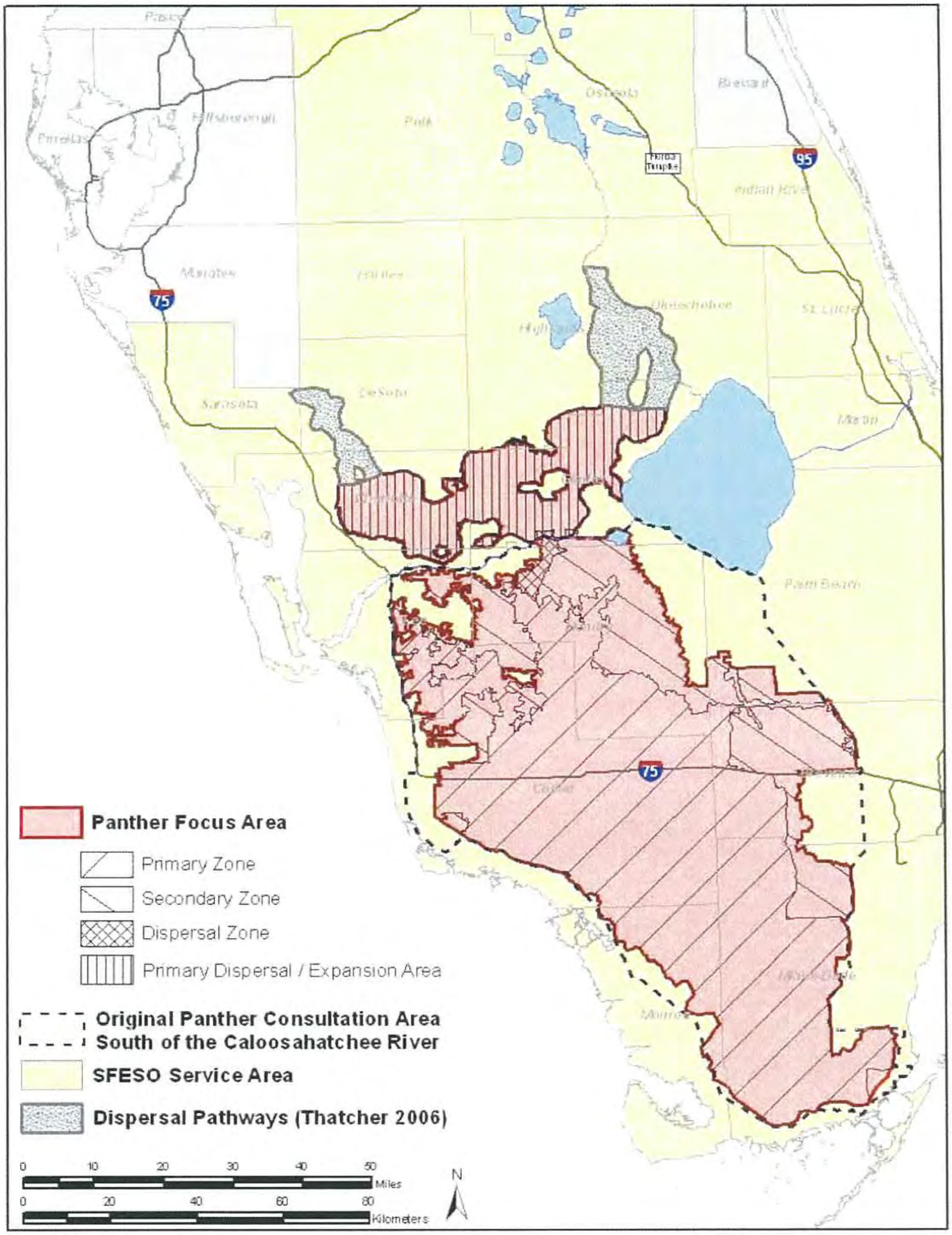

Figure 4. The Service's Florida Panther Focus Area.

APPENDIX A: FPL Avian Protection Plan

APPENDIX B: Status of the Species

Avian Protection Plan
Florida Power & Light Company

Submitted to:

Florida Power & Light Company
700 Universe Blvd.
Juno Beach, FL 33408

Prepared by:

Pandion Systems, Inc.
4603 NW 6th Street
Gainesville, FL 32609
www.pandionsystems.com

With assistance from:

EDM International, Inc.
4001 Automation Way
Fort Collins, Colorado 80525

May 2007

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ACRONYMS AND ABBREVIATIONS

AEC	Area Environmental Coordinator (Distribution Systems)
APLIC	Avian Power Line Interaction Committee
APP	Avian Protection Plan
BGEPA	Bald and Golden Eagle Protection Act
CFR	Code of Federal Regulations
ESA	Endangered Species Act
ESBA	Environmentally Sensitive Bird Area
FAC	Florida Administrative Code
FPL	Florida Power & Light Company
FWC	Florida Fish and Wildlife Conservation Commission
USFWS	U.S. Fish and Wildlife Service
IEEE	Institute of Electrical and Electronics Engineers
JES	Juno Environmental Services
KDS	Knowledge Delivery System
MBTA	Migratory Bird Treaty Act
NRECA	National Rural Electric Cooperative Association
PSC	Power Systems Coordinator
ROW	Right-of-way
SAP	System Applications and Products
SME	Subject Matter Expert
SSC	Species of Special Concern
T&E	Threatened and Endangered
TPS	Transmission Project Siting
U.S.	United States

1. INTRODUCTION

Florida Power and Light Company (FPL) has been committed to the protection of endangered and migratory birds through corporate policy since 1985. This includes compliance with applicable Federal and State regulations, avian-adapted design standards, an active mandatory training program for personnel, and various avian protection programs including nest management and avian enhancement activities.

Recently the Avian Power Line Interaction Committee (APLIC) and the U.S. Fish and Wildlife Service (USFWS) developed Avian Protection Plan Guidelines (2005) for utilities to design and document their program for reducing operational avian risks that result from avian interactions with electric utility facilities. As a member of the APLIC, FPL was a contributor to those Guidelines.

As an on-going commitment to avian protection of Federal and State listed species and all migratory birds, FPL has developed an Avian Protection Plan (APP) that adheres to the APLIC and USFWS Guidelines. This APP, which brings together all existing avian protection programs in a single document, is designed to provide a single resource for all activities relating to avian protection for FPL management and field personnel. This document addresses avian protection issues including FPL's corporate policy, the regulatory context for avian protection, regulatory compliance procedures, proactive electric utility structure retrofit program, FPL avian-adapted construction design standards, mandatory training program in avian protection, and various avian protection strategies.

For further information regarding FPL's Avian Protection Plan please contact FPL Power Systems Permit Specialist, Area Environmental Coordinator (AEC), Transmission Project Siting (TPS), and/or Juno Environmental Services (JES).

2. FPL CORPORATE AVIAN PROTECTION POLICY

It is the intent of FPL to conduct its business in a manner that is consistent with responsible avian protection, including compliance with applicable regulations. In order to achieve this goal, FPL has developed this APP with specific methods, approaches, and directives to minimize avian electrocutions and collisions. These requirements include, but are not limited to:

- Proper Siting of Electric Utility Structures
- Use of Approved Avian-adapted Construction Design Standards
- Timely Repair and Retrofitting of Structures
- Proactive Retrofitting of Structures Identified by the Risk Assessment Process
- Regulatory Compliance Procedures
- Employee Training in Avian Protection
- Personnel Safety Procedures
- Coordination with Regulatory Agencies

FPL continues to work on improving avian protection because it recognizes that providing safe, reliable, and cost-effective electricity can be accomplished in a manner that also protects avian species.

3. BACKGROUND: AVIAN INTERACTIONS WITH UTILITY FACILITIES

More than 400 species of birds can be found in Florida (Ewel 1990). This great diversity of birds is due to the combination of climate and geography. The temperate climate in North Florida and the broad attachment/connection between the Florida panhandle and the remainder of the Continental US results in diversity of temperate bird species. The subtropical climate in South Florida and its physical proximity to the Caribbean and Central and South America result in an influx of tropical bird species that have limited distribution elsewhere in the US. Some species occur in flocks of several hundred to thousands of birds at nesting sites in Florida, especially South Florida.

This diversity of species can be expressed using parameters of size, behavior, and habitat use. Florida bird species range from some of the smallest birds in North America such as the Ruby-throated Hummingbird (*Archilochus colubris*) at approximately 3 inches in length to some of the largest birds such as Sandhill Cranes *(Grus canadensis*) and Bald Eagles (*Haliaaetus leucocephalus*) at more that 3 feet in length and with wingspans greater than 6 feet. Foraging behaviors include still hunting, aerial capture, gleaning, etc. Chick rearing behaviors range from nearly no parental involvement after hatching to parental care that stretches for months. Nesting behaviors range from ground nesting in sandy scrapes to massive stick nests that are expanded each year to grow over 6 feet wide. Habitat use includes Florida habitats from the dry sandy uplands to the cypress swamps and marshes, from coastal to inland, and from remote areas to those in the midst of urban areas.

Florida also has the one of the fastest growing human populations in the US, with the majority of Florida's growth occurring in South Florida and coastal areas (Smith 2005). With the expansion of Florida's human population and the resultant increase in the number of utility structures, it is inevitable that avian electrocutions and collisions will result. Table 3-1 is a list of Florida bird species that have been reported injured or killed by collisions and/or electrocutions from electric utility structures in Florida. Six bird groups, including birds of prey, wading birds, swimming birds, seabirds, perching birds, and waterfowl representing 41 species have been affected. Birds of prey (e.g., Bald Eagles and various species of hawks) and wading birds (e.g., Wood Storks and various species of herons) are the most common species affected by electric utility structures. Of these 41 species 20 have been reported to have been injured and killed on FPL utility structures (Table 3-2).

Regardless of the number of birds affected, all these species are protected under the Federal Migratory Bird Treaty Act and fourteen species are protected under the Federal Endangered Species Act and/or the Florida Endangered and Threatened Species Act. In most instances, bird mortality involves a single bird and does not present a biologically significant effect to the population or species.

Table 3-1. List of Florida Bird Groups and Species that have been Reported as Injured or Killed from Interaction with Electric Utility Structures in Florida.

Species Groups[1]	Bird Species	Listed Status[2]		Type of Mortality		Source
		Federal Status	State Status	Collisions	Electrocutions	
Birds of Prey	Bald Eagle	T	T	X	X	Forrester and Spalding, 2003, FPL annual records
	Peregrine Falcon		E	X	X	Forrester and Spalding, 2003
	Red-shouldered Hawk			X	X	Forrester and Spalding, 2003
	Red-tailed Hawk			X	X	Forrester and Spalding, 2003, FPL annual records
	American Kestrel		T	X	X	Forrester and Spalding, 2003, FPL annual records
	Merlin			X		Forrester and Spalding, 2003
	Osprey		SSC	X	X	Forrester and Spalding, 2003, FPL annual records
	Barn Owl			X	X	Forrester and Spalding, 2003
	Screech Owl			X	X	Forrester and Spalding, 2003, FPL annual records
	Black Vulture			X	X	FPL annual records
	Turkey Vulture			X	X	Forrester and Spalding, 2003, FPL annual records
	Crested Caracara	T	T		X	FPL annual records
	Barred Owl				X	Forrester and Spalding, 2003, FPL annual records
	Great Horned Owl				X	Forrester and Spalding, 2003
Perching Birds	American Crow				X	Forrester and Spalding, 2003

Species Groups[1]	Bird Species	Listed Status[2]		Type of Mortality		Source
		Federal Status	State Status	Collisions	Electrocutions	
	Loggerhead Shrike				X	Forrester and Spalding, 2003
Seabirds	Brown Pelican		SSC	X	X	Forrester and Spalding, 2003
Swimming Birds	Double-crested Cormorant			X		Forrester and Spalding, 2003, FPL annual records
Wading Birds	Sandhill Crane		T	X	X	Forrester and Spalding, 2003, FPL annual records
	Whooping Crane	XN	SSC	X	X	Forrester and Spalding, 2003,
	Mottled Duck			X		Forrester and Spalding, 2003
	Great Egret			X	X	Forrester and Spalding, 2003, FPL annual records
	Snowy Egret		SSC	X		Forrester and Spalding, 2003, FPL annual records
	Great Blue Heron			X	X	Forrester and Spalding, 2003, FPL annual records
	Great White Heron			X		Forrester and Spalding, 2003, FPL annual records
	Green Heron			X		Forrester and Spalding, 2003
	Little Blue Heron		SSC	X		FPL annual records
	Tricolored Heron		SSC	X		Forrester and Spalding, 2003
	Glossy Ibis			X	X	FPL annual records
	White Ibis		SSC	X	X	Forrester and Spalding, 2003, FPL annual records
	Black-crowned Night-Heron			X		Forrester and Spalding, 2003

Species Groups[1]	Bird Species	Listed Status[2]		Type of Mortality		Source
		Federal Status	State Status	Collisions	Electrocutions	
	Yellow-crowned Night-Heron			X		Forrester and Spalding, 2003
	King Rail			X		Forrester and Spalding, 2003
	Solitary Sandpiper			X		FPL annual records
	Black-necked Stilt			X		Forrester and Spalding, 2003
	Wood Stork	E	E	X	X	Forrester and Spalding, 2003, FPL annual records
	Roseate Spoonbill		SSC		X	Forrester and Spalding, 2003
Waterfowl	American Coot			X		Forrester and Spalding, 2003
	Common Moorhen			X		Forrester and Spalding, 2003
	Blue-winged Teal			X		Forrester and Spalding, 2003
	Green-winged Teal			X		Forrester and Spalding, 2003

Notes:

1. Species Grouping follow Based on Peterson (1980)
2. E = Endangered, SSC = Species of Special Concern, T = Threatened, XN = Experimental Non-essential Population

Table 3-2 List of Florida Bird Groups and Species that have been Reported as Injured or Killed from Interaction with FPL Electric Utility Structures

Species Groups[1]	Bird Species	Listed Status[2]		Type of Mortality	
		Federal Status	State Status	Collisions	Electrocutions
Birds of Prey	Bald Eagle	T	T	X	X
	Red-tailed Hawk			X	X
	American Kestrel		T	X	X
	Osprey		SSC	X	X
	Screech Owl			X	X
	Black Vulture			X	X
	Turkey Vulture			X	X
	Crested Caracara	T	T		X
	Barred Owl				X
Swimming Birds	Double-crested Cormorant			X	
Wading Birds	Sandhill Crane		T	X	X
	Great Egret			X	X
	Snowy Egret		SSC	X	
	Great Blue Heron			X	X
	Great White Heron			X	
	Little Blue Heron		SSC	X	
	Glossy Ibis			X	X
	White Ibis		SSC	X	X

Species Groups[1]	Bird Species	Listed Status[2]		Type of Mortality	
		Federal Status	State Status	Collisions	Electrocutions
	Solitary Sandpiper			X	
	Wood Stork	E	E	X	X

Source: FPL Annual Reports to USFWS
1. Species grouping follow based on Peterson (1980)
2. Status -E = Endangered, SSC = Species of Special Concern, T = Threatened, XN = Experimental Nonessential Population

The primary hazards posed to certain groups of birds from utility structures such as distribution lines, transmission lines, and substations are injury or mortality from collision or electrocution. Two definitive publications by APLIC summarize the hazards of collisions and electrocutions and provide guidance on new designs and modification of existing designs to reduce these hazards. These publications are:

- *Suggested Practices for Raptor Protection on Power Lines* (APLIC 2006)
- *Mitigating Bird Collisions with Power Lines* (APLIC 1994).

Electrocutions result when the bird or parts of the bird make contact with energized equipment. Common electrocution situations occur when birds perch, roost, or nest on distribution poles, transmission towers, or substation structures. Collisions occur when the birds are in flight and collide with power lines.

3.1. Factors Contributing to Avian Electrocutions

Electrocution can occur whenever a bird completes an electrical circuit by spanning energized contacts (e.g., conductors, jumpers, or connectors) or spanning an energized and a grounded contact. This can happen when birds nest, perch, or roost on energized utility structures. There are a number of factors contributing to the risk of birds including bird size, bird behavior, bird abundance and habitat use, and structural design. See Section 10 for a detailed discussion of risk assessment.

3.1.1. Bird Size

Bird dimensions are important characteristics when considering bird protection from electrocution. Birds with large wingspans, including most birds of prey (e.g., hawks and eagles) are more likely to make contact with energized structures and are at greater risk of electrocution than smaller birds (e.g., songbirds) with smaller wingspans. Table 3-2 provides a summary of average bird wingspans and sizes for large bird species that occur in the FPL Service Area. These larger birds such as cranes, great blue herons, bald eagles and pelicans can be considered at greater risk for electrocution than smaller birds, as demonstrated by past avian mortality (see Table 3-1).

Table 3-3. Large Florida Bird Species that Occur in the FPL Service Territory.

Species	Wingspan (Inches)	Body Length (Inches)	Weight (Pounds)
Great Blue Heron*	84	47	6.5
Bald Eagle*	80	31	9.5
Brown Pelican*	79	51	8.2
Sandhill Crane*	79	47	10.4
Turkey Vulture*	67	26	4.0
Osprey*	63	22	3.5
Wood Stork*	61	40	5.3
Black Vulture*	59	25	4.4
Great Egret*	51	39	1.9
Great Horned Owl*	50	22	5.5
Roseate Spoonbill	50	32	3.3
Crested Caracara*	49	23	2.2
Red-tailed Hawk*	49	19	2.4
Snail Kite	42	17	0.9
Red-shouldered Hawk*	40	17	1.4
American Crow*	39	18	1.0
Fish Crow	36	15	0.6

Adapted from Wheeler and Clark 1995, Terres 1991, and Sibley 2000
* Have reported mortality due to power lines (see Table 3-1)

3.1.2. Bird Behavior

Behavioral characteristics of a bird species can increase their tendency to utilize power structures or other elevated manmade structures.

Nesting

Eagles and Ospreys will use man-made nesting structures when natural substrates (e.g., large pine trees) are not found in otherwise suitable habitat. Nesting on these structures creates an increased likelihood of contact between two energized parts (electrocution risk) because the nesting behavior requires that the birds spend much of their time in proximity to these structures. Young birds are particularly vulnerable when fledging due to their flight inexperience and reduced maneuverability. The nest itself can also increase electrocution risk as it can span the gap between energized equipment.

Some species have adapted to using utility structures and other man-made structures for nesting and are at greater risk than other species that have not adapted. For example, the Osprey has adapted and benefited from using artificial structures for nesting. In 2003, more than 100 Osprey nests were located on FPL utility structures. Although benefiting the species as whole by expanding its range, this adaptation presents a hazard to this species from electrocution. The nests also present an operation and management issue when they interfere with electrical reliability.

Foraging

Foraging behaviors that may increase the risk of electrocution include perching on power structures as part of a still-hunting strategy employed by many raptors. Also, perching with large prey items or wet prey (e.g., Osprey with fish) may result in electrocution. An incident of electrocution of a Bald Eagle attempting to bring a fish to a distribution line has been reported in the FPL Service Area.

Perching and Roosting

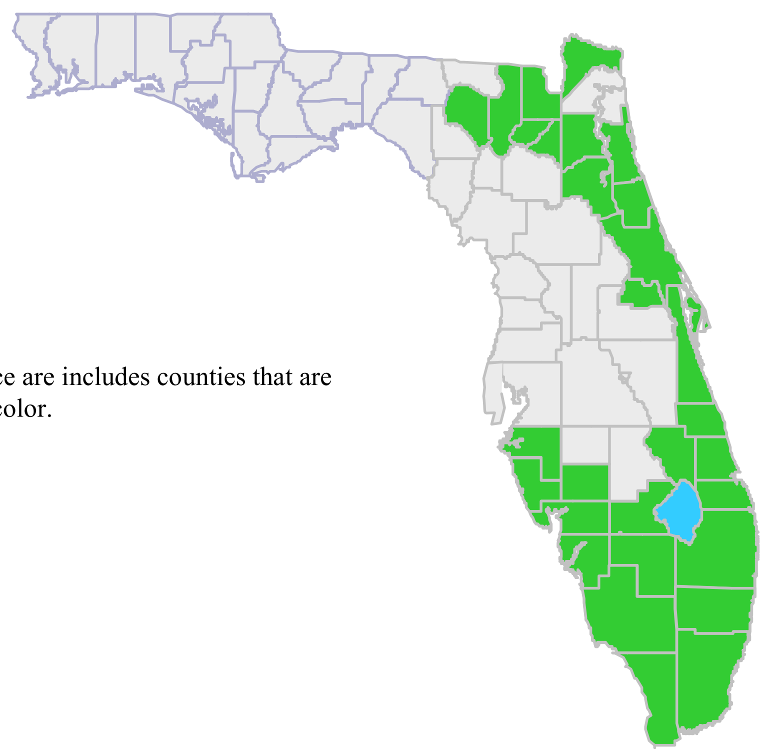
Birds of prey (e.g., vultures) may use power line structures as roost sites (nocturnal perching), or as daytime perches. Communal roosting birds such vultures are at greater risk than birds that roost singly because crowding on the structure can lead to greater likelihood of energized contact. Some wading birds (e.g., Great Blue Herons) may also perch on utility structures.

3.1.3. Bird Abundance and Habitat Use

The FPL Service Area (Figure 3-1) has a wide diversity of coastal freshwater and saltwater wetland and aquatic habitats from Nassau County in the north to Miami/Dade County in the South around to Manatee County on the west coast. These coastal ecosystems support an abundant bird life. Inland ecosystems in the FPL Service Area include forested and non-forested uplands interspersed with lakes, streams, and rivers that are used by both resident and migratory birds for feeding, perching, roosting, and nesting.

Man-made habitats such as retention ponds, canals, and water management areas are common through out the FPL Service Area. These man-made habitats also attract birds and are used as feeding, perching, roosting, and nesting habitats. The risks of electrocution associated with these habitats can be exacerbated when power line structures are established in or around such habitats for servicing residential or commercial development.

Figure Error! No text of specified style in document.**-1. FPL Service Area.**



In other cases, human activity has attracted birds to habitats with utility structures where artificial food sources exist (e.g., dairy pasture and backyards). In one instance, electrocutions resulted when wood storks fed chicken hot dogs became habituated to this food source and started perching on a distribution pole.

3.1.4. Structural Design

APLIC and the Raptor Research Foundation recommend a minimum 60-inch spacing between phases and phase-to-ground for minimizing bird (specifically eagle) electrocutions (APLIC 2006). Birds with a shorter wingspan are assumed to be protected by this spacing.

The presence of other energized equipment (e.g., transformers, jumper lines) may reduce this spacing to less than 60 inches, thus presenting an electrocution risk.

3.2. Factors Contributing to Avian Collisions

A number of factors contribute to species vulnerability to collision with overhead wires, including bird size, flight behavior, bird abundance and habitat use, and structural design.

3.2.1. Bird Size

Large birds such as herons, cranes, swans, and pelicans are reported as casualties from distribution and transmission line collisions because of their large wingspans and heavy body mass (see Table 3-2) and the resulting lack of agility.

3.2.2. Flight Behavior

Bird species vary in their flight behavior and flight agility, which are products of the aspect ratio and wing loading of each species. Aspect ratio is the ratio of wing area to wing breadth. High aspect ratio translates into faster and more maneuverable flight behavior. For example, the more agile eagle has an aspect ratio of around 9.3 versus a wading bird with an aspect ratio of 12.5 (Earthlife 2005). Wing loading is a ratio of total body weight to total wing area. High wing loading translates into a heavier and more labored flight pattern. Many wading birds have high wing loading recognized by their low rate of wing flapping. They are at more risk of collision than birds with low wing loading. Generally, species that fly rapidly, pursue prey aerially, or have a high wing loading are more vulnerable to collision hazards than other species. Birds flying in flocks, such as waterfowl and wading birds, may result in lower maneuverability and thus increases collision risk. The less controlled flight of juvenile or immature birds also increases their collision risk.

3.2.3. Bird Abundance and Habitat Use

The wide diversity of natural and manmade wetlands and deep-water habitats in the FPL Service Area are used for feeding, perching, roosting, and nesting as well as migration stop over sites and over wintering. Preferred habitats have higher bird abundance than other areas. Power lines that occur in or between the preferred habitats, such as between a foraging area and a roosting site of wading birds can be problematic. This is especially true when only a short distance separates them. In general, birds in these situations will fly at low altitudes potentially putting them at the height of conductors and static wires. Birds that cross power lines at low altitudes several times a day are more susceptible to collision.

In these habitats birds may also engage in behaviors that increase the risk of collision (e.g., courtship, nest building, brood rearing) as compared to other habitats.

3.2.4. Structural Design

Type of structure and arrangement of those structures is also important when determining collision likelihood. Conductors that are larger in diameter and more closely grouped are more visible to birds. In Florida, it has been observed that cranes can avoid phase conductors by rising above them, only to collide with the smaller diameter and less visible overhead static wires of transmission lines (Nesbitt pers. comm. 2005). Several collision reports have stressed that these smaller static wires are particularly likely to cause bird collisions (APLIC 1994).

3.3. Other Avian Interactions with Utility Facilities

In some instances, bird use of power structures does not cause bird injury or mortality but does create a maintenance issue. When birds foul equipment or build nests on structures, outages can result and affect electrical reliability.

3.3.1. Streamers and Fouling of Insulators

Birds can create outage problems on transmission lines and substations by fouling insulators with excrement. The excrement causes an electrical fault, which often results in an outage. There are two mechanisms of bird-caused outages due to excrement: contamination and bird “streamers.”

An electrical fault can be caused by contamination when feces build up on the insulator sheds or skirts from repeated defecation and undermine the insulating qualities, resulting in a phase-ground flashover across the surface of the insulator string under wet conditions.

A bird streamer is a long stream of excrement released by large birds, either perched on or in flight over a transmission line tower or distribution pole. A streamer that bridges the entire distance, or sufficient part thereof, between a ground and the nearest live hardware point, acts as a conducting path and an electrical fault occurs.

3.3.2. Stick Nests on Utility Structures

Many species of raptors use power line structures to nest, particularly in areas where natural nest substrates are scarce. Distribution poles and transmission towers are a very common type of artificial nest substrate used by raptors (APLIC 2006).

Nest locations on power structures vary by species and type of structure. For example, Ospreys are reported to prefer upper portions of transmission towers or tops of distribution poles. Double dead end and dead end distribution poles are the configurations commonly used by nesting osprey and other raptors in the western US (APLIC 2006).

Although most species that nest on power line structures inhabit open habitats, one notable exception is the Osprey. Of all raptors, Ospreys seem most adept at colonizing artificial nest structures, particularly power structures located near or over water sources where fish are abundant. Over 100 Osprey nests were reported in FPL utility structures in 2003.

Eagle nesting on utility structures has been reported with increasing frequency in Florida. These nest sites are located near water bodies where they forage.

3.3.3. Cavity Nests on Utility Structures

Woodpeckers create nest cavities in wooden distribution poles. The Southeastern American Kestrel (*Falco sparverius*), a State listed threatened species, has also used woodpecker cavities in utility poles for nesting.

These cavities can cause significant damage to poles by acting as an avenue for moisture intrusion and decay, and also reducing the structural integrity of the pole. Large or numerous excavations may require immediate restoration or replacement of the pole. Unfortunately, woodpeckers can cause extensive damage in a short period of time and can result in pole failures in the interval between routine inspections and the implementation of maintenance/repair or replacement procedures. The cavities also create problems for inspectors and maintenance personnel as poles with woodpecker cavities may fail at the cavity location or they may create a climbing hazard. Further, abandoned nest cavities may harbor other animals such as wasps.

3.3.4. Ground Nests in Right-of-way or Substations

Protected bird species, such as the Florida Scrub-jay (*Aphelocoma coeruilescens*) and the Burrowing Owl (*Athene cunicularia*), can nest within transmission and distribution line Rights-of-way (ROW). These nests are subject to protection during the nesting season, therefore mowing and other maintenance activities are affected.

ROWs are inspected biannually in areas where there are known scrub-jays. FPL has a Scrub-jay Habitat Management agreement with the USFWS for Brevard and Volusia Counties (Appendix I). Nests of known Burrowing Owls are marked along the ROW. Burrowing Owls are also known to nest in substations.

4. REGULATORY CONTEXT

4.1. Applicable Regulations

4.1.1. Federal Laws

There are three Federal laws that protect birds: the Endangered Species Act (ESA), the Migratory Bird Treaty Act (MBTA), and the Bald and Golden Eagle Protection Act (BGEPA). When these protected species are injured or killed by any unauthorized human activity the penalties of the applicable laws may be enforced at the discretion of USFWS.

FPL is cooperating with Federal and State agencies to minimize avian mortality and injury by developing this formal APP and continuing to implement its existing avian protection policy, procedures, and design standards. It is important for FPL personnel to be aware of and comply with these laws and applicable permit conditions including reporting any mortality of an MBTA, ESA, or BGEPA species to FWC and/or USFWS (see Section 5). Each of these Federal laws is discussed in greater detail below.

Endangered Species Act of 1973, as amended (ESA)
Special protection is afforded to threatened and endangered bird species under the Federal Endangered Species Act (7 U.S.C. 136; 16 U.S.C. 460 et seq. (1973) and Amendments). The law affords protection to fish, wildlife, and plants that are Federal listed as endangered or threatened (Appendix A). The ESA makes it unlawful to import, export, "take," transport, sell, purchase, or receive in interstate or foreign commerce any species listed as endangered or threatened alive or dead. "Take" under the ESA means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct in regards to a listed species. Violations may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. The ESA increases protection to habitat and prohibits the harassment of threatened and endangered birds. See Appendix A for a list of Federal protected species found in the FPL Service Area.

Maximum penalties (misdemeanor) for violations include fines up to $100,000 per individual and $200,000 per organization, as well as up to 1 year of imprisonment. Vehicles and equipment can also be confiscated.

ESA, as amended, has provisions for permitted "incidental take" under Section 7 and Section 10 of the Act. An Incidental Take Permit can be applied for Under Section 10 (a)(1)(B), which allows for otherwise prohibited take dependent on the following criteria: the take is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.

Migratory Bird Treaty Act (MBTA)
The Migratory Bird Treaty Act, (16 U.S.C. 703-712; Ch. 128; July 13, 1918; 40 Stat. 755 and Amendments) applies to the vast majority of birds in the United States (See 50 Code of Federal Regulations (CFR) § 10.13) with the exception of a few species, such as the introduced House Sparrow, European Starling, Rock Pigeon or Common Pigeon, and Monk Parakeet. The State of

Florida has approximately 480 confirmed species of birds (includes breeding and non-breeding migratory species) protected under the MBTA (Florida Ornithological Society 2003).

The purpose of the MBTA is to afford protection to migratory birds, their parts, nests, and eggs. The MBTA states that, unless permitted by regulation, it is unlawful to "pursue, hunt, "take," capture, kill, possess, sell, barter, purchase, ship, export, or import any migratory birds alive or dead, or any part, nests, eggs, or products thereof."

Culpability is strict liability; no degree of knowledge of the law need be proven during prosecution under this law. Migratory bird electrocutions violate the misdemeanor provisions of the MBTA. For misdemeanors, the penalties include fines up to $5,000 per individual and $15,000 per organization and up to 6 months imprisonment.

Bald and Golden Eagle Protection Act (BGEPA)
Bald and Golden Eagles, their eggs and their nests receive additional protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d, 54 Stat. 250 and Amendments). The BGEPA states "no person shall "take," possess, sell, purchase, barter, offer for sale, transport, export, or import any Bald or Golden Eagle alive or dead, or any part, nests or eggs, thereof without a valid permit to do so." The BGEPA expands protection beyond the MBTA to define "take" to include to molest or to disturb.

Culpability for BGEPA violations is knowingly or with wanton disregard for the consequences of their act. Maximum criminal penalties for misdemeanor violations of the BGEPA include fines up to $100,000 per individual and $200,000 per organization and up to 1 year of imprisonment. Vehicles and equipment can also be forfeited for violations.

4.1.2. Florida Statutes

General Rules for all Wildlife Species
Florida has laws and regulations that broadly protect all native wildlife, including those that are not protected by the Florida Endangered and Threatened Species Act.

Florida Administrative Code (FAC 68A-4.001) states that "no wildlife or freshwater fish or their nests, eggs, young, homes or dens shall be taken, transported, stored, served, bought, sold, or possessed in any manner or quantity at any time except as specifically permitted by these rules nor shall anyone take, poison, store, buy, sell, possess or wantonly or willfully waste the same except as specifically permitted by these rules."

Florida Endangered and Threatened Species Act
The Florida Administrative Code (68A-27.003, 68A-27.004, 68A-27.005) designates the species classified as Endangered, Threatened, or Special Concern and provides for the additional prohibitions, penalties, and permits for these species. See Appendix A for a list of State protected species found in the FPL Service Area.

The Florida Endangered and Threatened Species Act (Florida Statute, §372.072) declares "it is unlawful for a person to intentionally kill or wound any fish or wildlife of endangered, threatened, or special concern species or to intentionally destroy the eggs or nest of any such fish or wildlife," except as provided for in the rules of various State agencies.

The rules for obtaining a permit are most stringent for Endangered Species, in which instances permits are issued only when the permitted activity will clearly enhance the survival potential of the species. For threatened species permits are issued only for scientific or conservation purposes and only upon a showing by the applicant that the permitted activity will not have a negative impact on the survival potential of the species. For species of special concern permits are issued upon reasonable conclusion that the permitted activity will not be detrimental to the survival potential of the species.

4.1.3. Local Regulations

Local governments can further restrict certain wildlife activities covered by State and Federal statues; generally these are land development regulations or ordinances and apply in the siting and construction of power lines. For example, Lee County has specific land development regulations for Bald Eagles (Lee County Government 2005).

4.2. Enforcement Actions

Federal Laws

The ESA has procedures in place (Section 7 and Section 10 of ESA) for issuing a permit that allows some incidental mortality (take) of listed wildlife under specific circumstances. However, the MBTA and BGEPA do not have such a permitting process. Therefore, under the MBTA and BGEPA most bird mortality is considered take and could result in prosecution by USFWS.

USFWS recognizes that some birds may be killed even if all reasonable measures to avoid "take" are implemented. It is USFWS policy to exhibit prosecutorial discretion in enforcement of these laws where avian protection policies exist and are implemented (Avian Protection Plan Guidelines 2005).

According to the Avian Protection Plan Guidelines (APLIC and USFWS 2005), a utility that implements an avian protection plan will greatly reduce avian risk as well as its own risk of enforcement under the MBTA. The Avian Protection Plan Guidelines state:

> "While the Service generally does not authorize incidental take under these Acts, USFWS realizes that some birds may be killed even if all reasonable measures to avoid the take are implemented. USFWS Office of Law Enforcement carries out its mission to protect migratory birds through investigations and enforcement, as well as by fostering relationships with individuals, companies, and industries that seek to minimize their impacts on migratory birds. Unless the take is authorized, it is not possible to absolve individuals, companies, or agencies from liability even if they implement avian mortality avoidance or similar conservation measures. However, the Office of Law Enforcement focuses on those individuals, companies, or agencies that take migratory birds with disregard for their actions and the law, especially when conservation measures have been developed but are not properly implemented." (APLIC and USFWS 2005)

State Laws
Florida law states that violations regarding endangered or threatened species are a felony of the third degree, punishable as provided by statute (s. 775.082, s. 775.083, or s. 775.084). Prosecution for violations of State law falls under the jurisdiction and discretion of the State Attorney.

4.3. FPL Permits Relating to Avian Interactions with Utility Structures

In compliance with State and Federal regulations FPL holds several permits relevant to bird injury, bird mortality, and nest management at FPL facilities. These permits include two types of carcass salvaging permits and a migratory bird nest removal permit. In addition, JES maintains a copy of active permits in the FPL Permit Database that can be accessed through the FPL internet at the following path: INFPL > Services > Environmental Services > Programs & Services > Permit Database.

4.3.1. Carcass Salvaging Permits

FPL has two types of salvaging permits: a Florida Scientific Collecting Permit and a Federal Special Purpose Salvage Permit. Neither permit allows for possession of any birds or bird parts other than is necessary for transport and disposal as described in the permit language. A Federal permit is required to obtain and keep any part of any endangered species. Therefore, under no circumstances give away or keep any parts (e.g., feathers) of an endangered species.

Florida Scientific Collecting Permit
FPL's Scientific Collecting Permit issued by FWC is used for salvaging and possession of carcasses of birds protected under the MBTA, ESA, and BGEPA. Salvage of Federal protected species requires an additional Federal Special Purpose Salvage Permit. Salvaged birds may be temporarily transferred as long as a copy of the permit accompanies the carcass. An annual report detailing the number of each species, the dates, and locations of these carcasses must be submitted to FWC by the beginning of February. See Appendix B for a copy of this permit.

Federal Special Purpose Salvage Permit
FPL's Special Purpose Salvage Permit is issued by USFWS and addresses dead birds. It allows for the burial or incineration of migratory birds found dead on FPL property. If the bird is a Federal endangered or threatened species, USFWS must be notified within 48 hours of discovery of the carcass. If any migratory bird carcass is found where poisoning or shooting (criminal intent) is indicated, the carcass should not be salvaged but immediately reported to State and Federal Wildlife Enforcement authorities (see Section 15.2 for contact information). This permit requires that an annual report (January to December) be submitted to USFWS by January 31 of the following year. See Appendix C for a copy of this permit.

4.3.2. Migratory Bird Nest Removal Permits

Florida State Migratory Bird Nest Removal Permit
The management of *inactive* migratory bird nests, including Osprey and Burrowing Owl nests, is permitted through the Migratory Bird Nest Removal Permit process implemented by the FWC, as per Chapter 68A of the Florida Administrative Code. Inactive nests are determined by the absence of any egg or dependent (i.e., flightless) young in the nest. A copy of the permit must be available for inspection while engaging in the permitted activities. Permits are revocable and

require periodic renewal. Permit compliance requires that an annual report detailing the number of nests taken down and the dates and locations of these nests must be submitted to FWC at the end of June. See Appendix D for a copy of this permit.

Osprey Nest – For Ospreys, the permit allows the removal of inactive Osprey nests as a part of routine facility maintenance. The permit requires that a replacement nesting structure of comparable or better quality be erected by the permittee. The FWC provides guidelines for the construction of Osprey nest platforms (Appendix E).

Other MBTA Species Nest – The permit allows the removal of inactive nests of other migratory birds without replacement.

State and Federal Listed Species Nest (excluding Bald Eagle) – The permit **does not** authorize the taking of *active* nests of State or Federal listed species, or the taking of any Bald Eagle nest. A separate permit is required (see Section 5.6 for more information on protections for State and Federal listed species).

Federal Depredation Permit
This permit authorizes the relocation of active migratory bird nests in emergency situations throughout FPL service territory (except endangered or threatened species or bald and golden eagle nests) when birds, nests and eggs are posing a direct threat to human health and safety or when the safety of the bird is at risk if the nest and/or birds are not removed. Relocation of active migratory bird nests also requires permission from the state on a case by case basis. (See Appendix D.1)

4.4. Permittee Responsibility

Activities involving possession of bird carcasses, potential disturbance of birds, or removal of nests must follow the guidelines and procedures in Section 5. All employees shall be responsible for knowing and complying with this APP. FPL is ultimately responsible for activities performed by its contractors. This includes situations in which contractor activities impact birds.

The Permit Specialists or TPS are responsible for making arrangements with the USFWS and the FWC to obtain necessary permits or guidance. Any contact with a Federal or State officer should be handled as a regulatory inspection, and employees must follow their department's applicable procedure.

5. REGULATORY COMPLIANCE

FPL's Corporate Avian Protection Policy is to conduct its business in a manner that is consistent with responsible avian protection including compliance with applicable regulations. **FPL employees are responsible for understanding and complying with Federal and State requirements for endangered and threatened birds and other migratory birds.** Failure to comply can result in project delays and in personal and/or corporate liability.

This section contains specific procedures to follow for achieving regulatory compliance in the event of bird mortality, bird injury, and nest management. Achieving regulatory compliance involves the following factors that determine the applicable laws and regulations, relevant permits, and allowable actions to correct the situation:

- Determine the Significance of the Incident and/or Reliability Implications (emergency or non-emergency situation)
- Identify the Type of Species Involved
- Respond According to the Type of Incident. Different regulatory policies, permits and FPL policies for corrective action apply depending upon the type of incident:
    - Bird Mortality (a carcass is found)
    - Bird Injury
    - Nest Management

5.1. Determine Significance of Incident

Significance applies primarily to nest management in regards to reliability implications. There are two levels of significance: an emergency and a non-emergency situation.

Emergency situations are situations where human health and safety are at risk and immediate corrective action is necessary. Emergency situations include actual or potential electric outages to critical facilities such as hospitals. In emergency situations corrective action should be taken, as per FPL policy, regardless of the species or species group involved. The Permit Specialist or TPS should be notified before or as soon as possible after the corrective action has occurred. The Permit Specialist or TPS, or JES Environmental Specialist will apply for the appropriate permits and make every effort to meet permit requirements (including mitigation) but is cognizant of the fact that the regulatory consequences are secondary in the event of a hazardous situation.

Non-emergency situations are all other situations where immediate corrective action is not necessary. For non-emergency situations the Permit Specialist, TPS, or JES Environmental Specialist and appropriate agency personal must be notified before any action is taken.

5.2. Identify the Type of Species Involved

It is important to positively and accurately identify the species involved. If the species is incorrectly identified it can result in actions that are in violation of State and Federal laws discussed in Section 4. If you are uncertain about the identification of the bird contact the permit specialist, AEC, TPS, or JES Environmental Specialist for assistance.

To identify the type of species involved, see the Bird Species Field Identification Guide in Appendix F. Then use Figure 5-1 to identify which procedures to follow for regulatory compliance.

Summary of Protections for Types of Species
Birds encountered in the field will fall into one or more of the following species types with different protections and permitting requirements:

- Non-native Bird Species
- Bald Eagles
- Federal Listed Species (except Bald Eagles)
- Ospreys
- State Listed Species (except Ospreys)
- Migratory Birds

Non-native Bird Species – Do not receive protection under State or Federal environmental laws. Non-native species include pigeons (Rock Doves), House Sparrows, Monk Parakeets, and European Starlings.

Bald Eagles – Are protected by Federal (and State) policies including the ESA, BGEPA, and the MBTA. Both inactive and active eagle nests are protected, and it is a violation to disturb or harass eagles. Special permits can be obtained under extraordinary circumstances to perform activities that might impact these species. These permits are highly specific and of short duration. This type of permit is handled on a case-by-case basis should the need arise.

Federal Listed Species – Are protected by the ESA and MBTA. See Appendix A for a list of Federal protected species found in the FPL Service Area. It is a violation to injure, kill, disturb and otherwise harm Federal listed species. Active nests are specifically protected. Inactive nests are not specifically protected since many species build new nests every year, however, their nesting habitat is protected. For some species (e.g., the Snail Kite) geographically designated habitats have been defined by USFWS. Special permits can be obtained under extraordinary circumstances to perform activities that might impact Federal listed species. These permits are highly specific and of short duration. This type of permit is handled on a case-by-case basis should the need arise.

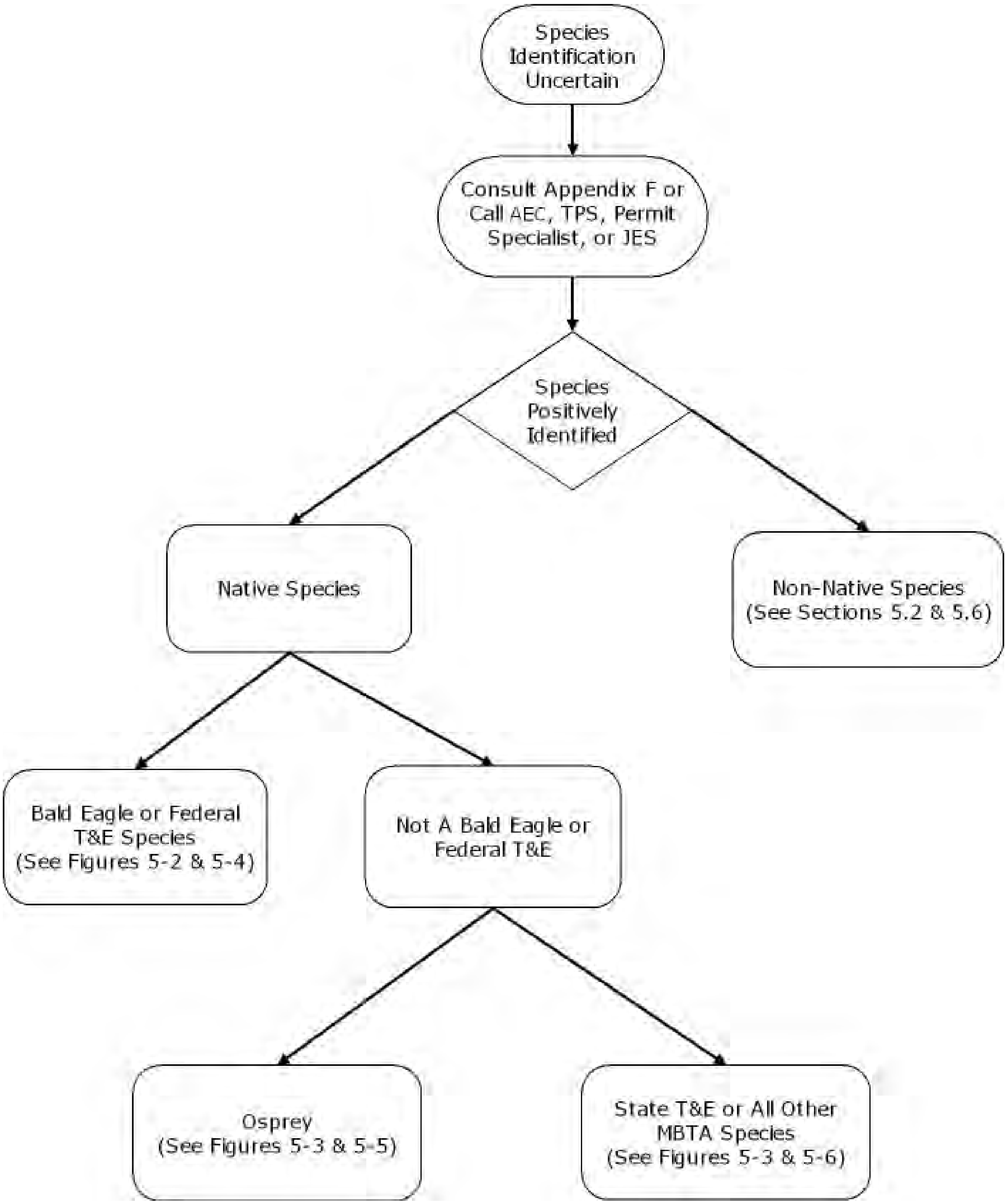
Ospreys – Are protected as a Species of Special Concern under Florida's Endangered and Threatened Species Act. FWC has developed a permitting program and nest removal policies for managing Osprey nests on utility structures (see Appendix E). FPL has a State Migratory Bird Nest Permit issued by FWC that covers nest management for Ospreys. The major difference for the management of Osprey nests is that replacement nests must be constructed if an Osprey nest is taken down.

State Listed Species (including Burrowing Owl) – Are protected under Florida's Endangered and Threatened Species Act. See Appendix A for a list of State protected species found in the FPL Service Area. Individual birds protected as well as their eggs and nests. Permits need to be obtained if there is any threat to these species or their active nests (see Section 4.3). The burrowing Owl is listed as a Species of Special Concern and specific permits and protection policies apply during the nesting season, therefore destruction of these nests due to mowing and other maintenance activities is not allowed by State and Federal law.

Migratory Birds – Are protected under Federal MBTA. This includes the vast majority of birds encountered in the field, even if they are not considered endangered or threatened at the Federal and State level. In addition, the State of Florida has adopted the Federal MBTA law. Removal or relocation of active nests of MBTA species requires a permit. FPL has a State Migratory Bird Nest Permit (see Section 4.3). Inactive nests are not protected.

Figure Error! No text of specified style in document.**-1. Species Identification and Regulatory Compliance Procedures.**

Use the decision tree to determine which procedures to follow based on the type of species. Refer to the figures indicated for detailed information on regulatory compliance procedures.



5.3. Bird Mortality Procedures

The procedures for bird mortality vary depending on the type of species involved.

- Bald Eagle and Federal Listed Species – see Figure 5-2
- Osprey, State Listed Species, Migratory Birds (Non-Federal) – see Figure 5-3

General Onsite Management

The following general guidelines apply in all bird mortality situations.

FPL Contacts – When a bird carcass is found at an FPL facility, the Permit Specialist or the TPS must be notified, and they will then notify the agencies and the AEC notifies the PSC Group (see Section 15.1). **Employees must not take possession of any bird (live or dead), portion of a bird, an egg, or portion of an egg without first contacting the Permit Specialist or TPS for guidance on proper management.**

Carcass Salvage – A Federal Special Purpose Salvage Permit and a Florida Scientific Collecting Permit (see Section 4.3) are required to retrieve carcasses. FPL JES holds these permits (see Section 4.3). Salvaged bird carcasses must be disposed of and recorded per conditions set forth in the permits.

Carcass Disposal – Local operations crews/leaders should request guidance from the Permit Specialist/TPS/AEC on the method of carcass disposal (see Figures 5-2 and 5-3). Carcass disposal methods vary according to the applicable State and Federal laws and permits and include: bury onsite, double-bag and dispose of in a dumpster at a Service Center, or preserve carcass by freezing and wait for further instructions from local USFWS contact or agent.

Personnel Safety – Utility employees should be aware of and follow Personnel Safety Procedures (Section 7) when handling bird carcasses. Diseases can be transmitted by contact with wildlife and employees should wear gloves and/or use an inverted plastic bag to pick up carcasses.

Reporting

The AEC or TPS must complete an FPL Avian Interaction Form (Appendix G) and submit to the Permit Specialist who then forwards the form to JES. The form includes the following information:

- Date
- Location
- Structure Type
- Specific Hazard (e.g., transformer, exposed jumper, etc.)
- Species or Type of Bird
- Type of interaction (e.g., nest, electrocution, collision, injury, mortality, etc.)
- Tag or banding information, if present
- Countermeasures

In the case of electrocution, it is also important to provide accurate information on how it is believed the bird made phase-to-phase or phase-to-ground contact with electric facilities. This information will be used to specify how the pole and its associated equipment are to be properly protected. Field crews must also record the action taken to correct the hazard (see Figures 5-2 and 5-3). If temporary repairs are made, suggestions for a permanent solution should be recorded. A permanent solution can be as complex as a total structure redesign or as simple as installing perching deterrents. When a permanent solution is installed, this too must be recorded.

For Power Generation, the Environmental Lead will report any bird mortalities found at the plants to JES via email.

FPL JES files annual reports with the FWC and USFWS that encompasses the company wide bird injury, mortality, and nest management activities for the preceding year.

Figure Error! No text of specified style in document.**-1. Response for Carcass of Bald Eagle and Other Federal Listed Species.**

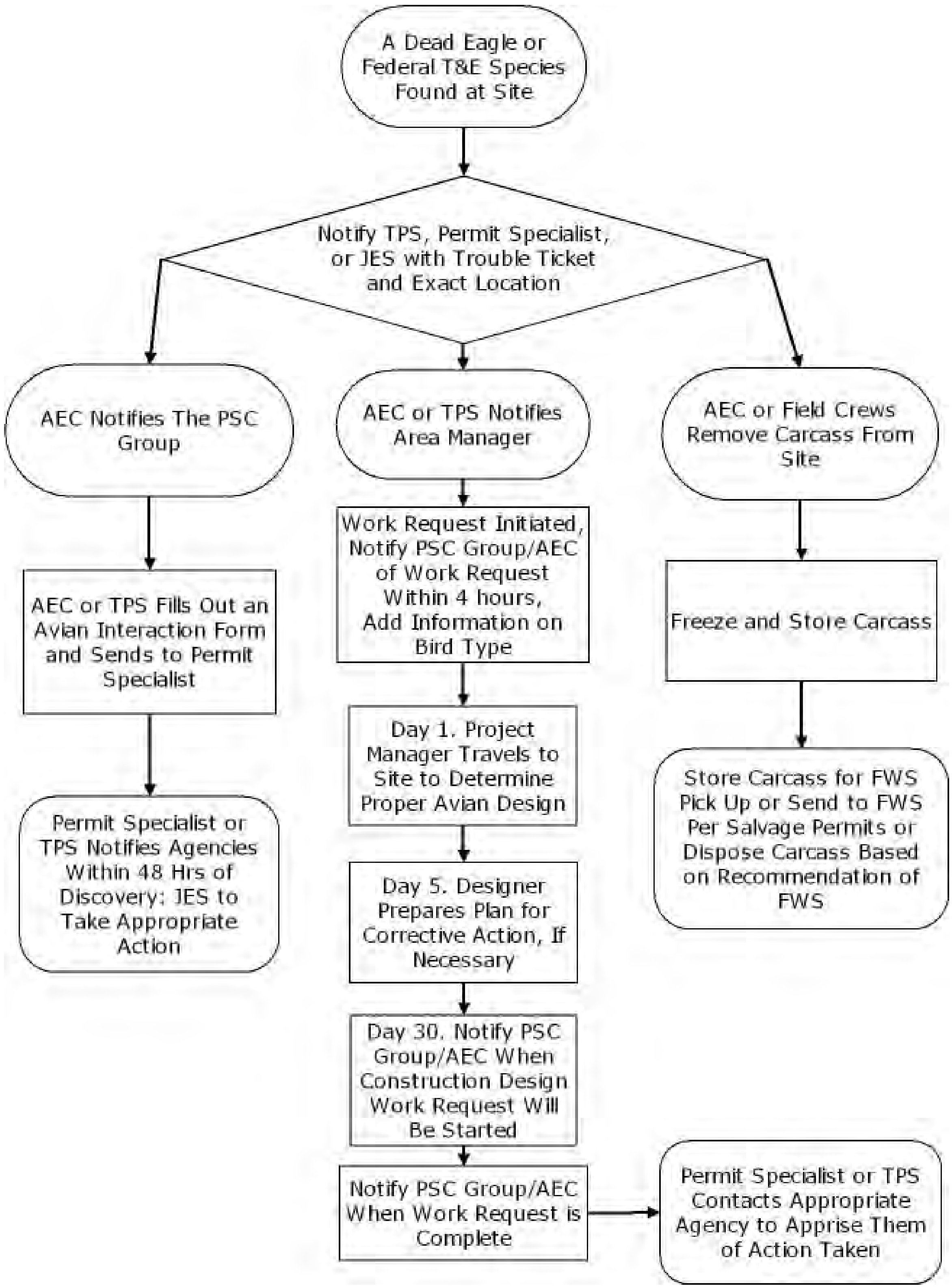
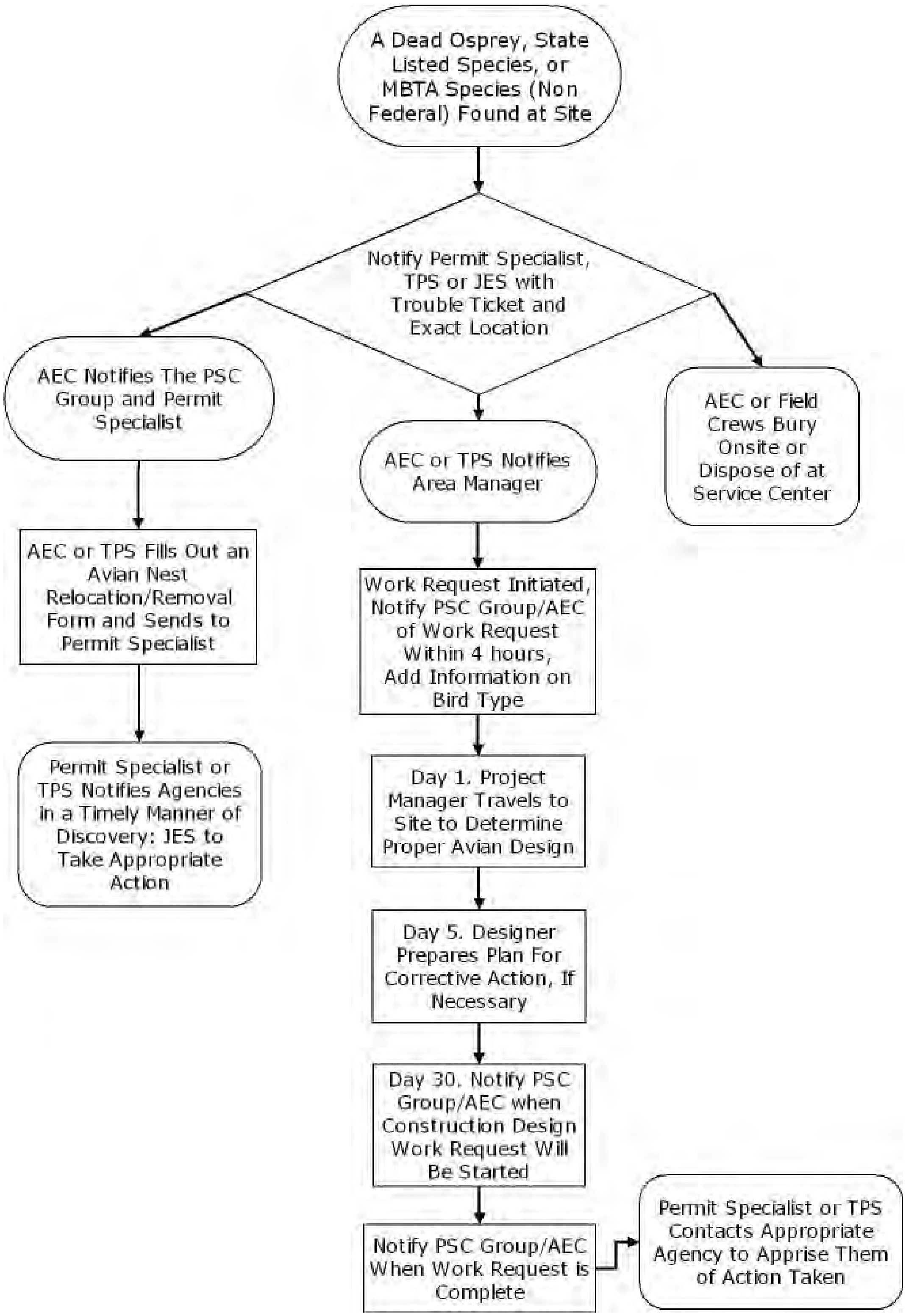

A Dead Eagle or Federal T&E Species Found at Site
Notify TPS, Permit Specialist, or JES with Trouble Ticket and Exact Location
AEC Notifies The PSC Group
AEC or TPS Notifies Area Manager
AEC or Field Crews Remove Carcass From Site
AEC or TPS Fills Out an Avian Interaction Form and Sends to Permit Specialist
Work Request Initiated, Notify PSC Group/AEC of Work Request Within 4 hours, Add Information on Bird Type
Freeze and Store Carcass
Day 1. Project Manager Travels to Site to Determine Proper Avian Design
Store Carcass for FWS Pick Up or Send to FWS Per Salvage Permits or Dispose Carcass Based on Recommendation of FWS
Permit Specialist or TPS Notifies Agencies Within 48 Hrs of Discovery; JES to Take Appropriate Action
Day 5. Designer Prepares Plan for Corrective Action, If Necessary
Day 30. Notify PSC Group/AEC When Construction Design Work Request Will Be Started
Notify PSC Group/AEC When Work Request is Complete
Permit Specialist or TPS Contacts Appropriate Agency to Apprise Them of Action Taken

Figure Error! No text of specified style in document.**-2. Response for Carcass of Osprey, State Listed Species, or Migratory Birds (Non-Federal Listed Species).**



5.4. Injured Bird Procedures

Call a Florida licensed wildlife rehabilitator (Appendix H) and use the following procedures for dead birds based on the type of species involved:

- Bald Eagle and Federal Listed Species – see Figure 5-2
- Osprey, State Listed Species, Migratory Birds (Non-Federal) – see Figure 5-3

If you must handle or capture a bird, follow the *Procedure to Restrain and Transport Birds* outlined below, while also following Personnel Safety Procedures (Section 7).

Personnel Safety – Utility employees should be aware of and follow Personnel Safety Procedures (Section 7). Do not handle any wildlife if doing so risks your safety or the safety of others. When in doubt, do not attempt to capture an injured animal. Call a licensed wildlife rehabilitator (see Appendix H) or a wildlife officer (see Section 15.2) for assistance. Remember, even a seriously injured bird is potentially dangerous. Wild birds are very unpredictable and will defend themselves.

Bird of Prey, Wading Birds and Similar Species – FPL discourages its employees from handling large bird species such as hawks, owls, eagles, falcons, egrets, herons, etc. These species have powerful and potentially dangerous defenses such as talons and piercing beaks that can result in serious harm to employees, including eye injuries. FPL employees should contact a Florida licensed wildlife rehabilitator (see Appendix H) or a FWC wildlife officer (see Section 15.2) for assistance.

While awaiting professional assistance for birds of this type, you can cover the bird, or at least its head, with a loosely woven cloth. This will minimize stress and still allow it to breath. This should only be done if the employee is wearing eye protection and can cover the bird while maintaining a safe distance from the animal.

Songbirds and Similar Small Birds – For smaller birds such as songbirds, woodpeckers, jays, crows, etc. contact a Florida licensed wildlife rehabilitator (see Appendix H) for advice on handling these species.

Procedure to Restrain and Transport Birds

Handle an injured bird as little as possible and transfer the bird as soon as possible. Any delay reduces the bird's chance for recovery. When transporting a bird, make sure the bird does not get overheated. Do not offer an injured bird food or water as this severely decreases its chance for survival. Wear gloves and eye protection.

- Obtain a cardboard box lined with a soft cloth. The box should be well ventilated (cut plenty of air holes) and just large enough to allow the bird some movement, but not so large as to allow the bird to thrash around inside.
- Obtain a towel, blanket, jacket, or any other lightweight material. At a minimum it should be large enough to cover the head and upper portions of the bird’s body but preferably it should be large enough to cover the entire bird.
- Approach the bird from behind, where it cannot track you as readily. If the bird is alert and can track your movement, anticipate that it will struggle when first covered.

- Carefully place the jacket, towel, or blanket over the bird. Make sure it is covered completely.
- Quickly restrain the bird under the covering.
- As the bird calms down, gather the covering together, being careful to get the bird's wings gently folded against the body, and place it into the cardboard box lined with a soft cloth. Once the bird is safely in the box, a lid with holes punched in it should be placed over the box to prevent the bird from escaping and to give the bird privacy. Frightened birds also find darkness calming.

Reporting
Reporting is the same as that required for dead birds (see Section 5.3 and Figures 5-2 and 5-3).

5.5. <u>Nest Management Procedures – General</u>

Procedures for nest management vary with the significance of the incident, the type of species (see Figure 5-1), and whether the nest is active or inactive. Active nests contain either eggs or young. Inactive nests are defined as those that contain no eggs or young.

See Figures 5-4 through 5-6 for the specific steps required to comply with the regulations regarding a particular species type.

- Bald Eagle and Federal Listed Species – see Figure 5-4
- Osprey – see Figure 5-5
- State Listed Species or Migratory Bird (excluding Federal listed species) – see Figure 5-6

When a trouble ticket about a nest on an FPL facility is issued, Operation Leads or the field crews should request support from the TPS or the AEC to assist with nest removals.

General Onsite Nest Management
The type of corrective action to take depends on the significance of the incident (emergency or non-emergency situation).

<u>Emergency</u> – It is FPL policy that in an emergency situation nests may be removed to address the emergency. Immediately thereafter, appropriate agencies should be notified (see Figures 5-4 to 5-6). Permits can also be requested by telephone in special emergency situations. Emergency situations are situations where human health and safety are at risk and immediate corrective action is necessary. Emergency situations include actual or potential electric outages to critical facilities such as hospitals.

If the nest is active or there are injured birds present, see Section 5.4 and contact a wildlife rehabilitator (see Appendix H). In emergency situations active nests may be trimmed (see Section 5.7). This should be coordinated with the FWC (for Osprey) and USFWS (for all Federal listed species) to minimize the chances of birds abandoning the nest.

<u>Non-Emergency</u> – In non-emergency situations for most bird species (excluding Federal listed species) a permit to remove nests can be obtained within approximately 2 weeks. Non-emergency situations are all other situations where immediate corrective action is not necessary

Personnel Safety – FPL employees should be aware of and follow Personnel Safety Procedures (Section 7). Some parasites and diseases can be transmitted by contact with nests. Appropriate safety procedures should be observed and protective clothing, eye protection, and gloves should be worn.

Public Awareness – FPL employees need to take into account public reaction in nest removal situations and act in an appropriate manner including explaining the reliability issues and maintenance requirements. FPL Corporate Communications Department will develop talking points for field crews to use in nest removal situations.

FPL Standard Procedures

When field personnel encounter a problem nest they should notify TPS or AEC. The notification should include:

- Name
- Date
- Phone number
- Service area
- Nest location
- Approximate size
- Structure involved
- Activity status (presence of eggs or young)
- Species name
- Type of emergency response
- Plan of action

To determine if the nest is active or inactive, a field visit should be conducted by Operations and TPS or AEC. The response protocol is based in part on the type of species involved and the significance of the incident (whether the nest is likely to cause an outage, i.e., an emergency situation). Emphasis should be placed on system reliability.

For active nests or for nests of Federal or State Listed Threatened and Endangered Species the field crew or AEC should immediately coordinate with the TPS or permit specialist to request approval from the appropriate agencies to remove/relocate a nest. The TPS or permit specialist will inform the field crew or AEC of the agency response.

Employees must not take possession of a nest without first contacting the Permit Specialist or TPS for guidance on proper management. Copies of the applicable permit must be in hand during any removal/relocation of a nest.

Reporting

See Figures 5-4 to 5-6 for specific reporting procedures. Depending upon the species involved USFWS and FWC as well as FPL personnel will need to be contacted.

5.6. Nest Management Procedures – Specific Bird Groups

5.6.1. Non-native Birds

Nests of non-native species are not regulated; therefore, activities involving these birds or nests can proceed without interruption. However, consideration should be given to the method of relocation or disposal of these species relative to public reaction. Non-native species include pigeons (Rock Doves), House Sparrows, Monk Parakeets, and European Starlings.

5.6.2. Bald Eagle

Procedures for managing a Bald Eagle nest are shown in Figure 5-4. Special permits and agency coordination is required for any activities potentially impacting Bald Eagles. Removal of Bald Eagle nests constitutes “take” under the ESA. Inactive nests of this species may not be impacted in any way without special permission and permits. Active nest removal also requires a special permit. These permits are difficult to obtain and a compelling reason is warranted for this authorization. Agencies typically provide authorization to remove or move an active nest only under emergency conditions.

If an eagle nest is found in the vicinity of a utility structure or on a utility structure, site specific management zones and restrictions may apply. Contact FPL Environmental Services if any activity is planned within the suspected management zones during the nesting season of October 1 to May 15. Activities around active Bald Eagle nests have restrictions that may limit operation and maintenance activities. The Habitat Management Guidelines for Bald Eagles in the Southeast Region (USFWS 1987) recommends management zones of variable distances (primary zone 0 to 750 feet and secondary zone 750 to 1,500 feet) around Bald Eagle nests. The size of the zones is determined by USFWS on a case-by-case basis depending upon surrounding land use and degree of buffer from human activity. The FWC maintains a database of known eagle nests (See http://wildflorida.org/eagle/default.htm).

5.6.3. Federal Listed Species (except Bald Eagle)

The Crested Caracara is the only other Federal Listed Species known to nest on utility structures. For managing the nest of a Federal listed species follow the procedures in Figure 5-4 for emergency and non-emergency situations. Special permits and agency coordination is required for any activities that may potentially impact these species.

Florida Scrub-jays are known to nest within transmission and distribution line corridors, known as a Right-of-way (ROW). FPL has a Scrub Habitat Management agreement with the USFWS for Brevard and Volusia Counties (Appendix I). ROWs are inspected quarterly in areas where there are known scrub-jays. When a scrub-jay nest is encountered it is not disturbed.

5.6.4. Osprey

Procedures for managing an Osprey nest are shown in Figure 5-5. FPL possesses a Migratory Bird Nest Permit, which allows removal of inactive Osprey nests (see Section 4.3). The permit requires installation of a replacement nest structure. FWC Osprey nesting guidelines are included in Appendix E.

5.6.5. State Listed Species, Migratory Birds, Burrowing Owl (except Federal Listed Species)

Procedures for managing the nest of a State listed species are shown in Figure 5-6. An FWC permit is required for both active and inactive nest management for State listed Species. FPL possesses a Migratory Bird Nest Permit (see Section 4.3), which allows removal of inactive Burrowing Owl nests. A separate permit is required for removal or disturbance of any active Burrowing Owl nest.

Nests of known Burrowing Owls are marked along the ROW. Maintenance crews should be aware of these and should not mow during the active nesting season. Follow Burrowing Owl nest guidelines established by the State if Burrowing Owl nests are encountered (Appendix J).

Procedures for managing a migratory bird nest are shown in Figure 5-6. If the species is native but not a State or Federal listed species it is still a migratory bird and as such is protected under the MBTA. FPL possesses a Migratory Bird Nest Permit, which allows removal of inactive migratory bird nests (see Section 4.3). FPL possesses a Federal Depredation Permit allowing relocation of active migratory bird nests in emergency situations. A separate State permit is required for removal or disturbance of any active migratory bird nest.

Figure Error! No text of specified style in document.**-1. Procedures for Managing Nest of Bald Eagle or Federal Listed Species**

Emergency situations are situations where human health and safety are at risk and immediate corrective action is necessary. Emergency situations include actual or potential electric outages to critical facilities such as hospitals.

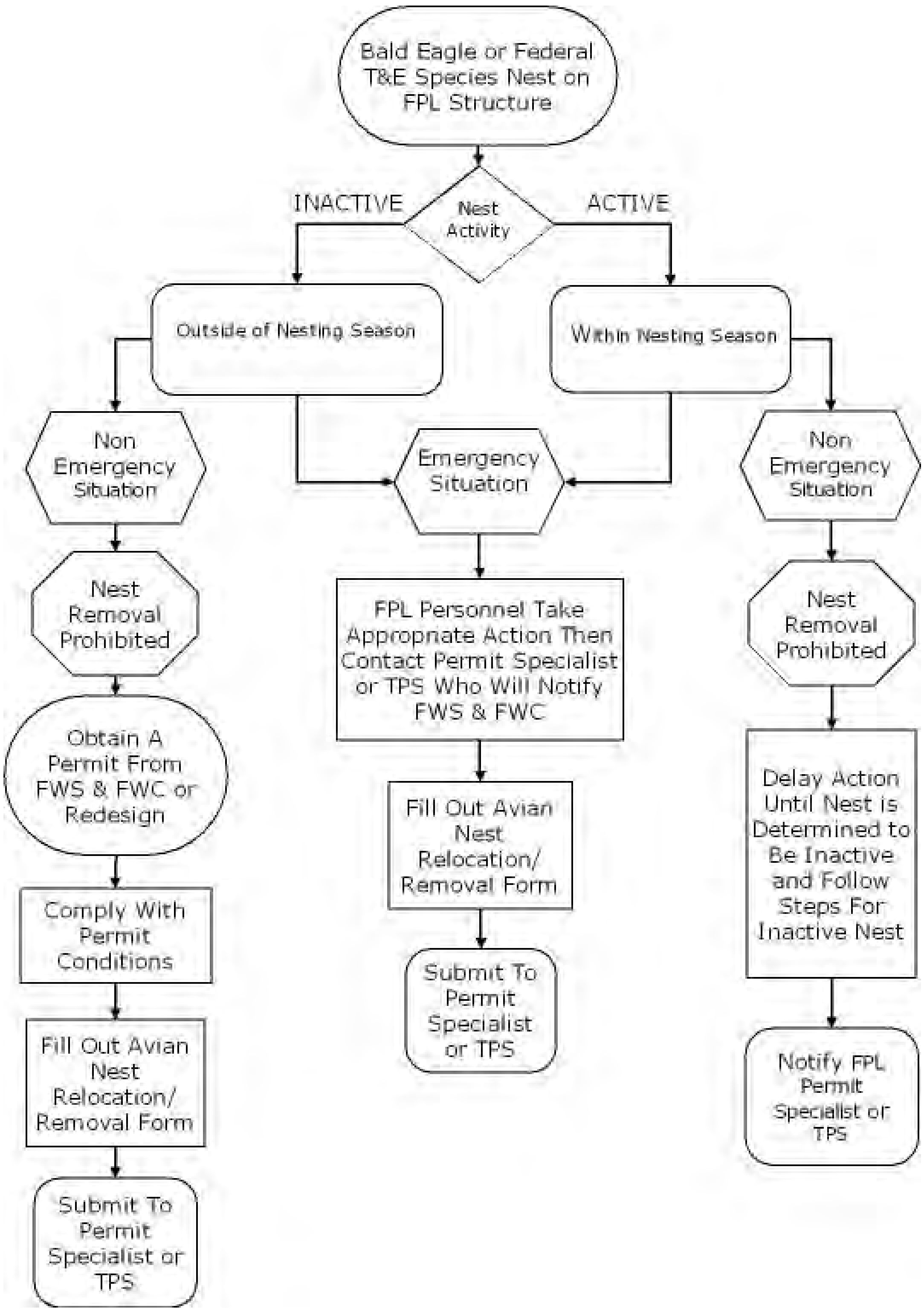


Figure Error! No text of specified style in document.**-2. Procedures for Managing Nest of an Osprey.**

Emergency situations are situations where human health and safety are at risk and immediate corrective action is necessary. Emergency situations include actual or potential electric outages to critical facilities such as hospitals.

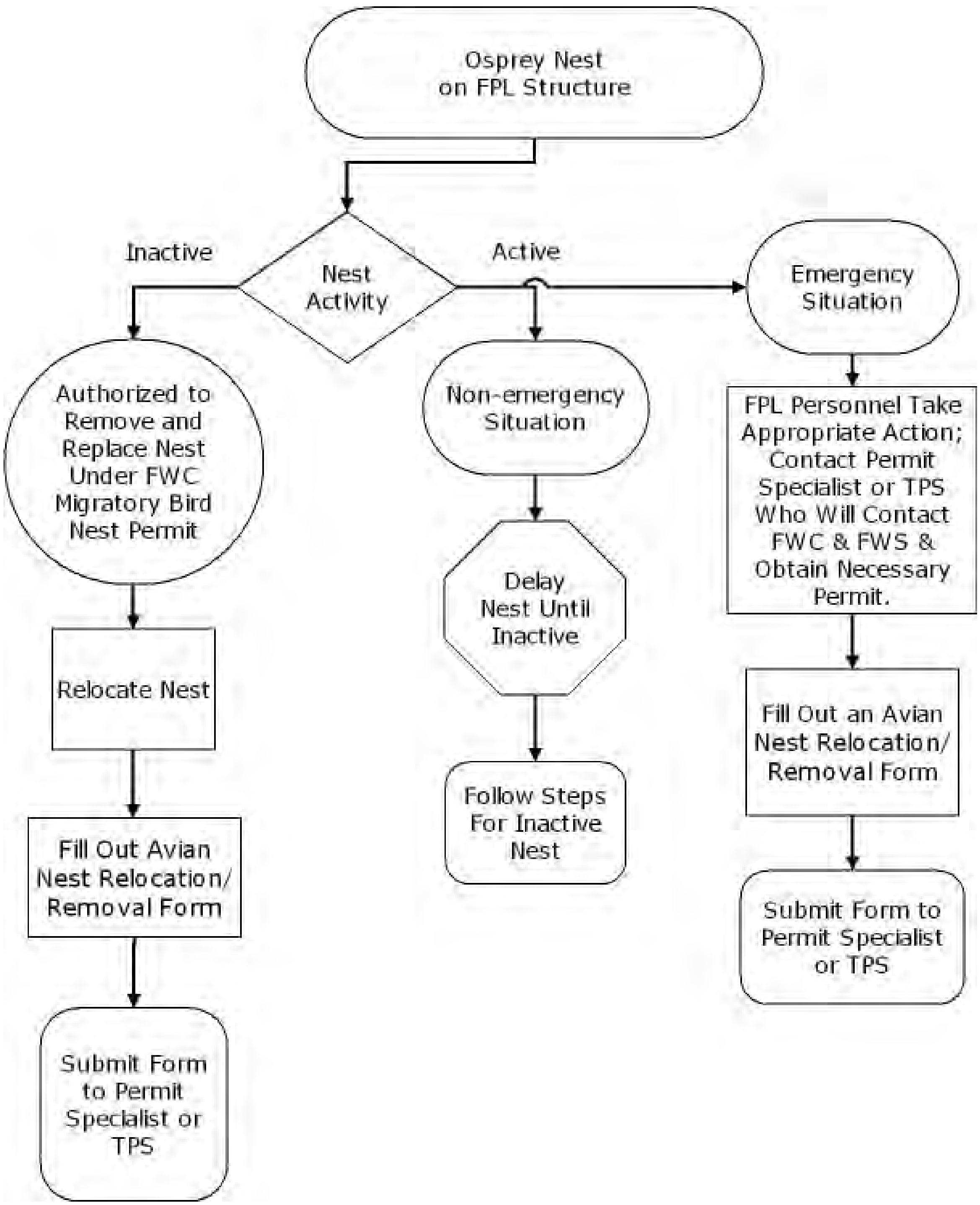
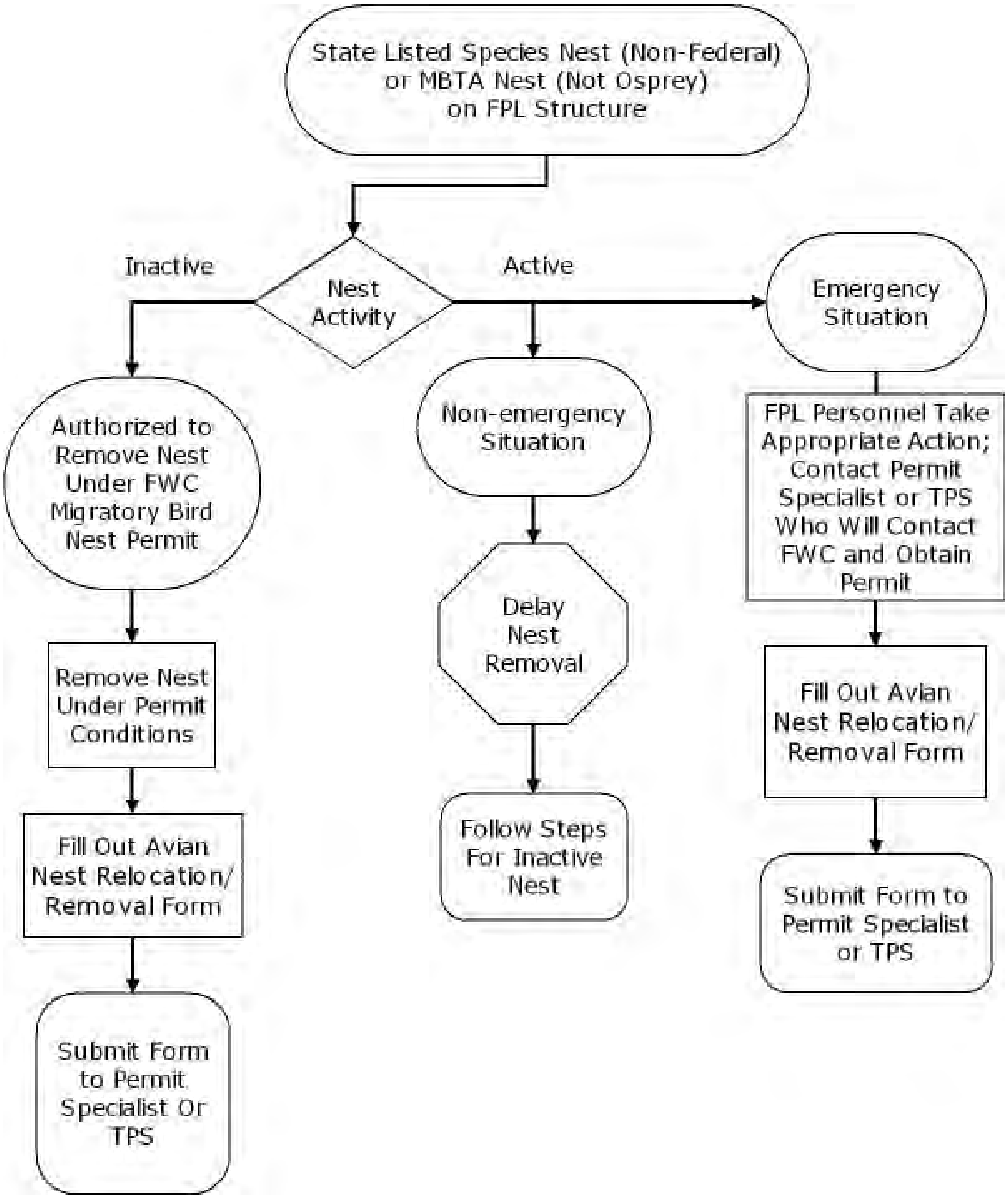


Figure Error! No text of specified style in document.**-3. Procedures for Managing Nest of a State Listed Species or Migratory Bird (Non-Federal Listed Species).**

Emergency situations are situations where human health and safety are at risk and immediate corrective action is necessary. Emergency situations include actual or potential electric outages to critical facilities such as hospitals.



5.7. Nest Management Procedures – Other Situations

5.7.1. Nest Trimming

The nests of Bald Eagles, Osprey, and listed species may not be trimmed without special permission from FWC and USFWS. FPL does not trim eagle nests.

In emergency situations, nest trimming of active nests of Federal listed species should be coordinated with the USFWS and the trimming of active Osprey nests should be coordinated with FWC to minimize the chances of birds abandoning the nest.

If trimming is needed before relocating an Osprey nest, FWC should be contacted and informed of what the AEC and crew will be doing and where. The Supervisor or Crew Foreman have only a brief period of time to do their work and can only remove the sticks directly in harms way.

5.7.2. Woodpecker Nests and Other Cavity Nests

Woodpecker species are migratory birds; therefore, the procedures for active and inactive nesting MBTA species are applicable (See Figure 5-6). Relocation of an active woodpecker nest requires a permit from FWC and USFWS under the MBTA (see Section 4.3.)

In the event of a woodpecker pole being "changed-out" an inspection must be performed to determine if the nest is active or inactive. The FPL procedure is to check the woodpecker pole hole with a flashlight and an angled dentist's mirror to look in and then straight down to where the woodpeckers might be nesting. If all the hole(s) on a pole do not contain any eggs or young then the nest is inactive and the pole may be removed. If the nest is active then the pole is cut while the jaws of a boom truck hold the pole, the portion that is free of nests is removed, and the portion with the active nest is bolted or banded to a new pole.

If an active nest (with eggs or young) is found the field crew or AEC should notify the Permit Specialist or TPS who will then determine if the situation warrants emergency removal. If so, the field crew or AEC should notify the Permit Specialist or TPS who will request approval from FWC for emergency removal. When management action is taken on an active nest, mitigation is required in the form of an alternate nesting structure whenever possible.

6. AVIAN REPORTING SYSTEM

TPS or AEC completes an Avian Interaction Form (see Appendix G) for each incident and activity and submits it to the Permit Specialist. After the permit specialist notifies the agencies the permit specialist will submit a hard copy of the report or send an email to Stacy Foster or Jim Lindsay. JES will submit the required annual reports to the agencies.

JES maintains a company-wide database system and Avian Interaction Forms to report and track mortality and document corrective actions. Nest Management is also tracked by this database.

FPL is using Agency website(s) for reporting avian incidents http://myfwc.com/bird and/or (add FWS link) and then forwards the Avian Interaction Form and/or the FWC screen capture to JES where it is tracked into a database.

Transmission contacts the appropriate agency and will immediately inform JES of a listed species and monthly for all other species. JES will track this information in the JES database.

Specific information on reporting can be found in Section 5.

7. PERSONNEL SAFETY PROCEDURES

Depending upon the situation FPL personnel may be asked to handle injured birds, carcasses, and nests that may have bird parasites and diseases that are transmittable to humans. To protect your self, wear protective gear and follow the safety procedures as directed below.

7.1. Injured Birds

Do not handle any wildlife if doing so risks your safety or the safety of others. When in doubt, do not attempt to capture an injured animal. Call a licensed wildlife rehabilitator (see Appendix H) or a wildlife officer (see Section 15.2) for assistance. If you must handle or capture a bird, follow the *Procedure to Restrain and Transport Birds* in Section 5.4. Remember, even a seriously injured bird is potentially dangerous. Wild birds are very unpredictable and will defend themselves.

Birds of Prey (Eagle, Hawk, Owl, Vulture, Kite, Osprey) – Birds of prey use their feet and talons as a primary means of defense. Birds of prey also have sharp beaks and will bite. Birds of prey are most easily caught by first covering their head with a towel and then restraining their feet. **Wear gloves and eye protection when handling a bird of prey.**

Wading Birds and Similar Species (Herons, Egrets, Loons, Cranes) – Wading birds and similar species primarily use their beaks to defend themselves. Particular caution should be used when approaching these and other long beaked birds. Their long, spear-like beaks used for catching fish are positioned like a coiled spring. The beaks of these birds should be held securely when picking them up. Take care not to cover their nostril opening when holding the beak. **Wear eye protection when approaching water birds.**

7.2. Carcasses

When handling a carcass wear protective clothing. Wear gloves and/or use an inverted plastic bag to pick up carcasses. Bald Eagles and Federal listed species require special handling (see Figure 5-2). For all other species bury the carcass onsite or dispose of at Service Center (see Figures 5-3).

7.3. Bird Nests

Nests can have debris, dust, and some insects that can cause irritation to the skin or eyes. Personal Protective Equipment for nest removal includes fire retardant disposable coveralls and shoe covers, a dust mask, and insect repellent. Some or all of this equipment may be advisable depending upon the size and location of the nest. A face shield is recommended for mechanical hazards (sticks, other nest materials). When working around a nest, a breathing filter should be worn to prevent inhaling dried feces. Where possible it is advised to work upwind of the nest.

8. CONSTRUCTION DESIGN STANDARDS

To minimize avian electrocutions and collisions FPL has developed and uses its own avian-adapted design standards for its distribution lines, transmission lines, and substations. These avian-adapted designs are used when constructing new lines or facilities where avian interaction issues exist (see Section 10 Risk Assessment). Appropriate avian-adapted designs are also used when retrofitting an existing structure to solve an avian interaction problem.

For transmission and distribution these standards include designs that reduce electrocution by providing separation of 60 inches between energized conductors and ground hardware or by covering energized parts and hardware where 60 inch spacing is not possible.

8.1. Distribution Standards

FPL avian-adapted design specification standards for distribution lines in Environmentally Sensitive Bird Areas (ESBA) are found in Section E-31 of Power Systems Distribution Construction Standards. The current standards can be found on the company intranet site (http://infpl/ps/dist/construction/trs/E-DCS/e-web.pdf). Bird flight diverters may be used to enhance visibility at locations where birds collide with distribution lines. Typically the diverters will be installed only on the overhead ground wire. Diverter installation on the phase conductors in the vertical configuration is only used on specific problem areas.

In addition, FPL has developed a "Designer Field Environmental Impact Evaluation Sheet" to guide the use of avian-adapted designs in ESBAs that includes avian-adapted design standards and recommendations to mitigate electrocutions and collisions.

8.2. Transmission Standards

FPL avian-adapted design specification standards for Transmission Lines can be found in "The Transmission Structure Standards" Volume 1, Section 2.1 titled, "Framing and Pulloff Details." They include several bird discourager, perch guard, bird platform, and insulator shield designs. Bird flight diverters may be required to enhance visibility where birds collide with distribution lines. Typically the diverters will be installed only on the overhead ground wire.

In addition, FPL has developed an "Environmental Assessment Checklist" to guide the use of avian-adapted designs in ESBAs that includes design standards and recommendations to mitigate electrocutions and collisions.

8.3. Substation Standards

Although animal-caused outages at substations typically occur less frequently, they can impact a far greater number of customers. FPL's substation animal protection standard (E-125334) includes use of animal guards and insulation to prevent animal/bird contacts. Animal protection is installed in new distribution substations and is added to existing distribution substations on an as needed basis.

9. TRAINING IN AVIAN PROTECTION

Understanding and knowledge of FPL's avian protection policy and procedures is essential in reducing the risk of avian interactions. FPL conducts mandatory training in avian protection issues for utility personnel and for new designers each time a group is hired. The program educates FPL employees on the reasons and need to comply with the FPL Corporate Policy and imparts an understanding of the applicable Federal and State laws and policies governing avian interactions with power lines. Topics also include FPL avian-adapted design standards, reporting and carcass disposal, injured bird procedures, and nest management procedures.

Training materials are updated as needed to reflect new regulations, changing policies, new products, new technology, and advances in avian protection. Training is administered by the Permit Specialist or TPS. Training is tracked using a program called Systems Applications and Products (SAP) or Knowledge delivery System (KDS) (Appendix K). Employees can sign up for training by contacting the local TPS or permit specialist for the Power Systems business unit.

Avian protection training is given annually to the following groups of employees:

- Distribution - Construction
  - Engineers
  - Construction Leaders

- Distribution - Operations
  - Crew
  - Leaders
  - Supervisors
  - AEC

- Transmission – Construction
  - Engineers
  - Construction Leaders
  - Managers
  - Crew

- Transmission – Operations
  - Crew
  - Leaders
  - Supervisors
  - Managers

- Substations - Construction and Operations

10. RISK ASSESSMENT

FPL has implemented a risk assessment program to evaluate the risk to birds from electric utility structures. Risk is the probability of an adverse event or hazard occurring to birds from collision and electrocutions. As a part of this program FPL has developed a risk assessment methodology that accounts for avian biology and utility structure characteristics (See Appendix L: Eagle Electrocution Risk Analysis for FPL Avian Protection Plan).

This risk assessment methodology will be used for siting new lines and for evaluating the extent of retrofitting problem areas. The combination of these measures will reduce avian interactions and improve service reliability.

10.1. Risk Assessment Methodology

The risk assessment methodology considers the two main elements that contribute to mortality risk: bird biology and utility structures.

10.1.1. Bird Biology

The risk level for a particular bird species is a composite of its biological characteristics including: habitat utilized, bird size, bird flight characteristics, foraging strategy, nesting substrate and habitat, abundance, movement patterns, and reproduction behaviors. Higher risk species tend to:

- Have larger body size
- Have larger wing span
- Perch on structures
- Nest on structures
- Have low flight maneuverability

Based on these biological characteristics and past FPL records the following species are considered to have higher susceptibility to collisions and/or electrocutions in FPL's service territory.

- Bald Eagle (*Haliaeetus leucocephalus*)
- Red-tailed Hawk (*Buteo jamaicensis*)
- Red-shouldered Hawk (*Buteo lineatus)*
- Crested Caracara (*Caracara cheriway*)
- Black Vulture (*Coragyps atratus)*
- Turkey Vulture (*Cathartes aura)*
- Osprey (*Pandion haliaetus*)
- Snail Kite (*Rostrhamus sociabilis*)
- Great Horned Owl (*Bubo virginianus*)
- Brown Pelican (*Pelecanus occidentalis*)
- Great Blue Heron (*Ardea herodias*)
- Great Egret (*Ardea alba*)
- Roseate Spoonbill (*Ajaia ajaja*)
- Wood Stork (*Mycteria americana*)
- Whooping Crane (*Grus americana*)
- American Crow (*Corvus brachyrhynchos*)
- Fish Crow (*Corvus ossifragus*)

Historical records confirm susceptibility for these and other species in association with utility structures in Florida. The historical record includes most of these high-risk species as well as other species that are considered less susceptible (Table 10-1).

Table 10-1. Historic Bird Mortality Associated with Utility Structures in Florida.

Bird Species	Type of Mortality		Bird Species	Type of Mortality	
	Collisions	Electrocutions		Collisions	Electrocutions
Bald Eagle	X	X	Great Egret	X	X
Peregrine Falcon	X	X	Snowy Egret	X	
Red-shouldered Hawk	X	X	Great Blue Heron	X	X
Red-tailed Hawk	X	X	Great Egret	X	
American Kestrel	X	X	Green Heron	X	
Merlin	X		Little Blue Heron	X	
Osprey	X	X	Tricolored Heron	X	
Barn Owl	X	X	Glossy Ibis	X	X
Screech Owl	X	X	White Ibis	X	X
Black Vulture	X	X	Black-crowned Night Heron	X	
Turkey Vulture	X	X	Yellow-crowned Night Heron	X	
Crested Caracara		X	King Rail	X	
Barred Owl		X	Solitary Sandpiper	X	
Great horned Owl		X	Black-necked Stilt	X	
American Crow		X	Wood Stork	X	X
Loggerhead Shrike		X	Roseate spoonbill		X
Brown Pelican	X	X	American Coot	X	
Double-crested Cormorant	X		Common Moorhen	X	
Sandhill Crane	X	X	Blue-winged Teal	X	
Whooping Crane	X	X	Green-winged Teal	X	
Mottled Duck	X		–	–	–

Other raptor species also occur in the service territory (e.g., accipiters, falcons, other owls). However, electrocution incidence of the smaller species, such as the Southeastern American Kestrel *(Falco sparverius),* is not high based on the size of the bird. Larger raptors, including the Cooper's Hawk *(Accipiter cooperii)* and Short-tailed Hawk (*Buteo brachyurus*) occur through the region; however, these species are typically forest dwellers that forage on smaller bird species. Based on their foraging behavior and flight patterns, it is unlikely that these birds would regularly use distribution poles for perching, thereby minimizing the potential for electrocution.

10.1.2. Utility Structures

The risk level for a particular structure is a composite of the structure type and structure configuration. Structure type is categorized as distribution line, transmission line, or substation. Structure configuration is the juxtaposition and density of energized parts on a given vertical structure and the spatial relationship between multiple co-located structures (e.g., underbuilding).

10.1.3. Interaction of Bird Biology and Utility Structures

The combination of the risk level of the bird ecology and the risk level of the utility structures creates an overall risk that the birds will be electrocuted (or collide) with the structures. The geographically based intersection of risk for the bird biology and the utility structures creates a cumulative risk level. A diagrammatic depiction of this relationship is expressed in Figure 10-1.

It is the spatial interaction between these two risk elements that determines the actual risk to the birds. For example, a "high-risk" bird situation, such as an eagle nest with fledgling young that is distant from any power structure is at low risk no matter how inexperienced the young birds are. Whereas, if the nest is close to power lines then the risk of collisions can be considered very high.

Due to the inherently spatial nature of this interaction, the risk assessment modeling was developed in ArcGIS using raster grid layers. This type of GIS analysis is used in conjunction with ground truthing in evaluation of the risk level of new utility structures.

Figure Error! No text of specified style in document.**-1. Matrix Illustrating the Interaction Between Biological-derived and Structure-derived Risk.**

Structure-derived Risk

Biological -derived Risk	Low	Medium	High
Low	Low	Low	Medium
Medium	Low	Medium	High
High	Low	High	Very High

11. MORTALITY REDUCTION METHODS

FPL has effectively and economically reduced bird fatalities and injuries in several ways:

- FPL uses a set of avian-adapted construction design standards for new construction and when "retrofitting" locations where problems with electrocutions and collisions have occurred (see Section 8).
- FPL has an avian reporting system to track avian mortality, which aids in identifying and responding to problem areas (see Section 6).
- FPL has developed a pro-active risk assessment model that is used to evaluate the necessity for voluntary retrofits of existing facilities in high risk environmentally sensitive bird areas (see Section 10).

12. AVIAN ENHANCEMENT ACTIVITY

FPL has been recognized for many years as one of the leaders among utilities for its commitment to the environment. Many outside organizations have heralded its environmental leadership. In 2004 FPL Group earned a first place ranking among U.S. power companies, and second globally, in a report from the World Wildlife Fund for voluntary commitments to limit CO2 emissions. FPL was also recently ranked first out of 28 major electric utilities surveyed in an environmental assessment conducted by Innovest, an independent advisory group.

In addition, The Florida Department of Environmental Protection named FPL a "Partner for Ecosystem Protection" for its emission-reducing "repowering" projects at its Fort Myers and Sanford Plants. FPL was also awarded Edison Electric Institute's National Land Management Award for its stewardship of 25,000 acres surrounding its Turkey Point Plant.

Specifically, FPL has contributed to the conservation and protection of birds through various avian enhancement activities including managing habitat for birds, installing Osprey nest platforms, and establishing cooperative partnerships with agencies.

Managing Habitat for Birds
Migratory Birds – FPL has a long-standing commitment for managing habitats for migratory birds. In 1972 it preserved the Barley Barber Swamp, a 450-acre old growth cypress swamp, located in western Martin County. In addition to the Barley Barber Swamp, FPL maintains a 1,200 acre mitigation parcel at its Martin Power Plant. This property consists of over 300 acres of wetlands and 900 acres of diverse uplands. In southern Dade County, FPL manages 25,000 acres of fresh and estuarine wetlands and subtropical hardwood forests surrounding the Turkey Point nuclear and fossil plants. The Turkey Point site contains, and is home to 29 state and 17 federally protected animal species, including the Florida panther, the American crocodile and the wood stork. Included within this area is the 1,700-acre McGregor Smith Turkey Point Wildlife Conservation Area.

FPL was the first utility in the nation to establish a wetlands mitigation bank. The Everglades Mitigation Bank, a 13,000-acre buffer surrounding the Turkey Point site, provides a habitat for several unique wetland types, including herbaceous fresh water, mangrove, and saltwater marsh. FPL's Everglades Mitigation Bank is returning more than 13,000 acres of wetlands to their natural and historical condition, which increases the quality of habitat for migratory birds in South Florida.

On the west coast, FPL donated an 18 acre island on the Caloosahatchee River to the USFWS. This island, with a unique mix of fresh and saltwater native vegetation, provides roosting and forage potential to a host of avian species. FPL maintains over 20,000 acres of cooling ponds and canals through out Florida to provide heat exchange for its power plants. Over the years, these cooling systems have proven to provide excellent habitat for waterfowl, wading birds, and various raptors. Bald eagles have nested near the cooling systems since construction, and have reproduced successfully since the early 1970's.

Florida Scrub-Jays – FPL has Scrub Management Plan for Brevard and Volusia County (FPL 2004) that provides an established procedure for managing scrub habitat within transmission corridors to benefit Florida Scrub-jays and other species such gopher tortoises. The plan's objectives are to:

- Maintain vegetation with transmission corridors to reduce the threat of wildfires
- Continue to persistence of scrub-jay populations along the corridors
- Restore and maintain biological diversity of the scrub ecosystem within the corridors
- Develop a rotating maintenance system for the scrub oak habitat with a 5-7 year cycle

FPL has integrated management activities that have been used to manage scrub habitat at Kennedy Space Center with their need to maintain transmission corridors to reduce potential wildfires. These include the removal of slash and sand pine, exotic vegetation, and patches of oaks to open up habitat for scrub-jays. These management activities will be conducted using mechanical techniques and rubber tired equipment to minimize environmental disturbance within the corridors.

Osprey Nest Platforms

When Osprey nests are removed from transmission and distribution structures, FPL provides a replacement nesting structure following FWC's recommended Osprey platform design (FWC 2004b). This helps ensure that Osprey populations will not decline as a result of nest removals and it reduces the likelihood that the birds will rebuild their nests on the same structures.

Cooperative Partnerships

FPL has been an active participant in the Avian Power Line Interaction Committee (APLIC) since its inception. This involvement has included assisting in development of the Avian Protection Plan Guidelines (APLIC and USFWS 2005), Suggested Practices for Raptor Protection in Power Lines (2006 revision), and Mitigating Bird Collisions with Power Lines (APLIC 1994).

FPL has a relationship with Busch Wildlife Sanctuary in which FPL uses the Sanctuary's wildlife hospital to care for sick or injured birds that are found in the FPL service territory.

FPL funded research conducted by the Miami Museum of Science Falcon Batchelor Bird of Prey Center to assist in the development of bird perch discourager devices for transmission line structures. Prior to 1997, approximately 45% of transmission line outages were classified as unknown. The research revealed that these outages coincided with the southerly migration of avian species, as well as streamer and excrement contamination. Countermeasures were investigated and prototype bird discourages were developed and tested. The resulting bird discouragers are now successfully used throughout the Florida Power & Light service territory.

13. QUALITY CONTROL

FPL has an Environmental Audit team in place. The audit team will conduct an audit every three years to ensure that FPL is adhering to this APP. This team will also ensure that the APP is continually updated. FPL also has an Environmental Management System and Environmental Assurance Program in place.

Environmental Management System

FPL established an environmental management system to direct and control the fulfillment of the organization's environmental responsibilities. A key component of the system is an Environmental Assurance Program that is discussed below. Other components include: executive management support and commitment, written environmental policies and procedures, delineation of organizational responsibilities and individual accountabilities, allocation of appropriate resources for environmental compliance management (which includes reporting and corrective action when non-compliance occurs), environmental incident/emergency response, environmental risk assessment/management, environmental regulatory development and tracking, and environmental management information systems.

Environmental Assurance Program

FPL's Environmental Assurance Program consists of activities which are designed to evaluate environmental performance, verify compliance with Company policy as well as with legal and regulatory requirements, and communicate results to corporate management. The principal mechanism for pursuing environmental assurance is the environmental audit. An environmental audit may be defined as a management tool comprising a systematic, documented, periodic, and objective evaluation of the performance of the organization and of the specific management systems and equipment designed to protect the environment. The environmental audit's primary objectives are to: facilitate management control of environmental practices and assess compliance with existing environmental regulatory requirements and Company policies.

14. PUBLIC AWARENESS

FPL is involved in many efforts to enhance environmental protection through the facilitation of environmental awareness and public education, including:

- Offering an array of information to schools, community groups and individuals about how it does business and the environmental issues we all care about.
- Soliciting the views of community members before it undertakes major electric system expansion or upgrade projects.
- Environmental projects undertaken are driven by a strong network of employee volunteers.
- Donating land and implementing a number of innovative programs to aid local conservation and recreation activities.
- Working in partnership with community groups to preserve and enhance recreational opportunities as it grows its business.

FPL's endangered species education programs offer free educational books and brochures on several listed species. Over 110,000 pieces of environmental literature have been distributed to local, State, and Federal agencies as well as customers and public and private institutions.

In addition, FPL has an environmental website with information, resources, and links (http://www.fpl.com/environment/contents/index.shtml). Visited over 195,000 times, this website includes information on Bald Eagles, Wood Storks, FPL's Barley Barber Swamp, as well as invasive exotic species such as the European Starling and Monk Parakeet.

15. KEY RESOURCES

15.1. FPL Environmental Contacts

Name	Area of Responsibility	Location	Phone Number	Cell Phone
Cheryl Evans	PS AEC	North	386-947-6171	386-229-3008
Jack Alexander	PS AEC	North	386-947-6170	386-547-8070
Dan Rawson	PS AEC	East	561-845-3344	561-662-7540
Sky Whang	PS AEC	East	561-681-3135	561-818-5201
Doug Macke	PS AEC	Broward	954-926-1739	954-410-4367
Rufus Hoggan	PS Principal Env. Spec	Broward	954-321-2108	954-410-4366
Leroy Hubbs	PS Supv Env Ops	Dade	305-228-5230	305-586-6119
Jeff James	PS AEC	Dade	305-228-5231	305-439-0948
David Witte	PS AEC	West	941-316-6326	941-650-2482
Pete Andreasen	PS AEC	West	239-332-91218	239-691-0647
Beverly Musser	PS Env. Specialist	State/Distribution	954-321-2183	954-410-4956
Andrew Daugherty	PS Env. Specialist	State	954-321-2114	954-410-0124
Gregg Hall	PS Sr. Env. Specialist	State/Transmission	561-694-3284	
Grace Couret	PS Principal Engineer	State/Transmission	561-691-7367	
Jim Lindsay	JES Principal Env. Spec	State/Juno	561-691-7032	561-762-1296
Stacy Foster	JES Env. Specialist	State/Juno	561-691-7065	772-285-5653
David Niebch	Lab Tech	St. Lucie	772-467-7316	
Bob Bertelson	Plant Supervisor	Turkey Point	305-246-6166	
Willie Welch	PGD Leader I	Martin	772-597-7211	
Kelly Scott	PGD Leader III	Cape Canaveral	321-637-2252	
Christian Kiernan	PGD Sr. Leader	Ft. Lauderdale	954-797-1338	
Bernie Tibble	PGD Leader I	Ft. Myers	239-693-4390	
Christian Kiernan	PGD Leader II	Port Everglades	954-527-3507	
Mary Maxwell	PGD Leader II	Manatee	941-776-5278	
Gary Andersen	PGD Leader I	Cutler/Turkey Fossil/Turkey 5	305-242-3826	
Howard Cosgrove	PGD Sr. Leader	Riviera	561-845-3103	
Randy Hopkins	PGD Sr. Leader	Sanford	386-575-5385	
Mark Studley	PGD Principal Leader	Putnam	386-329-4658	
Darrell King	PS Sr. Engineer	Substations	561-694-4052	
Jerry McMullan	PS Principal Engineer	Engineering	561-845-4837	

15.2. Outside Experts

Federal Protected Species Issues

US Fish and Wildlife Service
North Florida Field Office
6620 Southpoint Drive South, Suite 310
Jacksonville, FL 32216-0958
Phone: 904-232-2580
Fax: 904-232-2404

US Fish and Wildlife Service
South Florida Ecological Services Office
1339 20th Street
Vero Beach, FL 32960
Phone: 772-562-3909
Fax: 772-562-4288

U.S. Fish and Wildlife Service
Office of Law Enforcement
20501 Independence Blvd
Groveland, Fl 34736
Phone: 352-429-1037 Fax: 352-429-1064

State Protected Species Issues

Florida Fish and Wildlife Conservation Commission
Farris Bryant Building
Angela Williams
620 South Meridian Street
Tallahassee, FL 32399-1600
Phone: 850-921-5990 X 17310
Fax: 850-921-1847

Florida Fish and Wildlife Conservation Commission
Northwest Region
Lt. Col. Louie Roberson, Regional Director
3911 Hwy. 2321
Panama City, FL 32409-1658
(850) 265-3676
24-Hour Law Enforcement:
(850) 245-7710

Florida Fish and Wildlife Conservation Commission
North Central Region
Rolando Garcia, Regional Director
3377 E. US Highway 90
Lake City, FL 32055-8795
(386) 758-0525

24-Hour Law Enforcement:
386-758-0529

Florida Fish and Wildlife Conservation Commission
Northeast Region
Dennis David, Regional Director
1239 S.W. 10th Street
Ocala, FL 34474-2797
(352) 732-1225
24-Hour Law Enforcement:
352-732-1228

Florida Fish and Wildlife Conservation Commission
Southwest Region
Greg Holder, Regional Director
3900 Drane Field Road
Lakeland, FL 33811-1299
(863) 648-3203
24-Hour Law Enforcement:
863-648-3200

Florida Fish and Wildlife Conservation Commission
South Region
Chuck Collins, Regional Director
8535 Northlake Boulevard
West Palm Beach, FL 33412
(561) 625-5122
24-Hour Law Enforcement:
561-625-5122

Florida Fish and Wildlife Conservation Commission
Monroe and Collier County
24-Hour Law Enforcement:
305-289-2320

Florida Fish and Wildlife Conservation Commission
Gainesville Wildlife Research Laboratory
4005 South Main Street
Gainesville, FL 32601
Phone: (352) 955-2230
Fax: (352) 376-5359

Wildlife Control Issues

USDA/APHIS/WS/NWRC
Florida Field Station
2820 E. University Ave.
Gainesville, FL 32641
Phone: (352) 375-2229
Fax: (352) 377-5559

15.3. Publications

APLIC. 1994. "Mitigating Bird Collisions with Power Lines: The State of the Art in 1994." This document contains biological and ecological information on birds and bird behavior relevant to collisions, information on habitat, land use and power line modifications, and an extensive bibliography.

APLIC. 2006. "Suggested Practices for Raptor Protection on Power Lines." A definitive publication on mitigating raptor electrocutions.

The Institute of Electrical and Electronic Engineers (IEEE). 1993. Guide for Animal Deterrents for Electric Power Supply Substations. Provides information regarding animals and the problems they cause in electric power supply substations. The guide documents methods and designs to mitigate interruptions and equipment damage resulting from animal access into electric power supply substations, thereby improving reliability, minimizing associated revenue loss, and minimizing animal mortalities.

Southern Engineering Company. 2006. Animal-caused Outages. Focused on understanding and preventing animal-caused outages. It describes common problems for transmission, distribution, and substation systems, animals involved, and available products and techniques for minimizing *animal-caused Outages* this includes information on mammals as well as birds. Most other reference compilations relate to avian interactions with utility structures. National Rural Electric Cooperative Association (NRECA) and is presently under revision.

16. DEFINITIONS

Active Nest – Nest that contains either eggs or young

Endangered Species – (Federal) The classification provided to an animal or plant in danger of extinction within the foreseeable future throughout all or a significant portion of its range. (State) Listing of species is essential to prevent imminent extinction. It is unlawful to pursue, molest, harm, harass, capture, possess, or sell a State listed endangered species.

Inactive Nest – Nest that does not contain eggs or young.

Listed Species – (Federal) A species, subspecies, or distinct vertebrate population segment that has been added to the Federal lists of Endangered and Threatened Wildlife and Plants as they appear in sections 17.11 and 17.12 of Title 50 of the Code of Federal Regulations (50 CFR 17.11 and 17.12).

Migratory Bird – Any bird, whatever its origin and whether or not raised in captivity, which belongs to a species listed in 50 CFR § 10.13, or which is a mutation or a hybrid of any such bird, or any product, whether or not manufactured, which consists, or is composed in whole or part, of any such bird or any part, nest, or egg thereof. The majority of bird species in the U.S. are considered to be migratory and protected under the Migratory Bird Treaty Act, except for introduced species, such as the house sparrow, European starling, rock pigeon, and monk parakeet and some game species, such as the ring-necked pheasant.

Nest – Any readily identifiable structure built, maintained, or occupied for incubating and rearing of protected species offspring. Nests can be found on the ground, in trees, or on structures. See also *inactive nest* and *active nest*.

Outage – The state of a component or part of a power system that is not available for service because of some event associated with the component of power system.

Possession – Detention and control of a protected species. This includes picking up or handling of any migratory bird, as defined above. This may also include moving or transporting.

Primary zone around bald eagle nest – (up to 750 feet) In this zone there is not any work on structures other that patrols without notification to USFWS. Maintenance is scheduled for outside of nesting season. FPL has a map with the location of eagle nest in relation to our facilities.

Protected Species – Any bird listed as a Federal endangered or threatened species found in 50 CFR § 17.11 and § 17.12 and on the list of migratory birds found in 50 CFR § 10.13. Bird species listed as endangered or threatened by the FWC also are protected.

Salvage Permit – A permit issued by the USFWS that authorizes the permittee to retrieve birds found dead in which the permittee had no part in the killing or death thereof.

Secondary zones around bald eagle nests – (750 to1500 feet) Maintenance can occur during nesting season and new construction can occur outside of nesting season.

Species of Special Concern (SSC) – State Species that for a number of reasons may become threatened in the future. It is unlawful to take, possess, transport, or sell a State listed species of special concern.

Take (Migratory Birds) – To pursue, hunt, shoot, wound, kill, trap, capture (alive or dead), or to attempt to engage in such conduct.

Take (Federal Endangered/Threatened Birds) – To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect (alive or dead), or to attempt to engage in such conduct. Take includes habitat degradation.

Take (Eagles) – To pursue, hunt, shoot, shoot at, wound, kill, trap, capture, collect, or molest or disturb (alive or dead), or to attempt to engage in such conduct.

Threatened Species – (Federal) The classification provided to an animal or plant likely to become endangered within the foreseeable future throughout all or a significant portion of its range. (State) Listing of species is essential to prevent likelihood of becoming endangered. It is unlawful to take, possess, transport, molest, harass, or sell a State listed threatened species.

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18. APPENDICES

Appendix A. Federal and State Listed Bird Species

The following list identifies birds found in the FPL service area that are listed as Threatened, Endangered, or Species of Special Concern by the Florida Fish and Wildlife Conservation Commission (FWC) or the U.S. Fish and Wildlife Service (USFWS) (FWC 2004a).

Protected Bird Species Found in the FPL Service Area

Species	Federal Status (USFWS)	State Status (FWC)
Piping plover	Threatened	Threatened
Snowy plover (Cuban snowy plover)		Threatened
American oystercatcher		Species of Special Concern
Brown pelican		Species of Special Concern
Black skimmer		Species of Special Concern
Least tern		Threatened
Roseate tern		Threatened
Limpkin	Threatened	Threatened
Reddish egret		Species of Special Concern
Snowy egret		Species of Special Concern
Little blue heron		Species of Special Concern
Tricolored heron		Species of Special Concern
White ibis		Species of Special Concern
Florida sandhill crane		Threatened
Whooping crane		Species of Special Concern
Wood stork	Endangered	Endangered
Roseate spoonbill		Species of Special Concern
Burrowing owl		Species of Special Concern
Crested caracara	Threatened	Threatened
Peregrine falcon		Endangered
Southeastern American kestrel		Threatened
Bald eagle	Threatened	Threatened,
Osprey		Species of Special Concern
Snail kite	Endangered	Endangered
Florida scrub-jay	Threatened	Threatened
Cape Sable seaside sparrow	Endangered	Endangered
Florida grasshopper sparrow	Endangered	Endangered
Scott’s seaside sparrow		Species of Special Concern
Wakulla seaside sparrow		Species of Special Concern
White-crowned pigeon		Threatened
Kirtland’s warbler		Endangered
Bachman’s warbler		Endangered
Ivory-billed woodpecker	Endangered	Endangered
Red-cockaded woodpecker	Endangered	Species of Special Concern
Marian’s marsh wren		Species of Special Concern
Worthington’s marsh wren		Species of Special Concern

Appendix B. Florida Scientific Collecting Permit

PERMIT

Issued Under Authority of the Wildlife Code of the State of Florida
(Title 68A, Florida Administrative Code) by the

STATE OF FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION
Division of Wildlife Bureau of Wildlife Diversity Conservation, 620 South Meridian Street Tallahassee, FL 32399-1600, (850) 921-5990 ext 17310

Permit No WS04246 Issuance Date 29 June 2004 Expiration Date 31 December 2007
Permit Type Scientific Collecting/Institutional Specific Rule Authority 68A-9.002; 68A-25.002; 68A-27.003-.005
Permittee James R. Lindsay Permitted Facility Florida Power & Light Company
Phone no (561) 691-7032 Environmental Services Department
P.O. Box 14000
Juno Beach, FL 33408

Signature Date 7-16-04
Not valid until signed

Certification: I hereby state and confirm by signature that I have received, read, understand, and agree to abide by all regulations, guidelines, and provisions regarding the issuance of this permit, and I further certify that the information submitted in this application and supporting documents is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to criminal penalties. I further state that I will abide by all applicable State, Federal, and local laws. Please return a signed copy to this office.

Provisions/Conditions:

1 Carcasses of non-listed wildlife may be salvaged upon encounter and possessed (i e - mounted and displayed) at Florida Power & Light Company - Environmental Services Department for scientific/educational purposes The salvage/possession of species protected by the Migratory Bird Treaty Act (16 U S C 703-712), the Endangered Species Act of1973 (16 U S C 1531), the Marine Mammal Protection Act (16 U S C 1361-1407) or the Bald and Golden Eagle Protection Act (16 U S C 668-668d) must also be federally permitted pursuant to any of those laws, as appropriate A copy of any such federal permit must be provided this office before collecting/possessing any species so protected Collections of species designated by the Fish and Wildlife Conservation Commission in Rule 68A-27 003- 005, F A C , as endangered, threatened or species of special concern must be reported to this office within 48 hours Final disposition of those specimens is subject to individual approval by the Commission, via an amendment to this permit

2 Salvaged specimens may be temporarily transferred to a taxidermist or tanner for mounting or tanning provided a copy of this permit is kept with the carcass or hide at all times

3 The Permittee may temporarily loan the mounted specimens to other entities, provided they are in possession of a letter of authorization from the Permittee and a copy of this permit The Permittee must maintain an inventory (i e , who has possession and at what physical location) of parts possessed independently of these individuals

4 This permit shall expire and the animal carcasses and other parts shall be returned to the Commission should they no longer be needed for exhibitional and/or educational purposes at Florida Power & Light Company - Environmental Services Department , or upon severance of the affiliation of the Permittee with Florida Power & Light Company- Environmental Services Department

1

PERMIT

Permit No: WS04246

Provisions/Conditions Continued:

5 This permit is in effect a renewal of WS01374, which expires on June 25 2004. itdoes not authorize access to any public or private properties. Any required permission accordingly must be secured from the appropriate landholders prior to undertaking any work on such properties

6 This permit is subject to revocation at any time pursuant to Chapter 120, Florida Statutes.

7 This permit and a copy of any required federal authorization/permits must be readily available for inspection while engaged in collecting and at the repository facility. An annual report detailing the number of specimens collected per species, dates and locations of collections, and final disposition of specimens must be submitted to this office by 1 February of each year. Copies of any other reports or publications, which result from the work, must also be provided upon their availability.

Kenneth D. Haddad
Executive Director

By: Bradley J. Gruver
for Thomas H. Eason, Ph.D., Chief
Bureau of Wildlife Diversity Conservation

W1067/THE/cy
LIC 6-1
WS04246.per

cc: South Region

2

Appendix C. Federal Special Purpose Salvage Permit

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

3-201
(1/97)

U.S. FISH & WILDLIFE SERVICE

FEDERAL FISH AND WILDLIFE PERMIT

1. PERMITTEE

FLORIDA POWER AND LIGHT COMPANY
700 UNIVERSE BOULEVARD
JUNO BEACH, FL 33408

2. AUTHORITY-STATUTES
16 USC 703-712

REGULATIONS *(Attached)*
50 CFR Part 13
50 CFR 21 27

3. NUMBER
MB697722-1 AMENDMENT

4. RENEWABLE
☒ YES
☐ NO

5. MAY COPY
☒ YES
☐ NO

6. EFFECTIVE
07/28/2006

7. EXPIRES
03/31/2009

8. NAME AND TITLE OF PRINCIPAL OFFICER *(If #1 is a business)*
JAMES R. LINDSAY
PRINCIPAL ENVIRONMENTAL SPECIALIST

9. TYPE OF PERMIT
SPECIAL PURPOSE SALVAGE

10. LOCATION WHERE AUTHORIZED ACTIVITY MAY BE CONDUCTED
SAME AS ABOVE

11. CONDITIONS AND AUTHORIZATIONS:

A. GENERAL CONDITIONS SET OUT IN SUBPART D OF 50 CFR 13, AND SPECIFIC CONDITIONS CONTAINED IN FEDERAL REGULATIONS CITED IN BLOCK #2 ABOVE, ARE HEREBY MADE A PART OF THIS PERMIT. ALL ACTIVITIES AUTHORIZED HEREIN MUST BE CARRIED OUT IN ACCORD WITH AND FOR THE PURPOSES DESCRIBED IN THE APPLICATION SUBMITTED. CONTINUED VALIDITY, OR RENEWAL OF THIS PERMIT IS SUBJECT TO COMPLETE AND TIMELY COMPLIANCE WITH ALL APPLICABLE CONDITIONS, INCLUDING THE FILING OF ALL REQUIRED INFORMATION AND REPORTS.

B. THE VALIDITY OF THIS PERMIT IS ALSO CONDITIONED UPON STRICT OBSERVANCE OF ALL APPLICABLE FOREIGN, STATE, LOCAL OR OTHER FEDERAL LAW.

C. VALID FOR USE BY PERMITTEE NAMED ABOVE.

D. You are authorized to salvage migratory birds found dead that you had no part in the killing or death thereof. You are also authorized to salvage abandoned nests and addled eggs after the nesting season.

E. Dead bald or golden eagles must be reported immediately to the National Eagle Repository at 303-287-2110. The Repository will provide directions for shipment of these birds.

F. Specimens are to be destroyed by incineration or burial.

G. Authorized to possess live migratory birds for the purpose of transporting to a State and Federally permitted rehabilitator.

H. You must comply with the attached Standard Conditions for Special Purpose - Salvage.

I. Any person who is under the direct control of the permittee, or who is employed by or under contract to the permittee for purposes authorized by this permit, may carry out the activity authorized by this permit.

J. Direct control of the permittee means that the permittee and the subpermittee has entered into an identifiable relationship where there is evidence that the permittee has relayed instructions outlining the authority given to the subpermittee for activities authorized by this permit.
For suspected illegal activity, immediately contact USFWS, Law Enforcement at: Clermont, Florida at 352-429-1037 or Miami, Florida at 305-526-2610.

☒ ADDITIONAL CONDITIONS AND AUTHORIZATIONS ALSO APPLY

12. REPORTING REQUIREMENTS
ANNUAL REPORT DUE: 01/31

ISSUED BY	TITLE	DATE
Carmen P. Simonton	FOR: ARD-MIGRATORY BIRDS & STATE PROGRAMS	07/28/2006

Standard Conditions
Special Purpose - Salvage
50 CFR 21.27

All of the provisions and conditions of the governing regulations at 50 CFR part 13 and 50 CFR 21.27 are conditions of your permit. The standard conditions below are additional provisions and conditions of your permit. Failure to comply with the conditions of your permit could be cause for suspension of the permit. If you have any questions regarding these conditions, refer to the regulations or, if necessary, contact your issuing migratory bird permit office. For copies of the regulations and forms, or to obtain contact information for your migratory bird permit office, visit: http://www.permits.fws.gov/mbpermits/birdbasics.html

1. You, and any subpermittees, must carry a legible copy of this permit and display it upon request whenever you are exercising its authority.
2. You may not exercise the authorization granted by this permit contrary to the laws of the applicable state, county, municipal, tribal, or foreign government or any other applicable laws.
4. You must maintain records as required by 50 CFR 13.46 and 50 CFR 21.27.
5. You must keep all records relating to the permitted activities at the location identified in writing by you to the issuing office.
6. Carcasses unsuitable for donation must be completely destroyed by burial or incineration.
7. This permit **DOES NOT** authorize salvage of specimens on federal lands without additional written authorization from the applicable federal agency.

   This permit **DOES NOT** authorize salvage of specimens on state lands or other public or private property without written permission or permits from landowner or custodian.
8. Within 48 hours report to the issuing office if any threatened or endangered species as listed in 50 CFR 17, and/or bald or golden eagles have been salvaged.
9. Immediately report any carcasses found in a situation indicating poisoning or criminal activity. These should not be salvaged, but reported immediately to state and federal wildlife law enforcement authorities.
10. You must tag each bird you salvage. Each tag must have the following information: (a) date and location the specimen was salvaged; (b) name of the person who salvaged the specimen; and (c) the permit number under which the specimen was salvaged.
11. All birds salvaged under this authorization must be deposited with the designated repository as indicated on the face of this permit within six (6) months of acquisition. Any migratory bird carcasses that are sent to a taxidermist must be returned to the designated repository for final disposition. All birds salvaged during any calendar year must be deposited with the repository by December 31 of that calendar year. **This permit does not allow personal possession of any birds salvaged** under the authority of this permit.
12. Acceptance of this permit authorizes inspection in accordance with 50 CFR 13.47. (9/12/2005)

Appendix D. Migratory Bird Nest Removal

PERMIT

Issued Under Authority of the Wildlife Code of the State of Florida
(Title 68A, Florida Administrative Code) by the

STATE OF FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION
Division of Habitat and Species Conservation, 620 South Meridian Street, Tallahassee, FL 32399-1600 (850) 921-5990 ext. 17310

Permit No. WN05247 **Issuance Date** 20 June 2005 **Expiration Date** 31 July 2007

Permit Type Migratory Bird Nest **Specific Rule Authority** 68A-9.002 & 68A-27.005

Permittee James Lindsay **Affiliation** Florida Power and Light Company

Phone No. (561) 691-7032

Environmental Services
700 University Boulevard
Juno Beach, FL 33408

Signature James Lindsay **Date** 7-6-2005
Not valid until signed

Certification: I hereby state and confirm by signature that I have received, read, understand, and agree to abide by all regulations, guidelines and provisions regarding the issuance of this permit, and I further certify that the information submitted in this application and supporting documents is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to criminal penalties. I further state that I will abide by all applicable State, Federal, and local laws. Finally I hereby confirm by signature that representatives of the Florida Fish and Wildlife Conservation Commission (Commission) have my permission as the applicant and that of the landowner(s) to enter on and inspect the property(ies) described in the application for all reasonable purposes pertaining to applicable Commission rules. Please return a signed copy to this office.

This permit authorizes the above named Permittee to remove and replace **inactive** (i.e., containing no eggs or flightless young) nests of ospreys (*Pandion haliaetus*) and other migratory birds, pursuant to Rules 68A-9.002 and 68A-27.005 (Monroe County only), F.A.C. and the Florida Fish and Wildlife Conservation Commission Osprey Nest Removal Policies, where necessary in the process of routine facility maintenance in Florida, and subject to the following provision/conditions.

Provisions/Conditions

1. The **inactive** osprey nests situated on structures maintained by Florida Power and Light Company may be removed and replaced in association with routine facility maintenance, pursuant to the enclosed Osprey Nest Removal Policies.

2. Replacement of osprey nesting structures of comparable or better quality than the nest support structure removed or destroyed must be erected by the Permittee. The replacement nest structure shall be located in the immediate vicinity of the old nest. **Suggested** guidelines for constructing replacement osprey nest structures are enclosed, but other designs may be used if the Permittee prefers.

3. **Inactive** nests of migratory birds other than osprey may be taken without replacement.

4. This permit does not authorize removal of **active** (i.e., containing eggs or flightless young) nests of osprey or other migratory bird species. The Permittee must obtain state and federal authorization permits prior to disturbing an active nest.

5. This permit does not authorize taking of nests of state-or-federally-listed Endangered or Threatened species (i.e. species or subspecies listed as 68A-27.003, or 68A-27.004 in the Wildlife Code of the State of Florida; or at Title 50, Part 17.11, in the Code of Federal Regulations), or state-listed Species of Special Concern (species or subspecies listed at 68A-27.005 in the Wildlife Code of the State of Florida). Permits for removal of nests of these species must be secured separately. In such cases, contact the Permit Coordinator via fax at [(850) 921-1847]

1

PERMIT

Permit No. WN05247

Provisions/Conditions Continued:

6. This permit does not authorize Permittee access to any public or private properties. In instances where written or verbal permission for access is required, such permission must be secured from the appropriate landowners or public agencies in advance of undertaking any work on those controlled properties.

7. This permit is in effect a renewal of permit WN03243, which expires on July 31, 2005 and supercedes all previous versions. It is nontransferable and must be readily available for inspection at all times while engaging in the permitted activities. Other qualified personnel may assist in the permitted work in the absence of the Permittee's direct supervision, when those assistants are designated as subpermittees via a letter from the Permittee to each designee, with this office provided a copy of such letter (s).

8. Formally designated assistants/subpermittees are also to be in possession of your letter of authorization, a copy of this state permit and any required federal authorization/permit when working in your absence.

9. The Permittee by signature above confirms that representatives of the Florida Fish and Wildlife Conservation Commission (Commission) have his/her permission as the Permittee, and that of the landowner(s) to enter on and inspect the property(ies) described in the application (herein incorporated by reference) for all reasonable purposes pertaining to applicable Commission rules.

10. An annual report detailing the number of nests taken and dates and locations of such, must be submitted to this office by 30 June of each year. Such annual reports (referencing permit number) should be directed to the Permit Coordinator at the above address. This permit is subject to revocation prior to the expiration date pursuant to Chapter 120, Florida Statutes. Application for renewal should be made at least 45 days in advance of the date it is needed.

Kenneth D. Haddad
Executive Director

By: Bradley J. Gruver
for Thomas H. Eason, Ph.D., Leader
Species Conservation Planning Section

ATW/THE/cy
LIC 6-20
WN05247 per
Enclosure

cc: Ms. Carmen Simonton (USFWS)
All Regions

2

Appendix D-1. USFWS Depredation Permit

3-201
(1/97)

DEPARTMENT OF THE INTERIOR
U S FISH AND WILDLIFE SERVICE

FEDERAL FISH AND WILDLIFE PERMIT

1 PERMITTEE

FLORIDA POWER AND LIGHT COMPANY
700 UNIVERSE BOULEVARD
JUNO BEACH, FL 33408
U S A

2 AUTHORITY-STATUTES
16 USC 703-712

REGULATIONS *(Attached)*
50 CFR Part 13
50 CFR 21 41

3 NUMBER
MB135540-0

4 RENEWABLE	5 MAY COPY
☒ YES	☒ YES
☐ NO	☐ NO

6 EFFECTIVE	7 EXPIRES
04/01/2007	03/31/2008

8 NAME AND TITLE OF PRINCIPAL OFFICER *(If #1 is a business)*
STACY M FOSTER
SENIOR ENVIRONMENTAL SPECIALIST

9 TYPE OF PERMIT
DEPREDATION

10 LOCATION WHERE AUTHORIZED ACTIVITY MAY BE CONDUCTED
Service territory in Florida

11 CONDITIONS AND AUTHORIZATIONS:

A GENERAL CONDITIONS SET OUT IN SUBPART D OF 50 CFR 13, AND SPECIFIC CONDITIONS CONTAINED IN FEDERAL REGULATIONS CITED IN BLOCK #2 ABOVE, ARE HEREBY MADE A PART OF THIS PERMIT. ALL ACTIVITIES AUTHORIZED HEREIN MUST BE CARRIED OUT IN ACCORD WITH AND FOR THE PURPOSES DESCRIBED IN THE APPLICATION SUBMITTED. CONTINUED VALIDITY, OR RENEWAL, OF THIS PERMIT IS SUBJECT TO COMPLETE AND TIMELY COMPLIANCE WITH ALL APPLICABLE CONDITIONS INCLUDING THE FILING OF ALL REQUIRED INFORMATION AND REPORTS

B THE VALIDITY OF THIS PERMIT IS ALSO CONDITIONED UPON STRICT OBSERVANCE OF ALL APPLICABLE FOREIGN STATE LOCAL OR OTHER FEDERAL LAW

C VALID FOR USE BY PERMITTEE NAMED ABOVE

D. Authorized to take the following migratory birds for depredation control purposes: Authorized in emergency situations throughout the State of Florida to relocate active migratory bird nests (except endangered or threatened species or bald and golden eagles) when birds, nests and eggs are posing a direct threat to human health and safety or when the safety of the bird is at risk if the nest and/or birds are not removed.

E. Any person who is under the direct control of the permittee, or who is employed by or under contract to the permittee for purposes authorized by this permit, may carry out the activity authorized by this permit.

F Direct control of the permittee means that the permittee and the subpermittee has entered into an identifiable relationship where there is evidence that the permittee has relayed instructions outlining the authority given to the subpermittee for activities authorized by this permit

G. Permittee must also comply with the attached Depredation Standard Conditions.

☒ ADDITIONAL CONDITIONS AND AUTHORIZATIONS ALSO APPLY

12 REPORTING REQUIREMENTS
ANNUAL REPORT DUE: 1/31

ISSUED BY	TITLE	DATE
Carmen P. Simonton	FOR: ARD-MIGRATORY BIRDS & STATE PROGRAMS	04/19/2007

Appendix E. FWC Osprey Nest Removal Policies

Florida Fish and Wildlife Conservation Commission
Division of Habitat and Species Conservation
Species Conservation Planning Section
620 South Meridian Street, Mail Station 2A, Tallahassee, FL 32399-1600
(850) 921-5990, ext. 17310

OSPREY NEST REMOVAL POLICIES

Florida Fish and Wildlife Conservation Commission
OSPREY NEST REMOVAL POLICIES

A significant percentage of osprey (*Pandion haliaetus*) pairs in Florida nest on power poles or other man-made structures. Under permits issued by the Florida Fish and Wildlife Conservation Commission (Commission), a number of these nests are removed each year. This document outlines osprey nest removal policies and reporting requirements that help us determine the effects of these activities on Florida's osprey populations.

Osprey Protection and Nest Removal Regulation

The osprey is federally protected by the Migratory Bird Treaty Act (16 U.S.C. 703-712) and state protected by Chapter 68A of the Florida Administrative Code (F.A.C.). Pursuant to the federal act, it is unlawful to take, possess, buy, sell, purchase, or barter any migratory bird (including the osprey), including feathers or other parts, nests, eggs, or products, except as allowed by implementing regulations. Although both active and inactive osprey nests are protected Federally, only **active** nests require Federal permits for taking.

The specific state regulation protecting ospreys is rule 68A-4.001, F.A.C., which prohibits the taking or transporting of "...wildlife...or their nests, eggs, young, homes, or dens..." Additional state protection is provided in rule 68A-13.002, F.A.C., which adopts as state rules the federal Migratory Bird Treaty Act and all rules promulgated therefrom. Ospreys and their nests in Monroe County are provided even further protection by virtue of that population being listed as a "species of special concern" (rule 68A-27.005 F.A.C.), thereby protected by rule 68A-27.002, F.A.C.

Exceptions to these regulations are provided in rule 68A-9.002, F.A.C., which allows the Executive Director of the Commission to issue permits authorizing the taking or possession of wildlife or their nests for management or other "justifiable purposes." Such permits are subject to any terms, conditions, or restrictions that might be prescribed.

State permits to take active and inactive osprey nests are issued for the Executive Director of the Commission by the Section Leader of the Species Conservation Planning Section, Division of Habitat and Species Conservation, 620 South Meridian Street, Mail Station 2A, Tallahassee, Florida 32399-1600. Requests for such permits should be submitted to that office (see Attachment A for application form). Federal permits to take active osprey nests are issued by the U.S. Fish and Wildlife Services Region IV, Division of Law Enforcement, Special Agent in Charge, 1875 Century Boulevard, Atlanta, Georgia 30345,(404) 679-7049. There are no provisions in state law for verbal authorizations to remove active or inactive nests. Likewise there is no provision in Federal law for verbal authorizations to remove active nests.

Description of Permit Conditions

1. Only *inactive* nests may normally be taken. Inactive nests may be determined by the absence of any egg or dependent (i.e., flightless) young in the nest. Permittees may take inactive osprey nests at any time while the permit is valid.

2. Replacement nesting structures of comparable or better quality than the nest support structure removed or destroyed must normally be erected by the permittee. The replacement nest structure shall be located in the immediate vicinity of the old nest, if possible. Extenuating circumstances may prevent the placement of an replacement nest structure. In these circumstances, the permittee shall explain why replacement is not an option on the Species Conservation Planning Section application and the situation will be reviewed on a case by case basis. *Suggested* guidelines for constructing replacement osprey nest structures are attached, but other designs may be used if the permittee prefers.

3. The permit is not transferable, but other qualified personnel designated and instructed by the permittee may assist in the permitted activities.

4. The permit must be readily available for inspection at all times while engaging in the permitted activities.

5. The permit does not authorize access to any public or private properties.

6. Permits include an expiration date, but are subject to revocation prior to that time pursuant to Chapter 120, F.S.

Reporting Requirements

Blanket permittee holders are required to submit annual reports to the Species Conservation Planning Section documenting all nest removal. Permittees removing only 1 nest are exempted.

1. Complete 1 report form for each relocated nest site or replacement nest structure **during the nesting season immediately following nest removal (See attachment B)**.

2. Enter the state nest removal permit number(s) and the full name of the permittee. Enter the unique identifier for the nest site as used in your records to differentiate among osprey nest sites. Give a brief but accurate written description of the replacement nest site location with enough detail to allow our personnel to locate the nest structure. Enter the county.

3. Record the dates the original osprey nest was removed and the replacement nest structure was erected.

4. Send completed forms to: **The Florida Fish and Wildlife Conservation Commission, Division of Habitat and Species Conservation, Species Conservation Planning Section, Protected Species Permit Coordinator, 620 South Meridian Street, Mail Station 2A, Tallahassee, Florida 32399-1600,** by June 30 each year.

These data will be used to assess the overall success of our nest removal policies and are designed to help us better manage Florida's osprey population.

Records

The Division of Habitat and Species Conservation in Tallahassee maintains a file of permits to take osprey nests, and sends copies to the appropriate Commission regional offices (and Regional U.S. Fish and Wildlife Service office, for active nests). Annual reports are received, reviewed and filed by the Species Conservation Planning Section. SCPS staff will analyze data collected in these reports.

Enforcement

Enforcement of illegal nest take (active or inactive) and permit adherence is the responsibility of the Commission's Division of Law Enforcement.

Acknowledgements

This report was prepared by Ms. Susan Cerulean and Mr. Brian Millsap of the Florida Fish and Wildlife Conservation Commission. Review and comments were provided by Mr. Don Wood, Major Kyle Hill, Ms. Julie Hovis, Dr. Doug Runde, and Dr. Brad Gruver of the Commission. Helpful comments were also provided by Dr. Michael Collopy, Mr. Mark Westall, and Mr. Peter Quincy.

This report was revised by Ms. Angela T. Williams of the Florida Fish and Wildlife Conservation Commission, Species Conservation Planning Section, in response to changes in Federal policy.

*Effective July 1, 2004 the Florida Fish and Wildlife Conservation Commission (Commission) restructured as follows:

- Division of Wildlife (DOW) became Division of Habitat and Species Conservation (HSC)

- Bureau of Wildlife Diversity Conservation (BWDC) became the Species Conservation Planning Section (SCPS)

These changes are reflected throughout this document.

State of Florida Fish and Wildlife Conservation Commission
Division of Habitat and Species Conservation

MIGRATORY BIRD NEST REMOVAL PERMIT APPLICATION

(*Please Print or Type*)
Applicant Name ________________________ Date of Application __________________
Applicant Signature ____
Affiliation ____
Mailing Address ____
____
Telephone Number(s):____
Voice line Fax Email address

Certification: I hereby state and confirm by signature that the information submitted in this application and supporting documents is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to criminal penalties. I further state that I will abide by all applicable State, Federal, and local laws. Finally I hereby confirm by signature that representatives of the Florida Fish and Wildlife Conservation Commission (Commission) have my permission as the applicant and that of the landowner(s) to enter on and inspect the property(ies) described in the application for all reasonable purposes pertaining to applicable Commission rules.

Bird species: Burrowing Owl*________ Osprey ________ Other ______________
Did you previously have a state permit for the proposed work at this site?____Permit number______________

Nest information:

Number of nests or burrows to be removed__________Duration of work_____________________
Location of nest (i.e., what structure [light pole, tree, tower etc.] block, lot, street address, city, county, Township/Range/Section [T,R,S]): ____
____
____

Are eggs or flightless young present? Yes/No Are any adult birds present? Yes/No. How many? _______
You must also contact Special Agent in Charge, US Fish and Wildlife Service, 1875 Century Boulevard, Atlanta, GA 30345, (404) 679-7049 for a federal permit, if any eggs and/or flightless young are in the nest.

Has an environmental consultant or other trained or experienced person inspected the nest(s) or owl burrow (s)? Yes/No. . If yes, please provide *written* confirmation of the inspection from the environmental consultant or other trained individual (indicating they have inspected the nest(s) or owl burrow(s) and have verified the current status.)____
____

Justification for removal of nest(s) or owl burrow(s) (i.e.-location of nest conflicts with proper functioning/installation of a structure or prohibits construction) ______________________________
____
____

Describe proposed measures to (i.e., placement of T-perch on-site, starter burrows, erecting replacement nest structure, etc.) mitigate for this loss of nesting habitat for this species (refer to appropriate species policy/guidelines): ____
____
____

* - Those applying for a permit to remove a burrowing owl nest burrow *must* include a site plan or scaled diagram of the property that shows the location of the burrow(s) relative to the proposed construction.

The Florida Statutes require state agencies to approve or deny *complete* applications within 90-days of receipt. This office operates on a self-imposed policy to make every effort to approve or deny *complete* applications within 45 days of receipt. Therefore we ask you to submit a complete application and include all relevant information as attachments (i.e. scientific project proposals, site plans etc.). Complete permit applications should be submitted a minimum of 45 days prior to the requested effective date.

Mail to: Protected Species Permit Coordinator, Florida Fish and Wildlife Conservation Commission, Division of Habitat and Species Conservation, 620 South Meridian Street, Mail Station 2A, Tallahassee, Florida 32399-1600, (850) 921-5990, ext. 17310, Fax: (850) 921-1847.
Nest removal application.doc
Revised 30 September 2004

4

GUIDELINES FOR CONSTRUCTION OF REPLACEMENT OSPREY NEST STRUCTURES

The Florida Fish and Wildlife Conservation Commission requires that osprey nests removed under migratory bird permits be replaced by replacement structures of comparable or better quality. The reasons for this policy are two-fold. First, it helps ensure that osprey populations will not decline as a result of nest removal activities. Second, ospreys are strongly attached to nest sites, and will often rebuild a nest in the undesirable location unless a superior site is provided nearby.

An acceptable replacement nest structure and site meet the following conditions:

1. It is as tall or taller than the original nest site. If the original nest support structure is to be removed, the replacement structure should be as tall or taller than other surrounding structures. The alternative nest structure should never be less than 15 feet above ground.

2. It is located as close as possible to the original nest site (no further than 300 feet, and preferably less than 150 feet).

3. It is in an exposed location (e.g., not under or within the canopy of a tree).

4. It consists of a suitable platform mounted securely on an adequate support structure.

   a. The platform and structure should be capable of supporting a nest that may weigh 100 to 200 pounds.

   b. The platform may be either circular or rectangular. Rectangular platforms should have side dimensions of no less than 2 feet on any side, with a minimal 3 foot diagonal. Circular platforms should have a diameter of at least 3 feet.

   c. Whenever possible, the old nest should be relocated intact onto the new platform. When this is not feasible, arrange sticks in the shape of a nest on the platform.

   d. Pole-top mounted nest platforms are preferred replacements for nests on power transmission poles, light poles, etc.

If the support structure for the original nest is to be left intact, it should be modified to discourage ospreys from rebuilding. This is best accomplished by covering the original nest site with material that will prevent ospreys from perching. Flexible rubber highway detour cones work well on open structures (such as power pole crossarms) if they are placed close together and cover all the potential nesting surface.

Woodworking for Wildlife: Homes for Birds & Mammals by Carrol L. Henderson contains diagrams for building raptor platforms.

Osprey policies.doc
Revised 30-Sept-04

Appendix F. Bird Species Field Identification Guide

FPL

BIRD SPECIES FIELD IDENTIFICATION GUIDE

Florida Power & Light Company

2006

FPL

BIRD SPECIES FIELD IDENTIFICATION GUIDE

Companion Document to the FPL Avian Protection Plan

Submitted to:

Florida Power & Light Company
700 Universe Blvd.
Juno Beach, FL 33408

Prepared by:

PANDION SYSTEMS

Pandion Systems, Inc.
4603 NW 6th Street
Gainesville, FL 32609
www.pandionsystems.com

March 10, 2006

INTRODUCTION

The species presented below were selected because they are listed (state, federal, or both) *and* they are more likely to be injured or killed by a utility structure than other species. Thus out of the over 300 bird species in Florida and more than three dozen listed species only 23 detailed Species Accounts are provided in this guide. This should be kept in mind when trying to identify a bird as many of the birds encountered may not be described below.

Each Species Account contains species photos, key identifying features, a map showing occurrence in Florida, and symbols that represent personnel safety guidelines for protective gear to be worn when handling injured or dead birds of that species (see the APP for procedures).

Many species are similar to other birds, so positive identification may be difficult and require expert assistance or more information than is provided here. If after reviewing the species accounts you are still uncertain about the identification of the bird, please consult other resources including field guides, internet images and descriptions, and bird experts. You can also contact the Permit Specialist, AEC, TPS, or JES Environmental Specialist for assistance.

Bird Groups

Birds of Prey generally have sharp thick curved beak, relatively large body, and talons. Examples would be Eagles, Ospreys, Kites, Caracaras, Falcons, Kestrels, Owls, and Vultures (see pages 2-5).

Wading Birds usually have a relatively long legs and long, usually straight beak spear-like bills. Frequently seen in moist to wet habitats such as roadside ditches, lakes, ponds, coastal areas. Examples would be herons, egrets, ibises, wood storks, limpkins (see pages 5-9).

Cranes appear similar to waders with their long legs and bills but cranes are mush larger (3-4 feet tall) and their bills are shorter overall. They frequent open areas such as grass lands and prairies (rather than waters and wetlands of the waders) (see pages 9-10).

Terns and Shorebirds are medium to small birds with short legs and long bodies and often long bills. Frequently observed on beach, coastal areas, and other shorelines. Terns and Skimmers catch fish in flight by skimming over the water or diving. Oystercatchers and Plovers feed by probing their short bills into the muck and sand along the shoreline (see pages 10-13).

Other Birds include small bodied birds with nearly any beak type except for the strong curved raptor or the long spear-like wader. Examples include familiar back yard birds like cardinals, mockingbirds, blue jays (see pages 13-15).

Sex and Age

Birds often vary in how they look depending on their age and sex. Males are often more bright and colorful than females. Young are often more drab or mottled than adults. During the time of transition from immature to adult the bird may appear as a combination of these colors and patterns.

SPECIES ACCOUNTS

HAWKS, EAGLES, FALCONS, KITES, OWLS (Birds of Prey)

Bald Eagle




Key Identifying Features
ADULT: Large bird. Brown body with white head and white tail, large yellow bill.
IMMATURE: Brown with variable light/white splotches all over. Dark head and dark tail, large dark bill.

Occurrence
Present state-wide and year round.
(Photos from USFWS DLS website)

Osprey


Key Identifying Features:
ADULT: Medium size bird. Much smaller than Bald Eagle. Mostly brown with white crown of head with dark brown eye stripe. Tail is brown. Females may have a speckled brown breast or a dark band across the breast.
IMMATURE: Similar to adults but may appear more speckled.

Occurrence
Present statewide and year-round in Florida.

Snail Kite


male © Robert Bennetts

Key Identifying Features
ADULT: Medium size bird. Bill is long, thin and strongly hooked. Female is brown backed with streaked breast and throat and yellow/orange bill and legs. Male is slate to black bodied with red/orange feet and red/orange bill with a dark tip.
IMMATURE: Similar in coloration to adult females.

Occurrence
Snail kites are found in central to south Florida throughout the year.

Crested Caracara


© Tom Vezo

Key Identifying Features
ADULT: Medium size (21 inches long). Body is mainly black-brown with buffy/white breast, throat, and under the tail. There is barring or spotting on the upper back and breast. Bare red/orange face, brown cap. Very long yellow legs.
IMMATURE: Brown all over. Darker brown on body and lighter brown on breast and throat. Bare skin is pink-grey.

Occurrence
Caracaras are non-migratory and are present in the central to south Florida area year-round.

Peregrine Falcon




Key Identifying Features
ADULT: Medium sized bird. Adults are slate-gray above with a distinct check/eye patch extending over the head. Breast is white with dark barring on the undersides.
IMMATURE: Brown above with brown streaking on the breast and undersides.

Occurrence
Found throughout Florida from September through May. (Kale and Maehr 1990).

Southeastern American Kestrel


© Tom Vezo

Key Identifying Features
ADULTS: Small bird of prey (crow-size). Both sexes have a blue-grey crown, black bars on their faces, orange-rufous back and rump with some black markings. Males have blue-gray wings. Females have rufous wings.
IMMATURE: Similar to adults of the same sex.

Occurrence
This resident species is found in Florida year-round.

Bird Species Field Identification Guide

Florida Burrowing Owl

© Barry Mansell

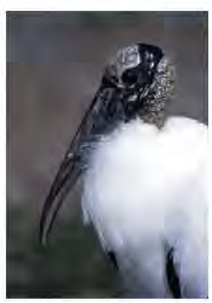
Key Identifying Features
ADULT: Small, crow-size bird. Long legs, a round head, a white chin stripe, and a stubby tail. Adults are brown with bold white spots and bars
IMMATURE A more solid brown above and buff below than adults.

Occurrence
This ground-dwelling (burrowing) species is found year round where it occurs.

WADING BIRDS

Wood Stork

© Barry Mansell



Key Identifying Features
ADULT: Large white wading bird (3 feet tall). Predominantly white with a short black tail, dark legs, beige feet, and black flight feathers that contrast with white along the wings. Adults have long, heavy, curved bills and bare, scaly, dark-gray heads and necks.
IMMATURE: Similar to adults but have grayish feathered necks and yellowish bills.

Occurrence
Wood storks are present statewide year round.

White Ibis

Key Identifying Features
ADULT: Medium-size wading bird, smaller than Wood Stork. Adults are white with black wingtips, long, downward-curving pinkish-red bills. Face and legs are similar in color.
IMMATURE: Similar to adults but with brown on their wings, neck, head, and tail with white patches making them appear mottled/patchy.

Occurrence
Present throughout the state year-round.

Snowy Egret

Key Identifying Features
ADULT: Medium sized wading bird. Entirely white feathered with long black legs and yellow feet. Black bill with a bright yellow base, yellow eye patches. May be more orange during breeding season.
IMMATURE: Similar to adults but legs are greenish.

Occurrence
Found throughout the state year round. Breed in Florida from January through August.

Reddish Egret

© Barry Mansell

Key Identifying Features
ADULT: Medium sized wading bird. Males and females alike. Comes is two color morphs – white and dark. The dark morph is more common. Mostly gray with a reddish head and neck that appear shaggy. The bill is pink and tipped with black. Legs are blue to black. The white morph is all white with a pink bill that is tipped with black.
IMMATURE: Dark morphs are a medium gray to gray-tan and a black bill.

Occurrence
Found throughout the coastal areas of Florida all year. Rarely venture into the interior of the state.

Tri-colored Heron

© Karla Brandt

Key Identifying Features
ADULT: Medium sized wading bird. Males and females similar. Head, neck, and body are a dark slate color. Rump, belly, and undertail are white. Slender neck is reddish-brown with a white streak extending down the front. Breeding adults have white head plumes and rufous to whitish shoulders,
IMMATURE: Similar to adults, but the head, neck and wing are more reddish.

Occurrence
This species is a permanent resident of Florida during all seasons.

Little Blue Heron


© Tom Vezo

Key Identifying Features
ADULT: Medium-size heron. Slate-blue body with reddish-brown head and neck and grayish-green legs. Their long, straight bills are black towards the tip. During breeding season, the head and neck turn dark gray or cobalt blue, and the legs turn black.
IMMATURE: Mostly white with black-tipped bills. They are easily confused with other white waders but the two-colored bill, pale gray tips on their primary feathers, and yellowish-green legs are distinctive.

Occurrence
Little blue herons are found throughout the state year-round.

Limpkin


© Karla Brandt

Key Identifying *Features*
ADULT: Small to medium wading bird. Males and females similar. Dark brown color with white spots and streaks. Face and throat paler. Long, heavy, and slightly down-curved bill. Long legs brown-black.
IMMATURE: Juvenile similar in color to adult but looks streaked (not spotted).

Occurrence
Present year round within their Florida range.

Roseate Spoonbill

© Barry Mansell

Key Identifying Features
ADULT: This medium-size wading bird. Males and females similar. Easy to identify by its bright pink body, contrasting white neck, and flat spoon-like bill.
IMMATURE: Whitish, acquiring pink coloration gradually.

Occurrence
Present year round within their Florida range.

CRANES

Whooping Crane

John and Karen Hollingsworth/USFWS

Key Identifying Features
ADULT: Tallest bird in North America at over 4 feet tall. Males and females similar. White with black wing tips that can be seen in flight but not when wings are at rest. Red crown extends from the forehead to the cheek. Black patch extends back from the bill. Can be confused with Sandhill Crane but Sandhills are grayer and smaller.
IMMATURE: Rusty or cinnamon brown. The brown gradually is replaced by white, creating a mottled appearance. The wing feathers are white with brown tips.

Occurrence
The populations of Florida are experimental reintroduced populations. The central Florida population is resident year round. The west coast population is migratory and is present only in the winter months.

Florida Sandhill Crane

© Karla Brandt

Key Identifying Features
ADULT: Tall bird (40-inch-long). Sexes similar. Gray and often stained with brownish-red (Nesbitt 1996). Chins, cheeks, and upper throats are whitish. Dull red skin patches on the crown. Very difficult to distinguish from the Greater Sandhill Crane.
IMMATURE: Grey all over (there may be tawny feathers on their heads and necks). No red skin patches.

Occurrence
Present year round within their Florida range.

TERNS AND SHOREBIRDS

Roseate Tern

© Barry Mansell

Key Identifying Features
ADULT: Medium-size tern (15-inches-long). Sexes similar. Pale gray wings and upper back, pale pinkish-white underparts. Black cap and back of neck. Legs and feet bright orange. Bill is thin and black, but becomes mostly red during the breeding season. Deeply forked tail. *Can be difficult to distinguish from other terns. It is paler in color and has shorter wings and a longer tail than the Common Tern and Forster's Tern.*
IMMATURE: Similar to adults but buff or grey with brownish cap. Black bill and legs.

Occurrence
Roseate Terns occur mostly during the summer breeding season, but may also be present in the spring and fall.

Least Tern

Key Identifying Features
ADULT: Smallest North American tern (9-inches-long). Sexes similar. Breeding adults are light gray above and white below with black wing tips visible when in flight. White forehead, black cap and nape, and a black line running through the eye to base of the bill. The bill is yellowish-orange with dark tip. Legs and feet are yellowish orange. Tail is short and deeply forked.
IMMATURE: Similar to adults in being light grey above and white below. Lack of black on head, instead back of neck is dark, there is a dark stripe through the eye, and crown is flecked.

Occurrence
Present in Florida during the nesting season. Absent from the state from November-February.

Black Skimmer

Key Identifying Features
ADULT: A large shorebird (18 inches long). Mostly black above and white below. Laterally compressed black and red bill with a lower bill that is much longer than the upper.
IMMATURE: Juveniles buffy brown, streaked with black above, whitish below.

Occurrence
Present year round within their coastal Florida range.

American Oystercatcher

© Karla Brandt

Key Identifying Features
ADULT: Large (19-inch-long). Mainly dark above and white below. Bill is long, straight, bright red to orange and laterally compressed. Legs pale pink legs. Eyes yellow with red eye ring.
IMMATURE: Overall is similar to adults but upperparts are dark brown to black, bill is a mix of red and black, eye is less yellow.

Occurrence
Present year round within their coastal Florida range.

Cuban Snowy Plover

© Dean Jue

Key Identifying Features
ADULT: Small shorebird (6.5-inch-long). Upper bodies are pale gray to brown with white to pale grey undersides. Black band across the forehead, dark collar patches on the side of each breast. Black bill. Legs grey to black.
IMMATURE: Similar to adults but undersides more buffy than white. Forehead and collar patches are less distinct than in adult.

Occurrence
Present year round within their coastal Florida range.

Piping Plover

Key Identifying Features
ADULT: Small shorebird. Pale brown to grey upper body and white to pale grey undersides. Single black neck band. Bill is short, stout, black. Legs yellow to orange. *Snowy Plovers are similar in size and plumage, but have a longer, more slender bill and darker legs.*
IMMATURE: Similar to adults but lack distinct black markings.

Occurrence
Present year round within their coastal Florida range.

OTHER BIRDS

Brown Pelican

Florida Scrub Jay

© Terr Vezo

Bird Species Field Identification Guide

Cape Sable Seaside Sparrow

Florida Grasshopper Sparrow

© Lang Elliott, Cornell Lab of Ornithology

Scott's Seaside Sparrow

© Karla Brandt

White crowned Pigeon

Red-cockaded Woodpecker

© Barry Mansell

Worthington's Marsh Wren

© Tom Vezo

Kirtland's Warbler

(Photo by Cory Gildersleeve)

Bachman's Warbler

(Photo by GADNR)

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Appendix G. FPL Avian Interaction Form

Avian Interaction Report

(SS-01.B Wildlife Compliance Program)
(Rev 07/27/06)

POINT OF CONTACT

Reported by: Date: Ticket #
Date AEC filled out Avian Interaction Report form: AEC

FATALITY/INJURY DETAILS

Date of report: Agency & contact name: Time:
Species of bird involved:
Was bird dead or alive: Age of bird: Adult Juvenile
Action taken:
Visible injuries to the bird:
Disposition of the bird: Name of representative & Rehab Center
Is bird banded: Y N Band number (retain band if deceased & send to Environmental Permit Specialist (EPS):
Cause of death: Electrocution Collision Other
Condition of body: Badly decayed Beginning to decay Recently deceased

LOCATION WHERE BIRD WAS FOUND

Location address: City County
Pole number: Circuit number:
Latitude/Longitude:
Nearest road or landmark:

CONFIGURATION DETAILS

Configuration:
Voltage:
Number of phases:
Was ground wire involved:
Was neutral involved:
If there was a cross-arm, what was the length:
If pole or equipment on pole is suspected cause, where was bird found in relation to pole or equipment?
Associated with outage: Y N

ENVIRONMENTAL CONDITIONS / INVESTIGATION (investigate a minimum of 5 spans each side)

Surrounding environment:
Weather conditions:
Time of day:
Food source(s) nearby:

EXISTING PROTECTION / RETROFIT MEASURES

Existing raptor protection on structure?
Type of protection:
Proposed retrofit countermeasures to location & area if necessary:
Work Request #:

Status of retrofits:	
Retrofit completion date:	

COMMENTS

Comments and additional information:

NOTES (EPS contact is Beverly Musser 954-321-2183 or 954-410-4956)

Any bird handled, salvaged, or transported to a wildlife hospital must be reported to the EPS.
FPL does not have a permit to handle live eagles or ospreys. If a bird is found alive it should be protected until a rehab center with proper permit can come to the site.
Bird or bird parts may only be given to authorized individuals
Retain listed species remains until agency provides specific instructions to EPS.

F:\Avian-Avian Interaction Report-FWS
revised 7/27/06

Appendix G-1. FPL Avian Nest Relocation/Removal Form

Nest Relocate
(9/28/06)

Date taken (relocated):

Applicable permit #:

Species (common name):

Location where taken (relocated):

Number of birds relocated:

List number of eggs and/or number of nests relocated:

Name of person taking (relocating – i.e. AEC):

Ticket # / Work Request #:

Person making report:

Final disposition of birds, eggs, nests:

*List name of person and wildlife rehab center if needed/used for relocation

Nest Remove

Date of work:

Applicable permit #:

Ticket # / Work Request #:

Person making report:

Location Address: **City:** **County:**

Species using nest:

Platform Installed: Y N

Platform Removed: Y N

Latitude **Longitude**
(If available)

Comments:

Notes:

Any bird handled, salvaged, or transported to a wildlife hospital must be reported to the Environmental Permit Specialist.

FPL does not have a permit to handle live eagles or ospreys or birds listed as protected by the Fish & Wildlife Service as well as the Fish & Wildlife Commission. If an injured bird is found alive it should be protected until a rehab center with proper permit can come to the site.

Bird or bird parts may only be given to authorized individuals (agency or wildlife centers), and AEC must obtain the name of the individual as well as the name of the agency or wildlife center.

F:/avian/nest relocate or removal

Appendix H. FWC Licensed Wildlife Rehabilitators (Peninsular Florida)

Name and Contact Information	County	Restrictions
Miller, Dawn.......................... Sunset Meadows Country Animal Clinic 15114 Northwest 32nd Avenue Newberry, FL 32669 Phone 1 : 352-332-3063	Alachua	
Rooney, Elijah....................... 10507 SW 85th Place Gainesville, Florida 32608 Phone 1 : (352) 372-4884	Alachua	Rehabber
Russell, Kathleen S................ Santa Fe Community College Teaching Zoo 3000 Northwest 83rd Street Gainesville, FL 32606 Phone 1 : (352) 395-5604 Phone 2 : 352-395-5605	Alachua	
Campbell, Janice F................ Coon's Run Wildlife Sanctuary Inc. 1010 Santa Rosa Drive Rockledge, FL 32955 Phone 1 : (321) 632-9582 Phone 2 : 321-504-7538	Brevard	
Cashe, Diana......................... Nature's Haven 1637 Sue Drive Cocoa, FL 32922 Phone 1 : (321) 632-8545	Brevard	
Chandler, Patricia Ann........... Florida Wildlife Hospital 3496 Sparrow Court Melbourne, FL 32935 Phone 1 : (321)254-8843	Brevard	
Loll, Patricia C....................... 271 Fay Drive Indialantic, FL 32903 Phone 1 : (321) 727-3787 Phone 2 : (321) 431-3857	Brevard	
Mederer, Hyta....................... Florida Wildlife Hosp. & Sanct. 3980 Turkey Point Drive Melbourne, FL 32934 Phone 1 : 321-698-0938 Phone 2 : (407) 242-7328	Brevard	

Small, Susan......................... Florida Wildlife Hospital and Sanctuary 4560 North U. S. Hwy 1 Melborne, FL 32935 Phone 1 : 321-254-8843 Fax Phone : 321-255-2213	Brevard	
Sypien, Jennifer..................... Coon's Run Wildlife 4960 Palm Ave. Cocoa, FL 32926 Phone 1 : 321-269-0198 Phone 2 : 321-385-5149	Brevard	
Sypien, Paul.......................... Coon's Run Wildlife 4960 Palm Ave. Cocoa, FL 32926 Phone 1 : 321-269-0198 Phone 2 : 321-385-5149	Brevard	
Westphal, Jacqueline M......... Village Animal Hospital and Bird Clinic 1340 Palm Bay Road Palm Bay, Florida 32907 Phone 1 : (321) 255-6572	Brevard	
Wise, Christine...................... Wildlife At Heart Rehab. 12 Forrell Avenue Titusville, FL 32796 Phone 1 : (321) 403-2732	Brevard	
Olejarski, Eileen.................... Florida Wildlife Hospital 262 Marion Street Indian Harbour Beach, FL 32937 Phone 1 : (407) 254-8843 Phone 2 : 321-508-1911	Brevard	
Oliver, Crystal Lee................. 1355 Malabar Road Malabar, FL 32950 Phone 1 : 321-426-5489	Brevard	
Karpouskas, Valerie L............. Wildlife Critter Care, Inc. P. O. Box 81-3539 2800 S. W. 73rd Way #1605/Davie/33314 Hollywood, FL 33081-3539 Phone 1 : 602-237-3385	Broward	

Kochinsky, Lyle...................... Everglades Habitat Preservation Incorporated Post Office Box 201 Dania, Florida 33004-0201 Phone 1 : (305) 681-6329	Broward	
Kohl, Joan F........................... Sawgrass Nature Center & Wildlife Hospital 3916 Northwest 73rd Avenue Coral Springs, Florida 3306 Phone 1 : 954/752-7732	Broward SR-024	
LaRose, Judy C...................... Wildlife Care Center 3200 Southwest 4th Avenue Fort Lauderdale, FL 33315-3019 Phone 1 : (954) 524-4302 Phone 2 : (954) 524-7464	Broward	
Nograd, Vered........................ 7907 NorthWest 67TH Avenue Tamarac, FL 33321 Phone 1 : (954) 726-9869 Fax Phone : 954/557-0789	Broward	
Poggi, Michael........................ Rare Exotics 11365 Earnest Boulevard Davie, Florida 33325 Phone 1 : (954)236-3788	Broward	
Rohkamm, Cynthia................. 2821 Northeast 45th Street Lighthouse Point, FL 33064 Phone 1 : (954) 942-6798	Broward	
Rubio, Freda.......................... Wildlife Care Center 11277 NW 15 Place 3200 Southwest 4th Avenue Pembroke Pines, FL 33026 Phone 1 : 954-447-7095 Phone 2 : 954-524-7464	Broward WMT#290	
Sayre, Jessica........................ Wildlife Care Center 3200 S. W. 4th Ave. Ft. Lauderdale, FL 33315 Phone 1 : 954-524-4302	Broward	

Schrager, Michael.................. State Wildlife Rescue 9421 SW 51 Place Cooper City, FL 33328 Phone 1 : (954) 680-1655	Broward	
Caron, Peter Octane............... Octagon Sequence of Eight 41660 Horseshoe Road Punta Gorda, FL 33955 Phone 1 : (941) 543-1130	Charlotte	
Graham, Margaret.................. Peace River Wildlife Center 1336 Sea Horse Ct. Punta Gorda, FL 33950 Phone 1 : 941-639-8068	Charlotte	Rehabber
Fiore, Cynthia........................ The Peace River Wildlife Center 3400 West Marion Avenue Punta Gorda, FL 33950 Phone 1 : (941) 637-3830	Charlotte	
Hilton, Judith a....................... 22123 Malone Ave. Port Charlotte, FL 33952 Phone 1 : 941-627-0990	Charlotte	
Rhodin, Lisa........................... 3400 West Marion Avenue Ponce De Leon Park Punta Gorda, FL 33950 Phone 1 : (941) 637-3830	Charlotte	
Kupcho, Meredith................... P.O. Box 193 6435 W. Craft Lane, 34448 Homosassa, Inverness, Florida 34451 Phone 1 : 352-621-0821	Citrus	
Mick, Diane............................ Mick, Diane 9880 North Misty-Janell Terrace Crystal River, Florida 34428 Phone 1 : (352)564-8152	Citrus	
Nayfield, D.V.M., K. C............ Midway Animal Hospital 1635 South Suncoast Boulevard Homosassa, FL 34448 Phone 1 : (352) 795-7110	Citrus	

Nelson, Robert W................... 11006 West Cove Harbor Drive Crystal River, FL 34428 Phone 1 : (352) 795-3278	Citrus	
Welzant, Linda....................... Clay County Humane Society 2230 Filmore Street Orange Park, FL 32065 Phone 1 : (904) 276-7729	Clay	
Waldren, Vicki and Roger....... Critter Care 20822 49th Drive Lake City, FL 32024-2214 Phone 1 : 386-935-3985	Columbia	
Kelton, Harry V....................... Pelican Harbor Seabird Station 1275 NE 79th Street Causeway Miami, FL 33138 Phone 1 : (305) 751-9840	Dade	
Knox, Patricia......................... Wee Care Wildlife Rehab. 15390 S. W. 269 Terrace Homestead, FL 33032 Phone 1 : (305) 248-0947	Dade	
Mealey, Brian K...................... Miami Museum of Science 3280 South Miami Avenue Miami, FL 33129 Phone 1 : (305) 858-8353 Fax Phone : (305)285-5801	Dade	
Miller, DVM, Christine............. Miami Metrozoo 12400 SW 152 Street Miami, FL 33177-1499 Phone 1 : 305-251-0400 Fax Phone : 305-378-6381	Dade	Rehabber
Radcliffe, Roy......................... Humane Society of Greater Miami 2101 N.W. 95th Street Miami, Florida 33147-2597 Phone 1 : 786/924-5222 Fax Phone : 305/696-4434	Dade	
Sykes, Cary W....................... 9450 SW 180 St. Miami, FL 33157 Phone 1 : 305-969-3819	Dade SR-078	Rehabber

Parrot, John D........................ Animal House Calls 2455 Northeast 184th Terra Miami, Florida 33160 Phone 1 : (305) 935-3715	Dade	
Perez, Michael a.................... Miami Museum of Science 3280 South Miami Avenue Miami, FL 33129 Phone 1 : 305-646-4244 Phone 2 : 305-646-4200 Fax Phone : 305-646-4300	Dade	
Stoddard, Hank...................... Shamrock Veterinary Clinics & Fisheries P O Box 1620 647 SW 10th Street Cross City, FL 32628 Phone 1 : (352) 498-5293 Phone 2 : 352/246-1145 Fax Phone : 352-498-2733	Dixie	Rehabber
Kapustin, DVM, Nikolay.......... Jacksonville Zoo and Garden Jacksonville Zoological Society 370 Zoo Parkway Jacksonville, FL 32218 Phone 1 : (904) 757-4463 Fax Phone : (904) 757-4315	Duval	Rehabber
Mobley, Mitzi Ginter............... 4711 Prince Edward Road Jacksonville, Florida 32210 Phone 1 : 904/381-0579 Phone 2 : 904-381-0507 Fax Phone : 904/635-7841	Duval	Rehabber
Myrick, DVM, Tecla B............. 4940 Brighton Drive Jacksonville, Florida 32217 Phone 1 : 904/448-8199	Duval NCR-025	
Tidwell, Barbara Y.................. 3930 Novaline Lane Jacksonville, FL 32277 Phone 1 : 904-744-8580	Duval	
Smith, Lora A......................... Post Office Box 307 1000 East Moody Blvd. Bunnell, Florida 32110-0307 Phone 1 : 386-437-2307 Phone 2 : 386-931-1864	Flagler	

Huston, Michael D.................. Huston Veterinary Clinic Post Office Box 1526 910 N.W. HWY 41 Jasper, FL 32052 Phone 1 : 386-792-3134	Hamilton	
Mizell, Kristina E.................... 22300 Hayman Rd. Brooksville, FL 34602 Phone 1 : 352-754-6022	Hernando	
Posey, Patricia C.................... Hernando Wildlife Rescue 6130 Waters Way Spring Hill, Florida 34607-4028 Phone 1 : 352/596-5175	Hernando	
Wrede, Karen R..................... Wrede's Wildlife Center, Inc Rehabilitation 4900 Wilderness Trail Sebring, FL 33875 Phone 1 : (863) 385-2770	Highlands	
Bond, Deborah...................... 410 Floriland Drive Tampa, FL 33612 Phone 1 : (813) 932-9545	Hillsborough	
Burton, Michalle D.................. 715 Rosier Road Brandon, Florida 33510 Phone 1 : (813) 684-0143	Hillsborough	
Busch Entertain., Corporation. Zoo Department Post Office Box 9158 Tampa, FL 33674-9158 Phone 1 : (813) 987-5250 Fax Phone : (813) 987-5548	Hillsborough	
Czyzowski, Arlene I................ Wildlife Haven 5633 Half Moon Lake Road Tampa, FL 33625 Phone 1 : 813-963-1022 Phone 2 : 813-263-3851	Hillsborough	

Czyzowski, Arlene I................ Wildlife Haven 5633 Half Moon Lake Road Tampa, FL 33625 Phone 1 : 813-963-1022 Phone 2 : 813-263-3851	Hillsborough	
Davis, Steven W.................... 3216 McIntosh Road Dover, FL 33527 Phone 1 : (813) 689-4075 Phone 2 : (813) 689-3961	Hillsborough	
Fox, Lee................................ Save Our Seabirds, Inc. 840 Third Avenue South 2709 Rt. 579, Wimauma 33598 Tierra Verde, Florida 33715 Phone 1 : (727) 864-0679 Phone 2 : (727) 867-0368 Fax Phone : (727) 251-9640	Hillsborough and Pinellas	
Grantham, Catheryn G........... Wildlife Center of Tampa Inc. 10318 Main Street Thonotosassa, Florida 3359 Phone 1 : 813/986-2314	Hillsborough SWR-045	
Hunter, Sharon R................... Noah's Ark Animal Hospital 4338 Bell Shoals Road Valrico, FL 33594 Phone 1 : (813) 662-7275 Fax Phone : 813/662-7285	Hillsborough	
Topor, DVM, Suzanne............ Livingston Animal & Avian Hospital 15104 Livingston Ave. Lutz, FL 33559 Phone 1 : (813) 979-1955	Hillsborough	
Young, Glenn......................... Busch Gardens 3605 E. Bougainvillea Ave. Tampa, FL 33612-6433	Hillsborough	
House, Deborah A.................. House of the Feathered, and Furred Orphaned 1550 19th Avenue SW Vero Beach, Florida 32962 Phone 1 : (772) 569-1305 Phone 2 : (407) 567-8000 X 446	Indian River	

Ferguson, Connie................... Friends of Nature Wildlife Refuge 15932 Thoroughbred Lane Montverde, FL 34756 Phone 1 : (407) 469-4602	Lake	
Finser, Yvonne Rose............. Amazing Exotics 17951 S. E. County Road 4 Umatilla, FL 32784 Phone 1 : 352-636-4058 Phone 2 : (352) 821-1234	Lake	
Rodgers, Jill.......................... Wildlife Rehabilitation Ctr of Lake County 32435 Averitt Lane Eustis, Florida 32736 Phone 1 : (352) 357-5153 Phone 2 : 352/406-5383	Lake	Rehabber
Pendleton, Edith..................... 1248 Miracle Lane Fort Myers, FL 33901 Phone 1 : (941) 489-9267	Lee	
Piper, Mary............................ Wildlife Rescue of Levy Co. Inc. 14160 N.E. 51st Place Williston, Florida 32696 Phone 1 : 352/528-2779	Levy	
Salls, Georgia E.................... 1449 N. W. Little Cat Rd. Madison, FL 32340 Phone 1 : (850) 973-4371	Madison	
Byrd, Larry............................ Wildlife, Inc. 4651 47th Street 2207 Ave. B, Bradenton Beach, 34217-2256 Sarasota, FL 34235 Phone 1 : 941-351-8759	Manatee SWR 110	Rehabber
Fansler, Daniel W.................. Wildlife Rescue Service 1111 Hagel Park Bradenton, FL 34222 Phone 1 : 941-720-2302	Manatee	Transport only

Matthews, Justin.................... Matthews Wildlife Rescue 7416 41st. Avenue East Bradenton, FL 34208 Phone 1 : 941-447-5369 Fax Phone : 941-955-0480	Manatee	Rehabber
Gallagher, Bob...................... Festival Fun Parks, LLC Db Silver Springs Attraction 5656 East Silver Springs Boulevard Silver Springs, Florida 3448 Phone 1 : (352) 236-2121	Marion	Rehabber
Hennessey, Tish.................... All Creatures Sanctuary P. O. Box 723 10252 Southeast Highway 464C Ocklawaha, FL 32179 Phone 1 : (352) 288-6754	Marion	
Kierstein, Lee Evan................ Magnolia Animal Hospital 2019 North Magnolia Avenue Ocala, FL 34475 Phone 1 : (352) 622-7143	Marion	
Kline, Michele A.................... 9297 North Kathleen Terrace Dunnellon, FL 34433 Phone 1 : 352-795-5764	Marion	Rehabber
Roseman, Pamela................. 27 Redwood Track Radial Ocala, Florida 34472 Phone 1 : 352-687-8173 Phone 2 : 352-598-3862	Marion	Rehabber
Smith, Russell R.................... 3078 Northeast 31 Place Ocala, FL 34479 Phone 1 : (352) 629-6846	Marion	
Tallman, Carol A................... Friends of the Feathered 7410 Newcastle Court Dunnellon, FL 34433 Phone 1 : (727) 942-8318	Marion	
Zandman, Anita Diane............ Animal Rescue Kingdom 10561 S. W. 67 Ct. Ocala, FL 34476 Phone 1 : 352-291-1678	Marion NER-063	Rehabber owned

Graham, Lori......................... Treasure Coast Wildlife Hospital 12914 Southeast Papaya Street Hobe Sound, FL 33455 Phone 1 : (561) 546-4705	Martin	
Martinelli, Daniel................... Treasure Coast Wildlife Hospital 8438 S. W. 48th Ave. Palm City, Florida 34990 Phone 1 : 772/546-8281	Martin	Rehabber
Grinter, Kelly C...................... Marathon Wild Bird Center, Inc. P. O. Box 501328 9900 E. 63rd Street Marathon, FL 33050 Phone 1 : 305-743-8382	Monroe	Rehabber
Quinn, Laura B...................... Florida Keys Wild Bird Ctr Rehabilitation 93600 Overseas Highway Tavernier, FL 33070 Phone 1 : (305) 852-4486 Fax Phone : 305-852-3186	Monroe	
Scott, Laura Christine............ 17229 Oleander Lane Summerland Key, FL 33042 Phone 1 : 305-304-8097 Phone 2 : 305-745-8688	Monroe	
Totman, Maya I..................... Exotic and Wild Bird Rescue of Florida Keys, Inc. 1388 Avenue B Big Pine Key, Florida 33043 Phone 1 : (305) 872-1982	Monroe	
Adams, Jeannie… 1774 Mobley Hts. Road Fernandina Beach, Florida 32034 Phone 1 : 904/321-0378	Nassau NCR-018	Rehabber
Arnold, Sue...................... Arnold's Wildlife Rehab Inc. 14895 NW 30th Terrace Okeechobee, FL 34972 Phone 1 : (941) 763-4630	Okeechobee	

Ebenhack, Amanda J............. South Florida Reptile Rescue 2005 N. W. 392nd St. Okeechobee, Florida 34972 Phone 1 : 863-697-6493	Okeechobee	
Bronzo, James....................... 805 Baron Road Orlando, FL 32828 Phone 1 : (407) 568-6449 Phone 2 : 897-9756	Orange	Transport Only
Flynt, Dianna King.................. Audubon Center for Birds of Prey 1101 Audubon Way Maitland, Florida 32751 Phone 1 : 407/644-0190	Orange	
Hardee, Ron and Carol........... Wildlife Rehabilitation Center of Central FL 21117 Reindeer Road Christmas, FL 32709 Phone 1 : (407) 568-3200	Orange	Rehabber
Harr, Leona B......................... 4621 Lenmore Street Orlando, Florida 32812 Phone 1 : (407) 277-7232	Orange	
Helsel, Deborah Ann.............. Back to Nature Wildlife Refuge 18515 East Colonial Drive Orlando, FL 32820 Phone 1 : (407) 568-5138	Orange	
Hess, Jr., Robert E................. Winter Park Veterinary Clinic 1601 Lee Road Winter Park, FL 32789 Phone 1 : (407) 644-2676	Orange	
Kerivan, Jr., John Michael...... SeaWorld Adventure Park Orlando 7007 Sea World Drive Orlando, FL 32821 Phone 1 : (407) 363-2351	Orange	
McCorkle, CVT, Carol V......... The Avian Reconditioning Center P. O. Box 296 351 West Lester Road Apopka, Florida 32704 Phone 1 : (407) 461-1056 Phone 2 : 407-880-3239	Orange	

Neiffer, V.M.D., Donald L....... Disney's Animal Kingdom Post Office Box 10000 1200 North Savana Circle East Lake Buena Vista, FL 32830-1000 Phone 1 : (407) 824-3784 Phone 2 : (407) 934-5994	Orange	Rehabber
Shaw, Carmen M................... Back To Nature Wildlife Refuge 18515 East Colonial Drive Orlando, FL 32820 Phone 1 : (407) 568-5138 Phone 2 : 407-760-4575	Orange	
Baranski, Susan.................... Susan's Raccoon & Wildlife Rescue 1361 Elmbank Way Royal Palm Beach, FL. 334 Phone 1 : (561) 753-1570 Phone 2 : 954-540-8782 Fax Phone : 561-753-1663	Palm Beach	
Brown, Kenny........................ 731 N. 5th St., Apt. 1 Lantana, FL 33462	Palm Beach	Transport only
Gradidge, Helenya................ McCarthy's Wildlife 17145 61st Pl. North 12943 61st St N., WPB, 33412 Loxahatchee, FL 33470 Phone 1 : 561-827-1000	Palm Beach	Rehabber
Hitzig, David.......................... Busch Wildlife Sanctuary 2500 Jupiter Park Drive Jupiter, FL 33458 Phone 1 : 561-575-3399 Phone 2 : 561-723-1465	Palm Beach	
Lovett, Keith.......................... Palm Beach Zoo @ Dreher Park Zoo 1301 Summit Boulevard West Palm Beach, FL 33405-3098 Phone 1 : (561) 533-0887 Phone 2 : (561) 533-0887 Fax Phone : 561-585-6085	Palm Beach	Rehabber

Mackey, Daniel...................... Folke Peterson Center for Animal Welfare 10948 Acme Road West Palm Beach, Florida 33414 Phone 1 : 561-793-2473 Phone 2 : 954-401-6168 Fax Phone : 561-422-3337	Palm Beach	
Marks, Jean Marie................. 126 Northwest 11th Avenue Boca Raton, FL 33486 Phone 1 : (561) 338-0403 Phone 2 : (305) 524-4302	Palm Beach	
McCarthy, Mark..................... McCarthy's Wildlife Inc. Sanctuary 12943 61st Street North West Palm Beach, FL 3341 Phone 1 : (561) 790-2116 Fax Phone : 561-790-6722	Palm Beach	
Meyer, Mary Jo..................... Milo's Ranch, Inc. P. O. Box 725 16757 Rustic Road Loxahatchee, Florida 33470 Phone 1 : 561/333-9571 Phone 2 : 954-249-7713	Palm Beach	
Rosenberg, Ellen................... Wildlife Recovery Center 12567 61st Street North Royal Palm Beach, FL 3341 Phone 1 : (561) 793-8075	Palm Beach	
Szejko, Allyn......................... Wildlife Rescue of South Florida 999 Southwest 8th Street Boca Raton, FL 33486 Phone 1 : (561) 338-0508 Phone 2 : (561) 419-0028 Fax Phone : (561) 338-0508	Palm Beach	
Wolf, Terrance F................... Lion Country Safari, Inc. 2003 Lion Country Safari R Loxahatchee, FL 33470-397 Phone 1 : (561) 793-1084 E 350	Palm Beach	

Rich, Mary E. (Beth)............... Wildlife Haven 36906 Christan Road Dade City, Florida 33523 Phone 1 : 352-457-1369 Phone 2 : (352) 518-9443 Fax Phone : 813-732-2002	Pasco	
Stearns, Kathryn P................. Stearns Zoological Rescue Rehab 36909 Blanton Road Dade City, Florida 33523 Phone 1 : (352)567-3418 Phone 2 : 813-714-2555 Fax Phone : 352-567-2579	Pasco	
Zablo, Lynn............................ 13214 Blissfield Rd. 13220 Blissfield Rd. Odessa, FL 33556 Phone 1 : 813-358-0205 Phone 2 : 813-310-9363	Pasco	
Barhorst, Lynda A................... Sky Harbor, Inc. 861 E. Klosterman Rd. PMB #12 603 Ivey Lane Tarpon Springs, Florida 34689-3927 Phone 1 : (727) 934-6829 Phone 2 : 727-424-9644	Pinellas	
Chaboudy, Rick...................... Humane Society of Pinellas 3040 State Road 590 Clearwater, FL 33759 Phone 1 : (727) 797-7722 Fax Phone : (727) 796-5527	Pinellas	Ken Johnson
Cianciolo, DVM, Janine M...... Clearwater Marine Aquarium Inc. 249 Windward Passage Clearwater, Florida 33764-2244 Phone 1 : (727)441-1790 Phone 2 : 727-638-6046 Fax Phone : 727-447-4922	Pinellas	
Hannameyer, Sally C............. Safe Haven Wildlife Center, Inc. 1216 Bell Drive Clearwater, Florida 33764-4858 Phone 1 : 727/449-8176	Pinellas SWR-020	

Heath, Ralph T...................... Suncoast Seabird Sanctuary, Inc. 18328 Gulf Boulevard Indian Shores, FL 33785-20 Phone 1 : (727) 391-6211 Phone 2 : 727-391-7962	Pinellas	Rehabber
Lutz, James D....................... SPCA of Pinellas County 9099-130th Avenue North Largo, FL 33773 Phone 1 : (727) 586-3591	Pinellas	
Odland, DVM, Steven............. The Woodlands Animal Hospital 3880 Tampa Road Oldsmar, Florida 34677 Phone 1 : (800) 850-7000 Phone 2 : 813-855-8888	Pinellas	
Perry, Diane.......................... Feline, Avian & Exotic Animal Hospital 427 Broadway (ALT19) Dunedin, FL 34698 Phone 1 : (727) 735-0500	Pinellas	
Yates, Vernon E.................... Wildlife Rescue and Inc. Rehabilitation 9500 82nd Avenue North Seminole, FL 33777 Phone 1 : (727) 399-1525 Fax Phone : 727/319-4121	Pinellas	
Fox, Lee................................ Save Our Seabirds, Inc. 840 Third Avenue South 2709 Rt. 579, Wimauma 33598 Tierra Verde, Florida 33715 Phone 1 : (727) 864-0679 Phone 2 : (727) 867-0368 Fax Phone : (727) 251-9640	Pinellas and Hillsborough	
Allaway, Kim......................... Genesis Zoological Center 747 Howard Road Auburndale, Florida 33823 Phone 1 : (863) 965-8706	Polk	
Baskin, Carole....................... Big Cat Rescue 12802 Easy Street Tampa, FL 33625 Phone 1 : (813) 920-4130	Polk	

Schotman, Thomas B............. Lake Wales Veterinary Hospital 520 Mt. Lake Cut Off Road Lake Wales, FL 33859 Phone 1 : (813) 676-1451 Fax Phone : 863/676-0142	Polk	
Cain-Stage, Melanie.............. H.A.W.K.E. Post Office Box 188 5285 St. Ambrose Church Elkton, FL 32033 Phone 1 : (904) 692-1777 Fax Phone : (904) 501-2291	St. Johns	Rehabber
Inman, Karen A..................... St. Johns Wildlife Care, Inc. 5705 County Road 208 St. Augustine, FL 32092 Phone 1 : 904-829-9210 Phone 2 : 904-829-8291	St. Johns	
Lynch, Karen......................... The ARIC Wildlife Rescue Rehab. 335 Sunset Drive St. Augustine, Florida 3208 Phone 1 : (904) 471-0336 Fax Phone : 904/808-4333	St. Johns	Rehabber
Sweeney, Linda J.................. 2268 Shore Drive St. Augustine, FL 32086 Phone 1 : 904-797-1691	St. Johns NER 076	Rehabber
Burns, Wyn Varcoe................ Creature Safe Place 4500 McCarty Road Ft. Pierce, FL 34945 Phone 1 : 772-468-6616	St. Lucie	
Eger, Rosmarie H.................. Kindness Animal Hospital 761 SE Port St Lucie Boulevard Port St. Lucie, FL 34984 Phone 1 : (561) 878-0100 Fax Phone : (561) 878-2943	St. Lucie	
Harsh, Debra......................... Wildlife Rehabilitation Center & Refuge Inc. 500 Easy Street Ft. Pierce, Florida 34982 Phone 1 : (561) 484-6546 Phone 2 : (561) 334-4277	St. Lucie	Transport only

Gooding, Mary........................ 4360 Lubec Ave. North Port, Florida 34287 Phone 1 : 941-423-9268	Sarasota	
Landess, DVM, Jack............... Nokomis Veterinary Clinic 405 W. Albee Rd. Nokomis, FL 34275 Phone 1 : (941) 484-2485	Sarasota	
Pierson, Edwin L.................... Amber Lake Wildlife Refuge & Rehab. Ctr 297 Artists Avenue Englewood, FL 34223 Phone 1 : (813) 475-4585	Sarasota	
Sewell, Sheila......................... Pelican Man's Bird Sanctuary 702 51st Street, Apt. 110A 1708 Ken Thompson Parkway, Sarasota, FL 34236 Bradenton, FL 34208 Phone 1 : 941-524-6583 Phone 2 : 941-388-4444	Sarasota SWR 116	Rehabber
Isner, Mary Jane..................... Haven for Injured & Orphaned Wildlife 610 Birch Boulevard Altamonte Springs, FL 3270 Phone 1 : (407) 260-6137	Seminole	
Sattler, Susan Kaye................ 2441 Mills Creek Road Chuluota, FL 32766 Phone 1 : 407-359-6548	Seminole	Rehabber
Young, Mary Ann.................... Ann Young Wildbird Refuge 205 Robin Road Altamonte Springs, FL 3270 Phone 1 : (407) 339-2900	Seminole	
Carter, Judith.......................... LaGuardar, Inc. 4966 County Rd. 656 Webster, FL 33597 Phone 1 : (352) 793-3094 Fax Phone : (352) 793-8792	Sumter	

Davis, Sandra Renee'............ Suwannee River Rescue 7130 112th Terrace Live Oak, FL 32060 Phone 1 : (386) 364-7058	Suwannee	
Greene, Brenda...................... 16369 8th Terrace Live Oak, FL 32060 Phone 1 : 386-842-5029	Suwannee	Rehabber
Riordan, Jeanette Christine.... 14872 49th Lane McAlpen, FL 32062 Phone 1 : 386-208-0742	Suwanee	
Anthony, Jackie and Michelle. Wildlife Rehabilitation of Daytona Bch, Inc 170 Lakeside East Port Orange, FL 32128 Phone 1 : (386) 767-2500 Phone 2 : (386) 274-1245	Volusia	
Burke, Pat A.......................... Halifax Humane Society Inc P. O. Box 9035 2364 LPGA Blvd. At I-95 Daytona Beach, FL 32120-9035 Phone 1 : (386) 274-4703 Fax Phone : 386-274-4710	Volusia	
Kanfer, Donald...................... Woodland Animal Clinic 1501 South Woodland Boulevard DeLand, FL 32720-770801 Phone 1 : (904) 734-1763	Volusia	
Keller, Mary A....................... 1216 Deneece Terrace Holly Hill, FL 32117 Phone 1 : (386) 252-2794	Volusia	
Weaver, Debralea................. 947 Essex Rd. Daytona Beach, FL 32117 Phone 1 : 386-257-3467 Phone 2 : 386-274-3460	Volusia	Rehabber

Wise, Christine....................... Marine Science Center 100 Lighthouse Dr. 4965 S. Peninsula Dr. Ponce Inlet, FL 32127 Phone 1 : 386-304-5530	Volusia	
Snyder, Dee Ann.................... 840 Samms Avenue Port Orange, FL 32119 Phone 1 : (386)295-7407	Volusia	

Appendix I. Scrub Habitat Management Agreement with USFWS

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
6620 Southpoint Drive, South
Suite 310
Jacksonville, Florida 32216-0912

IN REPLY REFER TO:

FWS/R4/ES-JAFL/05-0346

November 29, 2004

Post-it® Fax Note 7671	Date 11/30	# of pages ▸ 2
To Pete Quincy	From Annie Dziergowski	
Co./Dept.	Co. US FWS	
Phone # 561-747-6336	Phone # 232-2580 (904)	
Fax # 561-747-1377	Ext 116	

Mr. Peter Quincy
Cotleur and Hearing
Maplewood Professional Center
1934 Commerce Lane, Suite 1
Jupiter, Florida 33458

Re: FPL Scrub-Jay Habitat Management Plan
FWS Log No: 05-346

Dear Mr. Quincy:

This is in response to the Florida Power and Light Company's (FPL) Scrub-Jay Habitat Management Plan that we received on June 29, 2004. FPL historically has been maintaining the scrub vegetation along the transmission corridors to decrease the wildfire potential that could damage the powerlines. The habitat management plan would provide an established procedure on how to manage the scrub habitat to benefit Florida scrub-jays and other species such as gopher tortoises in Brevard and Volusia County, Florida. The FPL objectives are to: 1) maintain (through reduction/minimization) vegetation within transmission corridors to reduce the threat of wildfires; 2) continue the persistence of scrub-jay populations along the corridors; 3) restore and maintain biological diversity of scrub ecosystem within the corridors; and 4) develop a rotating maintenance system for the scrub oak habitat with a 5-7 year cycle.

FPL has integrated management activities that have been used to manage scrub habitat at Kennedy Space Center with their need to maintain the transmission corridors to reduce potential wildfires. These management activities include the use of mechanical techniques to remove slash and sand pine and exotic vegetation to open the habitat and provide suitable habitat for scrub-jays. FPL also proposes to remove patches of oaks to create open areas of bare sand between "islands" of scrub oak. The scrub oaks will be maintained between 4 to 10 feet in height. These activities will be conducted using rubber tired heavy equipment to minimize soil disturbance along the corridors. The use of herbicide/chemical controls should be a last option to maintaining vegetation. Prescribed fire is not a viable option due to the close proximity of urban development along the corridors. All the above maintenance activities will not occur during the scrub-jay nesting season (March 1 through June 30). FPL plans to survey for scrub-jays twice annually early spring (March) and fall (September-October).

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11/30/2004 09:12 9042322404 USFISHANDWILDLIF PAGE 02/02

The Service accepts the habitat management plan as proposed. If there are changes made that may impact scrub-jays or any other federally listed species then our office should be contacted. We look forward in reviewing the annual scrub-jay monitoring reports. Thank you for the opportunity to comment.

Sincerely,

Linda S. Walker

for Dave Hankla
Field Supervisor

Appendix J. Burrowing Owl Protection Guidelines and Procedures

BURROWING OWL NEST PROTECTION GUIDELINES AND PROCEDURES IN URBAN AREAS

The Florida burrowing owl (*Athene cunicularia floridana*) is listed by the State of Florida, Fish and Wildlife Conservation Commission (Commission) as a Species of Special Concern (Florida Administrative Code [F.A.C.] 68A-27.005). This classification means that the burrowing owl has a high vulnerability to factors that may lead to its becoming a threatened species in the absence of appropriate protection or management. As a Species of Special Concern, it is illegal to take (pursue, hunt, capture, molest, or kill) burrowing owls and their nest burrows and eggs without a permit issued by the Executive Director of the Commission (68A-9.002 & 68A-27.005 F.A.C.). Burrowing owls and their nests are also afforded protection under the Federal Migratory Bird Treaty Act. Rules promulgated under this act (Title 50, Code of Federal Regulations, Part 21) prohibit the destruction of active (i.e., nests which contain eggs or flightless young) nests without a federal permit, which is issued by the U.S. Fish and Wildlife Service Regional Office in Atlanta, Georgia.

The Commission's policy is to issue permits to destroy burrowing owl nest burrows only as a last resort, after all reasonable alternatives (such as realigning development to avoid the nest) have been shown to be impractical. When such permits are issued, they apply only to inactive nests (i.e., burrows containing no eggs or flightless young). Burrowing owl nests can generally be considered inactive from 10 July to 15 February, although some nesting occurs as early as October each year. Between 15 February and 10 July, burrows attended by one or more burrowing owls are considered active nests unless information is available to suggest otherwise (i.e., proof that young fledged from the nest prior to 10 July).

Burrowing owls often nest on vacant lots in rapidly developing suburban areas. In these areas, home construction is a major cause of burrow destruction. However, Commission studies in Cape Coral, Lee County, have shown that if development is conducted in such a way that the area within 50 ft of the burrow is protected from disturbance, nesting is seldom interrupted. No Commission permit is needed to build a home on a lot when at least a 50-ft radius circle can be provided around the burrow, but cautionary measures must be taken to guard against accidental destruction of the nest. A larger buffer, ideally 150 ft, will decrease chances the nest burrow will be adversely impacted. We recommend that the buffer circle around the burrow entrance be staked and roped-off prior to initiating construction. Sod may be laid within the protected area outside the "active" nesting period, but the burrow entrance must be left open. Plugging the burrow entrance or causing the burrow to collapse would effectively destroy the nest, and as such, require a permit. As a cautionary measure, we recommend that after completion of the home, the homeowners place a T-perch (see enclosed brochure) near the burrow or stake-off the area around the burrow to prevent someone from accidentally stepping into the entrance.

At present, the Commission has no guidelines for management of burrowing owls in other than urban/suburban areas. Protection criteria for these situations, or situations where numerous burrows will be impacted, will be developed on a case-by-case basis.

To request a permit to take a burrowing owl nest, submit an application packet to the Protected Species Permit Coordinator, Species Conservation Planning Section, Florida Fish and Wildlife Conservation Commission, 620 South Meridian St., Mail Station 2A, Tallahassee, FL 32399-1600, (850) 921-5990, ext. 17310, Fax (850) 921-1847. The packet must contain: (1) a complete application stating the location of the burrow(s), (2) a statement as to why the burrow(s) must be destroyed (i.e. nest burrow conflicts with proper installation/functioning of a structure or prohibits construction in a certain manner) in detail, (3) a detailed site plan or scaled diagram of the property that clearly indicates the location of the burrow(s) and it's proximity/distance to the proposed structure/construction activity, and (4) a statement of mitigation measures that will be enacted to offset the loss of nesting habitat for this species. Federal permits are required only if the nest is active (i.e., has flightless young or eggs present). Please contact Special Law Enforcement Agent in charge, U.S. Fish and Wildlife Service.

Nest removal application.doc revised 29 September 2004

State of Florida Fish and Wildlife Conservation Commission
Division of Habitat and Species Conservation

MIGRATORY BIRD NEST REMOVAL PERMIT APPLICATION

(*Please Print or Type*)
Applicant Name ______________________ Date of Application ______________
Affiliation ____
Mailing Address ____
____

Telephone Number(s):
Voice line Fax Email address

Applicant Signature ____

Certification: I hereby state and confirm by signature that the information submitted in this application and supporting documents is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to criminal penalties. I further state that I will abide by all applicable State, Federal, and local laws. Finally, I hereby confirm by signature that representatives of the Florida Fish and Wildlife Conservation Commission (Commission) have my permission as the applicant and that of the landowner(s) to enter on and inspect the property(ies) described in the application for all reasonable purposes pertaining to applicable Commission rules.

Bird species: Burrowing Owl*_______ Osprey _________ Other ______________
Did you previously have a state permit for the proposed work at this site?_______Permit number________

Nest information:

Number of nests or burrows to be removed________Duration of work______________________________
Location of nest (i.e., what structure [light pole, tree, tower etc.] block, lot, street address, city, county, Township/Range/Section [T,R,S]): ____
____
____

Are eggs or flightless young present? Yes/No Are any adult birds present? Yes/No. How many? _ *You must also contact Special Agent in Charge, US Fish and Wildlife Service, 1875 Century Boulevard, Atlanta, GA 30345, (404) 679-7049 for a federal permit, if any eggs and/or flightless young are in the nest.*

Has an environmental consultant or other trained or experienced person inspected the nest(s) or owl burrow (s)? Yes/No. If yes, please provide *written* confirmation of the inspection from the environmental consultant or other trained individual (indicating they have inspected the nest(s) or owl burrow(s) and have verified the current status.) ____
____

Justification for removal of nest(s) or owl burrow(s) (i.e.-location of nest conflicts with proper functioning/installation of a structure or prohibits construction) ______________________________
____
____

Describe proposed measures to (i.e., placement of T-perch on-site, starter burrows, erecting replacement nest structure, etc.) mitigate for this loss of nesting habitat for this species (refer to appropriate species policy/guidelines): ____
____
____

*** - Those applying for a permit to remove a burrowing owl nest burrow *must* include a site plan or scaled diagram of the property that shows the location of the burrow(s) relative to the proposed construction.**

The Florida Statutes require state agencies to approve or deny *complete* applications within 90-days of receipt. This office operates on a self-imposed policy to make every effort to approve or deny *complete* applications within 45 days of receipt. Therefore we ask you to submit a complete application and include all relevant information as attachments (i.e. scientific project proposals, site plans etc.). Complete permit applications should be submitted a minimum of 45 days prior to the requested effective date.

Mail to: Protected Species Permit Coordinator, Florida Fish and Wildlife Conservation Commission, Division of Habitat and Species Conservation, 620 South Meridian Street, Mail Station 2A, Tallahassee, Florida 32399-1600, (850) 921-5990, ext. 17310, Fax: (850) 921-1847.

Nest removal application.doc revised 29 September 2004

Appendix K. SAP and KDS – Employee Training Tracking Systems

SAP (System Application and Products) is the method FPL Power Systems uses to track their employee training for Transmission, Distribution and Substations. Employees are trained annually or as new employees arrive on avian and environmental issues that occur in the FPL system. The Area Managers or Training Coordinator input the training records into the SAP for tracking.

KDS (Knowledge Delivery System) is the method Power Generation Business Unit uses to educate and track environmental training.

Appendix L. Eagle Electrocution Risk Assessment Methodology

NOTE

This document serves as Appendix L for the FPL Avian Protection Plan. Introductory materials regarding bald eagle biology, electrocution mechanisms, and the goals and objectives can be found in the preceding chapters of the APP and are not repeated here.

I. INTRODUCTION

The purpose of the eagle electrocution risk assessment is to assist FPL in identifying high risk electric utility structures and environmentally sensitive bird areas to mitigate risks to bald eagles from electrocution. This information will be utilized by FPL in evaluating the risk of new and existing structures.

The behavioral and structural conditions that create electrocution risk for raptors have been well-studies, particularly in the western US (e.g. APLIC publication 1994, 1996, and 2006). Key factors related to electrocutions are fairly well understood [e.g. Avian Power Line Interaction Committee (APLIC) 1994 and 2006; Janss and Ferrer 2000, Lehman 2001]. What has been observed is that electrocution problems occur in very specific localized situations where a combination of power line structural characteristics and specific types of bird usage exists.

Research in the western US, primarily concerned with golden eagles and other raptors, suggests that the spacing of energized parts on structures influences the likelihood of an electrocution event occurring. Energized parts include the phases (e.g. wires), transformers, capacitors, jumper wires, etc. Generally the more equipment and lines on a pole the more energized parts present and the more closely spaced these parts are. This congestion increases the risk for large wingspan birds like raptors but also for medium sized birds (e.g. crows) as well (Pacific Corp 2002).

Biologic and other factors affect the likelihood of an electrocution event occurring including the birds' behavior and condition, number of birds on the structure, and weather conditions. For example, a group of birds or a wet rain-soaked bird has an increased likelihood of electrical arcing (in which the electricity "jumps" across an open gap to complete the circuit) and cause an electrocution.

In the eastern US, where density is lower and natural perches are more abundant, raptor electrocution in association with the utility structures has been less prevalent. For bald eagles in the Southeastern US electrocution is often associated with nesting. The large nests (>6ft across and weighing up to 1 ton) create increased likelihood of electrocution for several reasons. First, the large structure increases the chances of spanning the gap between energized parts. Second the amount of time spent in association with the nest structure (e.g. building, courtship, incubating, feeding) means that the birds will have many opportunities to encounter a situation in which they have the potential to be in contact with the line or facility. Third, the fledglings from the nest are naive, inexperienced, and less agile than their parents and thus may more readily come into contact with the energized parts especially when first learning to fly. Fourth, the behavior associated with reproductive activities such as courtship, nest building, provisioning the young increase the likelihood of electrocution.

The combination of the "riskiness" level of the bird ecology and the "riskiness" level of the structures creates and overall risk that the birds may be electrocuted by a structure.

It is the spatial interaction between these two risk components that determines the potential risk to the birds. For example, a "high risk" bird situation that is distant from any power structure is a low risk situation regardless of the eagle behavior or intensity of use. A diagrammatic depiction of this relationship is expressed in Figure 1.

Figure 1. Matrix illustrating the interaction between biological-based and structure-based risk.

		Structure-derived Risk		
		Low	**Medium**	**High**
Brd -derived Riski	**Low**	Low	Low	Medium
	Medium	Low	Medium	High
	High	Low	High	Very High

II. Conceptual Approach

Electrocution event can only occur when both the bird and the energized structure spatially co-occur. Thus to answer the question of what locations and structures are inherently riskier it is necessary to know: Where are the birds and how are they behaving? Where are the structures and how are they constructed? These spatial questions require a spatial methodology. The conceptual approach is to model the relative electrocution risk by considering the bald eagle biology and the structures present.

The Bald Eagle model is based on work done for SWFWMD to model bald eagle habitat use. Using this previously vetted model as a starting point it was modified to include weights to account for behaviorally-induced and frequency-related risks. The product is a surface grid that expresses the relative risk based on the eagle biology inputs.

The structure model is based on literature review on electrocution risk factors for large raptors. The model is weighted to account for higher risk due to a higher number and greater density of energized parts (Pacific Corp 2002). The product is a surface grid that expresses the relative risk based on the structural inputs.

The electrocution model is the culmination of both the biology and the structural models. The two risk surfaces are added together using raster math (a.k.a. map algebra) to produce a model of the relative electrocution risk to bald eagles for each of the structures throughout the FPL service area.

Table 2. Avian Risk Factors and Spatial or GIS Depiction Considerations

Major Avian Risk Characteristics	Potential Spatial or GIS Relationships
Structural Engineering Characteristics	
Number of phases	The number of phases and equipment load on a pole create a measure of the total number of energized parts on a pole.
Equipment load on a pole	
Structure Density	A surface expressing the structural risk due to the regional density of structures.
Biological Characteristics	
Behaviors linked to Habitat Conditions. Behaviors include Nesting, Feeding, Roosting, and Migration. The behaviors may be tied to bird age or physiology	Behavior cannot be directly modeled but certain habitat conditions are indicators of behavior. Habitat conditions can be spatial depicted with values assigned based on behavior and frequency and duration of use of the habitat
Landscape Factors	
Distance from habitat Juxtaposition of habitats to one another Juxtaposition of habitats to surrounding land uses Habitat Patch Size and Shape Vegetation Conditions (forested vs. non forested)	Many of the habitat characteristics of interest are Landscape-level factors and their spatial relationships to each other. For example, the presence of nesting habitat is a useful indicator of behavior if there is suitable foraging habitat nearby to support this nest.

III. METHODS

A. Eagle Biology Model

In the model four main components of eagle biology and habitat use are considered: primary and secondary nesting and primary and secondary foraging. The base GIS layers for deriving these components is the Florida Fish and Wildlife Commission's 2003 vegetation cover data (FWC 2003) and the FWC's annual eagle surveys from 1999 through 2003.

Nest locations are essential components in modeling eagle risk due to the type and intensity of activity associated with nesting and also the stability of nest locations through the years. For currently active nests the likelihood that a nest that was used at least once in the previous 4 years is 88 to 92% (Table 2).

Table 3. Florida Bald Eagle Population Status and Nest Fidelity between years

		Year				
		1999	**2000**	**2001**	**2002**	**2003**
Nest Status	**Active**	1012	1043	1089	1098	1117
	Inactive	116	133	158	251	352
	Unknown	16	30	41	32	21
	Total Surveyed	1144	1206	1288	1381	1490
	Nest was active in at least 1 of the previous years.	NA	919 (88%)	997 (92%)	1004 (92%)	1028 (92%)

A.1. Nesting

Primary Nesting

Primary nesting habitat is defined as: 1. all blocks of forest habitat currently occupied by nesting eagles and 2. Those forests blocks that are greater than 200 acres and less than 1 km away from a current nest. This second definition identifies those areas that are available if the nest is relocated within the same eagle territory (e.g. if the current nest structure is lost).

The nesting area is the focal area of use by nesting eagles and the young birds from the nests. Some behaviors exhibited within the nesting area are considered higher risk because they may distract the bird and reduce it awareness of its immediate environment (e.g. courtship, nest building, provisioning, anti-predator behaviors, and practice flights of young birds). Other behaviors are considered higher risk because they increase the effective size of the bird and thus increase likelihood of contact - e.g. when carrying a large prey item.

Additionally, the area immediately proximate to the nest is considered higher risk due to the frequency of trip-events in this area and because the adults and offspring spend a disproportionate amount of time within this area. For all of these reasons Primary Nesting is weighted the most heavily of the four biological variables (Table 3).

Secondary Nesting

Secondary nesting habitat is defined as all blocks of forested habitat at least 200 acres in size and greater than 3 km of a known nest location. The secondary nesting areas capture the area in which a new (not replacement) eagle nests might be established due to growth of or shifts in the eagle population. Additionally, these areas may be used throughout the year by non-nesting eagles.

If these areas are occupied by nesting eagles in the future they would be reclassed as primary nesting habitat. But since they are not currently occupied by nesting eagles and thus do not have the associated behavioral and usage risk factors, they are not weighted as heavily as Primary Nesting.

A.2. Foraging

Suitable foraging habitat defined as blocks of open/semi-open water at least 100 acres in size and at least 50m wide.

Primary Foraging

Primary foraging habitat is defined as suitable foraging habitat within 3 km of a known nest location. This is the focal foraging area for nesting eagles and the area most heavily used for foraging. Foraging creates risk because birds are distracted by their pursuit of prey and are effectively larger due to the prey item. Thus Primary Foraging is weighted more heavily than Secondary Foraging.

Secondary Foraging

Secondary foraging habitat is defined as suitable foraging habitat greater than 3 km from a known nest location. The secondary foraging areas are too far from known nest locations to be used regularly by nesting eagles but would be expected to be used during the non-nesting season and any time of the year by non-nesting birds. Foraging related risk behaviors such as pursuit of prey and perching with prey may occur in these areas but not as frequently as in Primary Foraging areas so this item is less heavily weighted.

Table 4. Valuation and model weights for the biological model components.

	Biological Model Components Summary			
	Primary Nesting Area	Secondary Nesting Area and Non-nesting habitat	Primary Foraging Areas	Secondary Foraging Area
Behaviors				
Courtship	2	0	0	0
Nest Building	2	0	0	0
Provisioning Young	2	0	0	0
Juvenile Practice Flights	2	0	0	0
Pursuit of Prey	1	1	3	1
Perching with Large Prey Items	5	2	5	1
Total	14	3	8	2
Weights used in the Model	**5**	**1**	**3**	**1**

A.3.Eagle Biology Model Output

The four layers were weighted and added together using map algebra. The following equation was used to produce the eagle biology risk model:

Biological risk = [(primary nesting*5) + (secondary nesting) + (primary foraging*3) + (secondary foraging)]

The output is a GIS surface for the entire FPL service area that expresses the relative biological risk for the Bald Eagle at a 10m cell resolution.

B. Structure Model

B.1. Structure Load

FPL currently maintains over 1.4225 million poles with over 1.67 million pieces of equipment attached (Table 4).

Table 5. Equipment types and number of occurrences.

Equipment Type	Occurrences
Auto Transformer	99
Capacitor	7,176
Fault Indicator	5
OH Auto Switch	343
OH Fuse Switch	141,411
OH Switch	38,029
OH Transformer	453,539
Primary Jumper	18
Primary Meter	125
Recloser	886
Regulator	125
Total	**642,986**

The primary determinant of structural risk is the number of energized parts and their proximity to each other. Parts less than 60" apart have the potential to cause an electrocution for a large raptor such as a bald eagle. The greater the number of parts in a confined space the greater the risk of a bird touching or spanning any two. So pole risk is a function of the number of energized parts. Potential energized parts are the phases and the equipment. Phases (e.g. lines) range from 1 to 3 per pole. Equipment is items such as transformers, capacitor banks, and jumper wires that are added to the pole for power management purposes. Equipment load values range from 1 to 4.

B.2. Structural Density

Although individual poles cause fatalities a density of high risk poles in an area can make an entire region of poles higher risk. Accordingly a pole risk density surface was created to express this relationship. The values ranged from 1 to 10.

B.3. Structural Model Output

The output is a GIS surface that expresses the relative cumulative risk for the structures within any 10m square cell throughout the FPL service area. There are two structural risk outputs, one for the individual poles which is expressed as discrete cell (10m squares) and another for the regional density of poles which is expressed as a continuous surface.

C. Cumulative Electrocution Model

The biological risk model output raster and the two versions structure risk output raster were added together using the raster calculator to create two versions of the cumulative risk surface layer.

The cumulative layer shows the relationship between these two independently derived data sets for the biology and the structures.

IV. RESULTS

A. Model Output

The biological risk model is a single surface layer that expresses the cumulative risk values for any location in the FPL service area based upon habitat type, level of habitat use and type of bird usage/behavior within that habitat. It is derived from a combination of the primary nesting, secondary nesting, primary foraging, and secondary foraging modeled layers.

The single pole version of the structure risk model presents each individual pole as a cell with a relative risk value based on the number of phases and equipment load.

The regional density version of the structure risk model presents the regionalized risk of the poles as a continuous surface.

The cumulative electrocution risk model is expressed two ways to reflect the two versions of the structural model. In both instances the output is a surface layer that is an expression of biological risk model and the electrocution risk model. This culmination is completed via the raster calculator such that the biological and structural risk values are summed to create a final electrocution risk output.

B. Model Interpretation

The modeled layers are normalized and weighted. The darkest color in each color ramp (Figures 3 t0 13) indicates the highest relative risk for the factor that is mapped (e.g. nesting habitat or foraging habitat).

With over 1.4225 million distribution structures and a very low recent annual bald eagle mortality rate of 2 per year, high risk areas should not be interpreted as an area of certain future mortality but rather as an area that may have a higher likelihood.

Figure 2. Bald Eagle Nest Locations as of 2003.

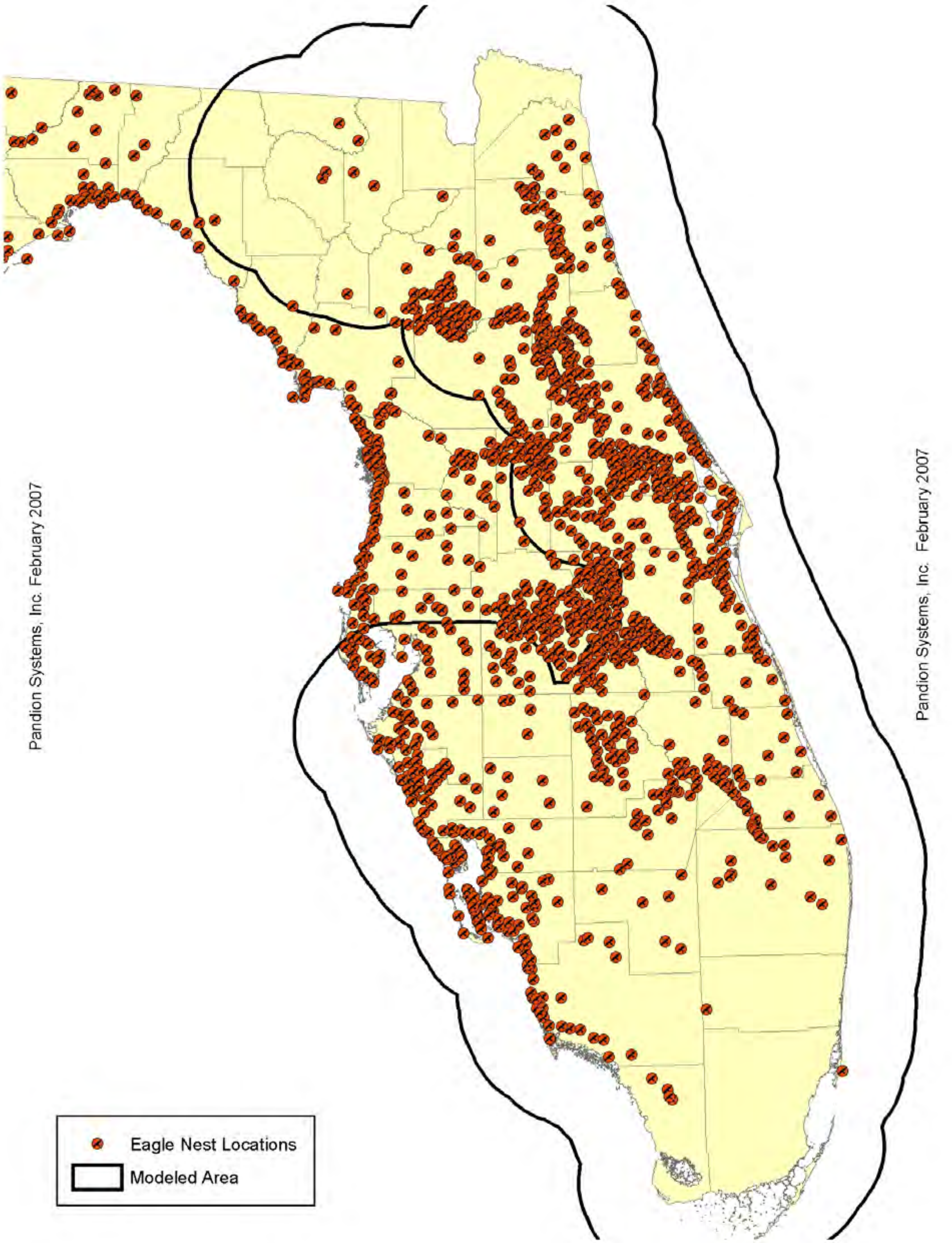


Figure Error! No text of specified style in document.**3. Primary Foraging Habitat Relative Risk**

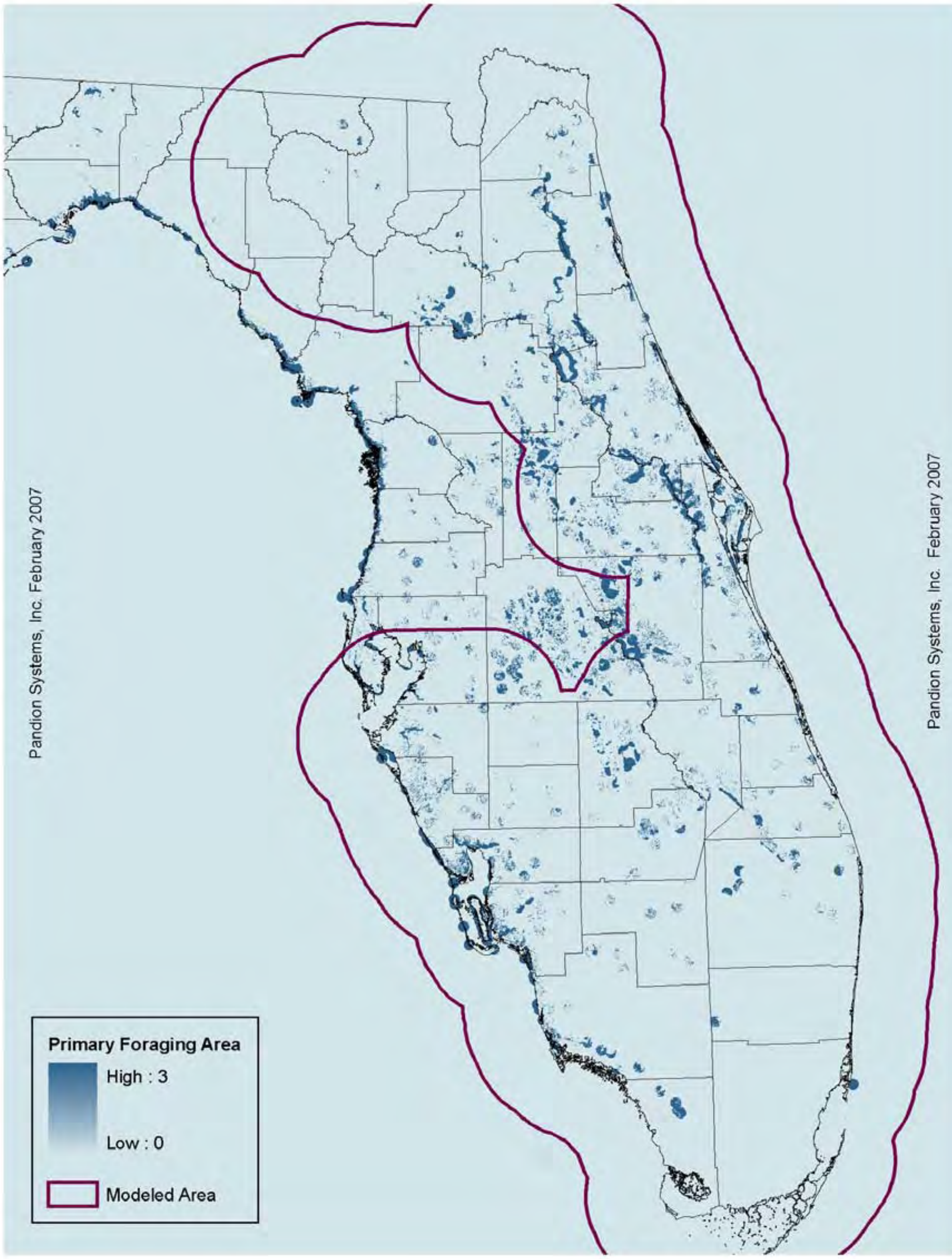


Figure 4. Secondary Foraging Habitat Relative Risk

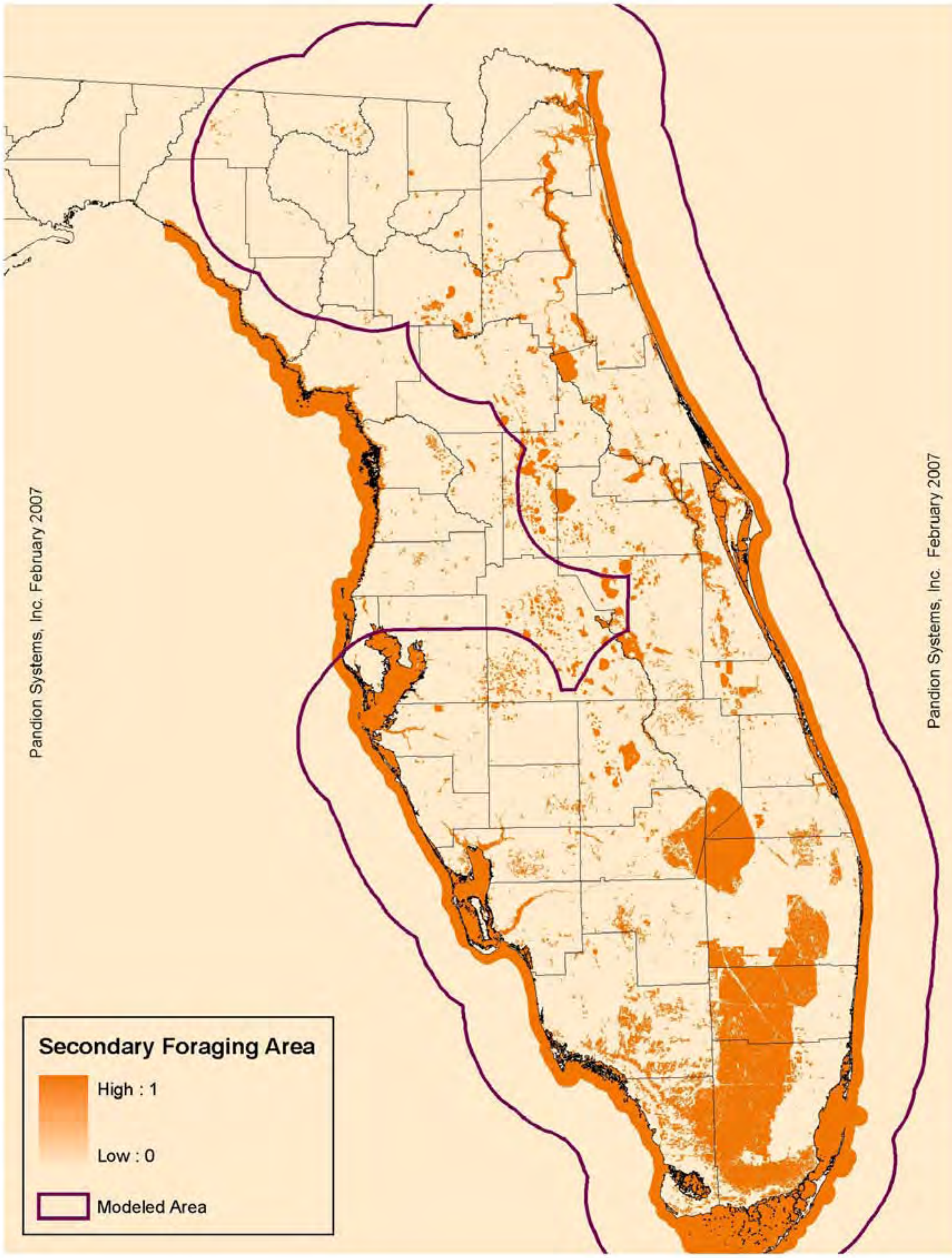


Figure 5. Summed Foraging Habitat Relative Risk

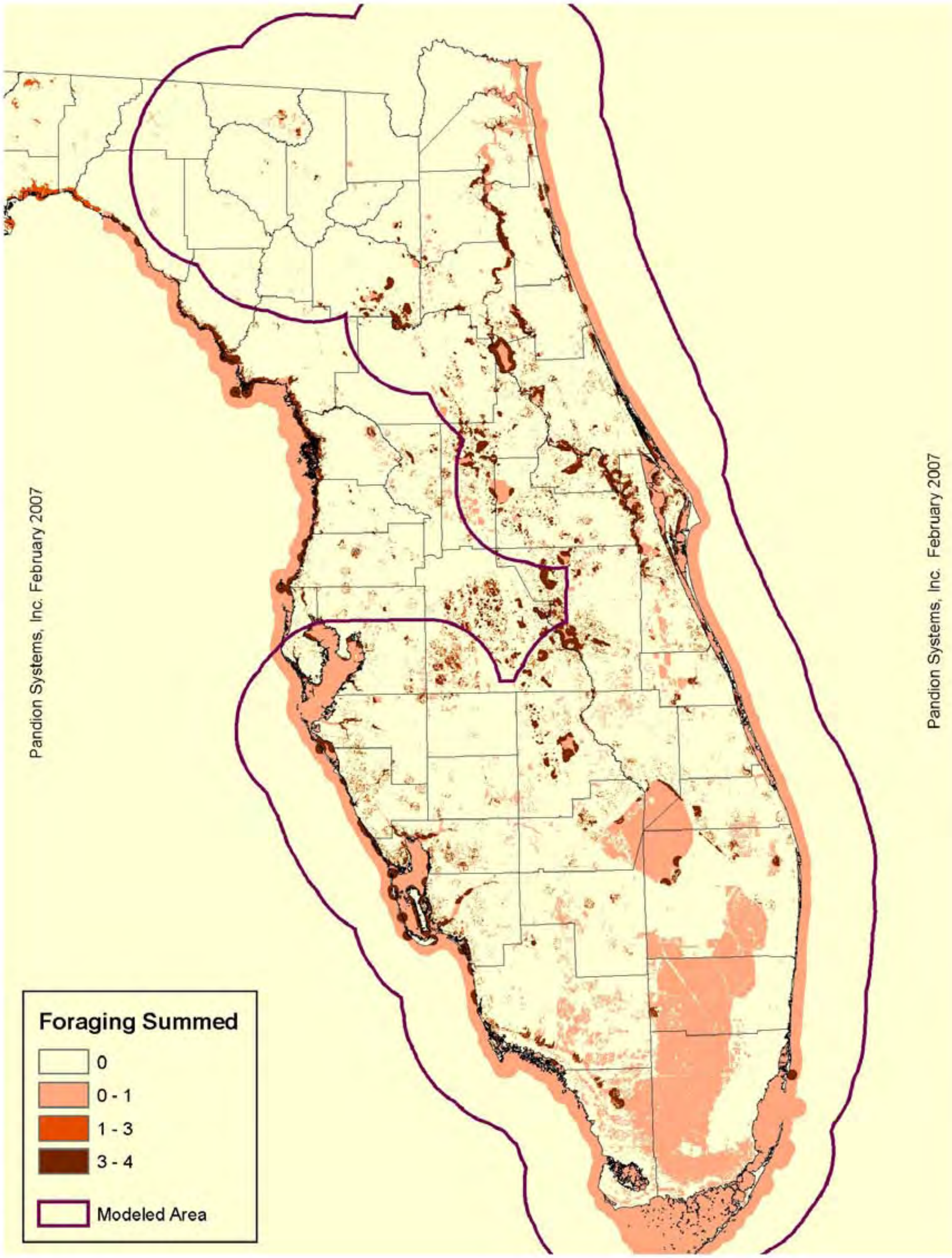


Figure 6. Primary Nesting Habitat Relative Risk

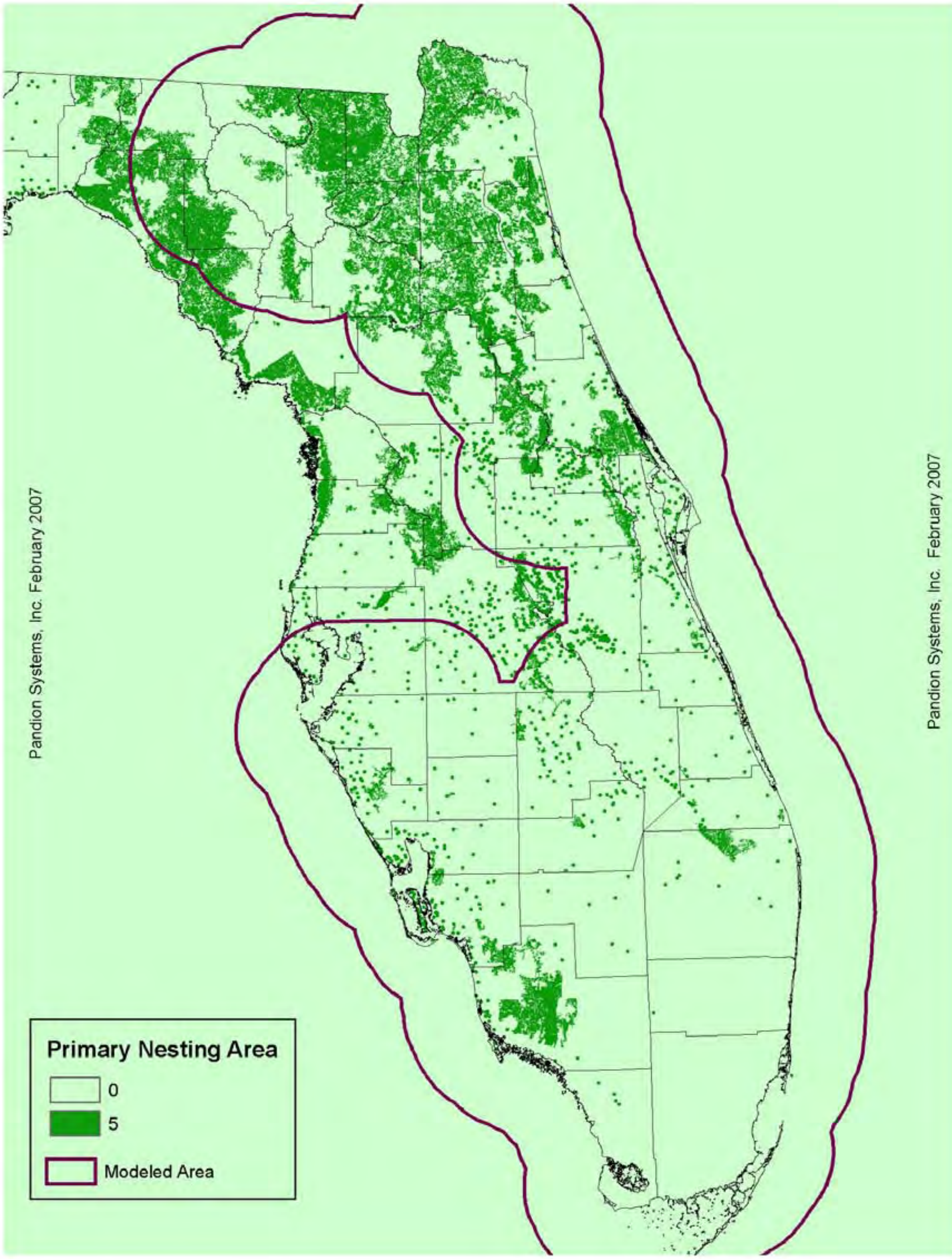


Figure 7. Secondary Nesting Habitat Relative Risk

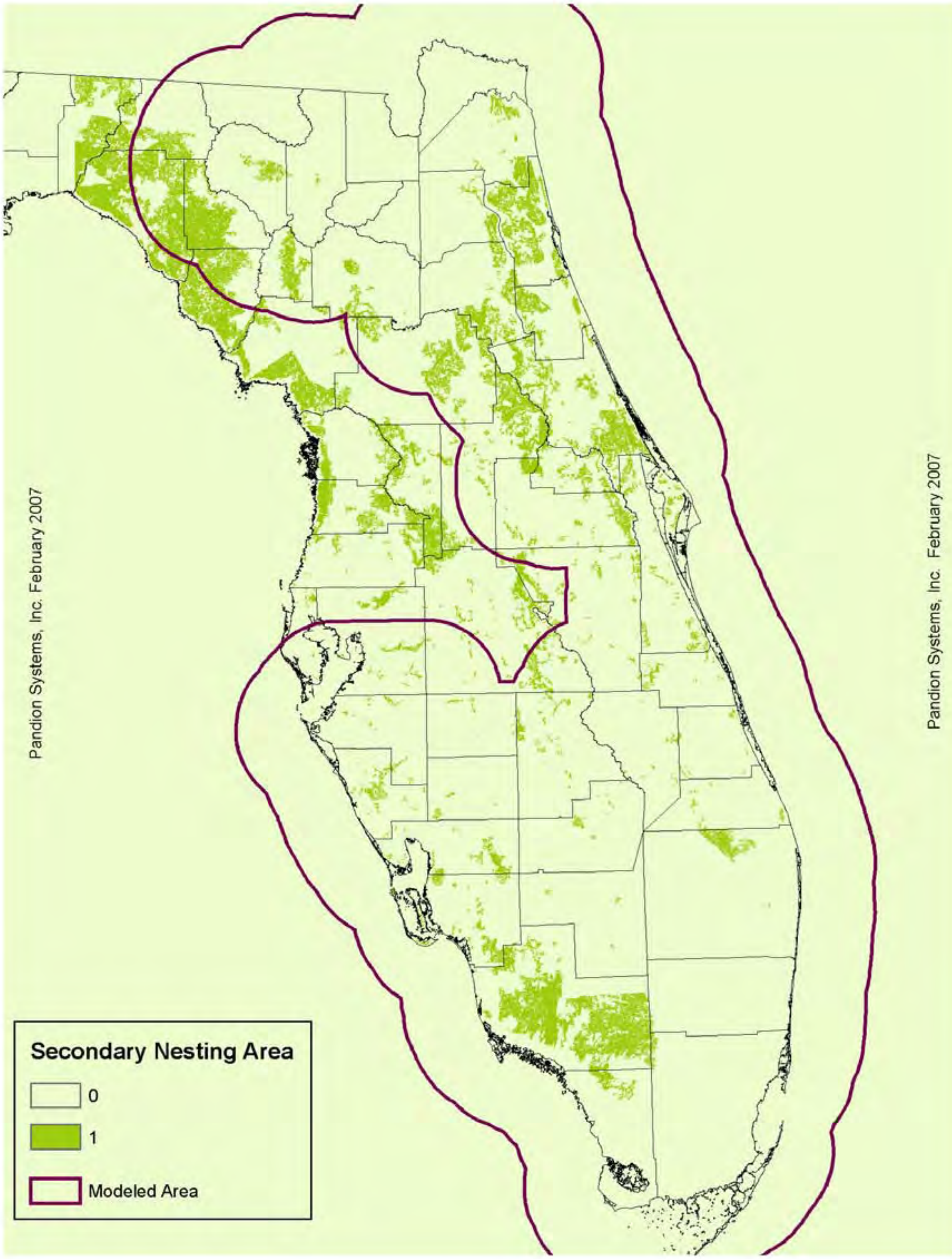


Figure 8. Summed Nesting Habitat Relative Risk

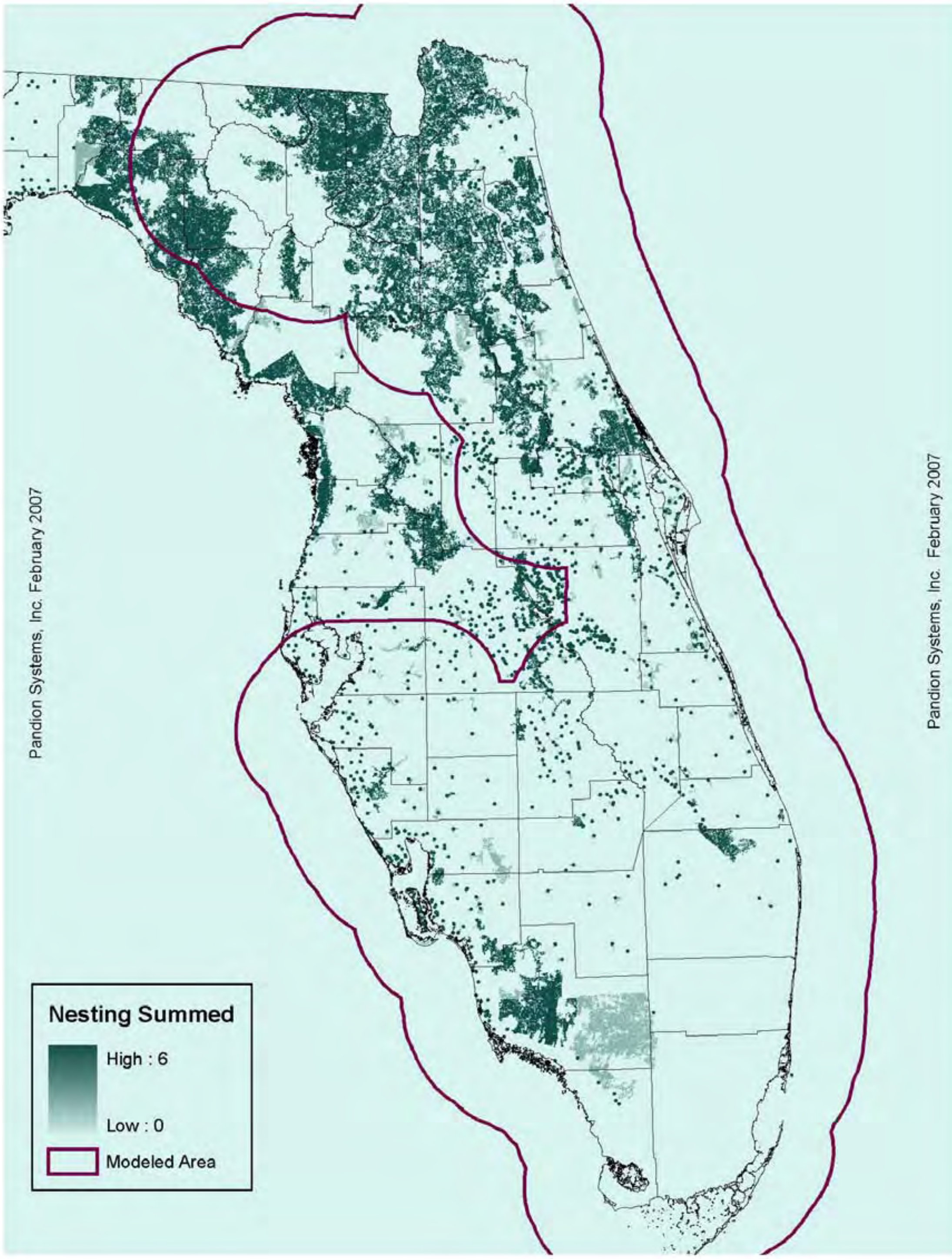


Figure 9. Summed Biological Relative Risk

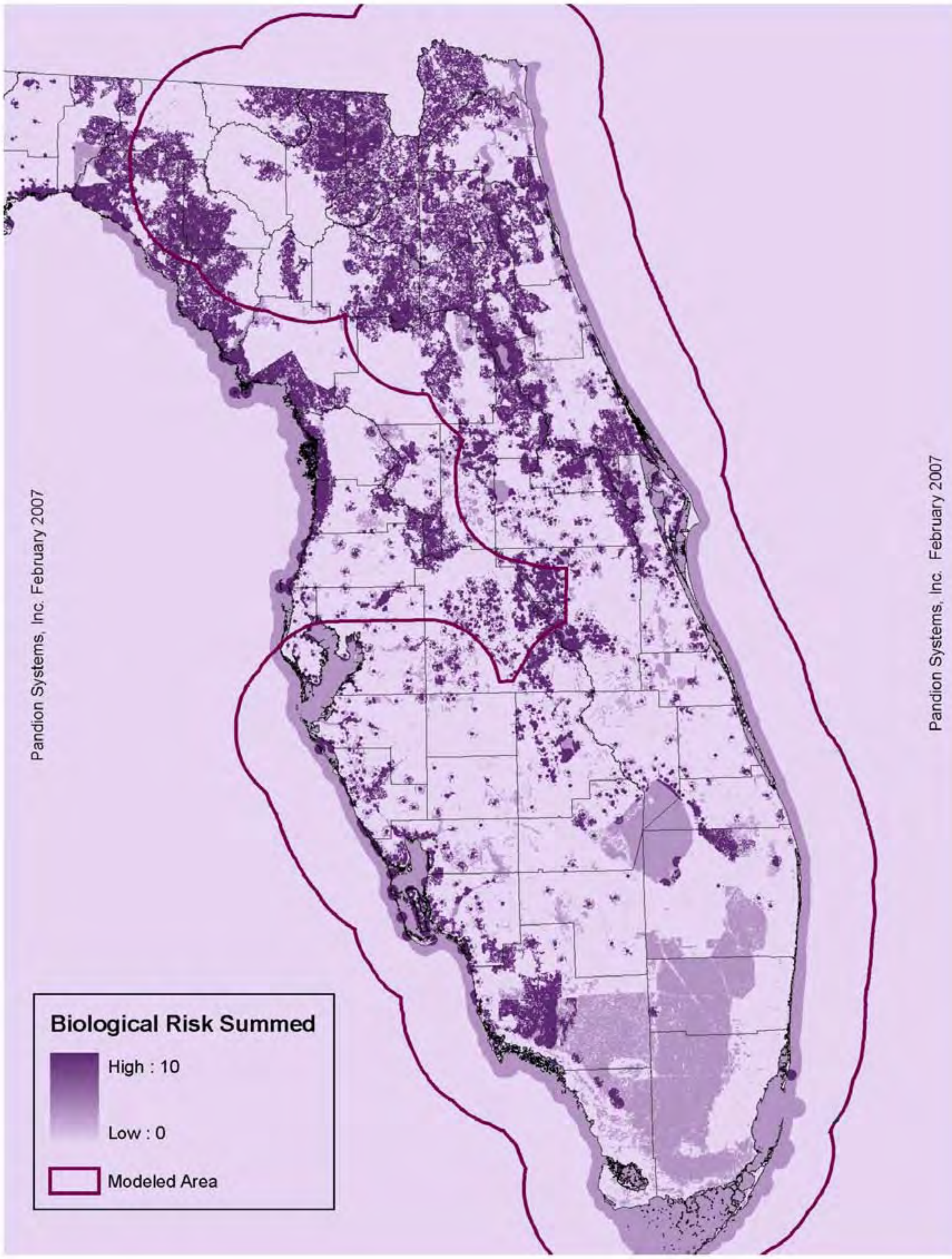


Figure 10. Structural Risk for individual distribution structures.

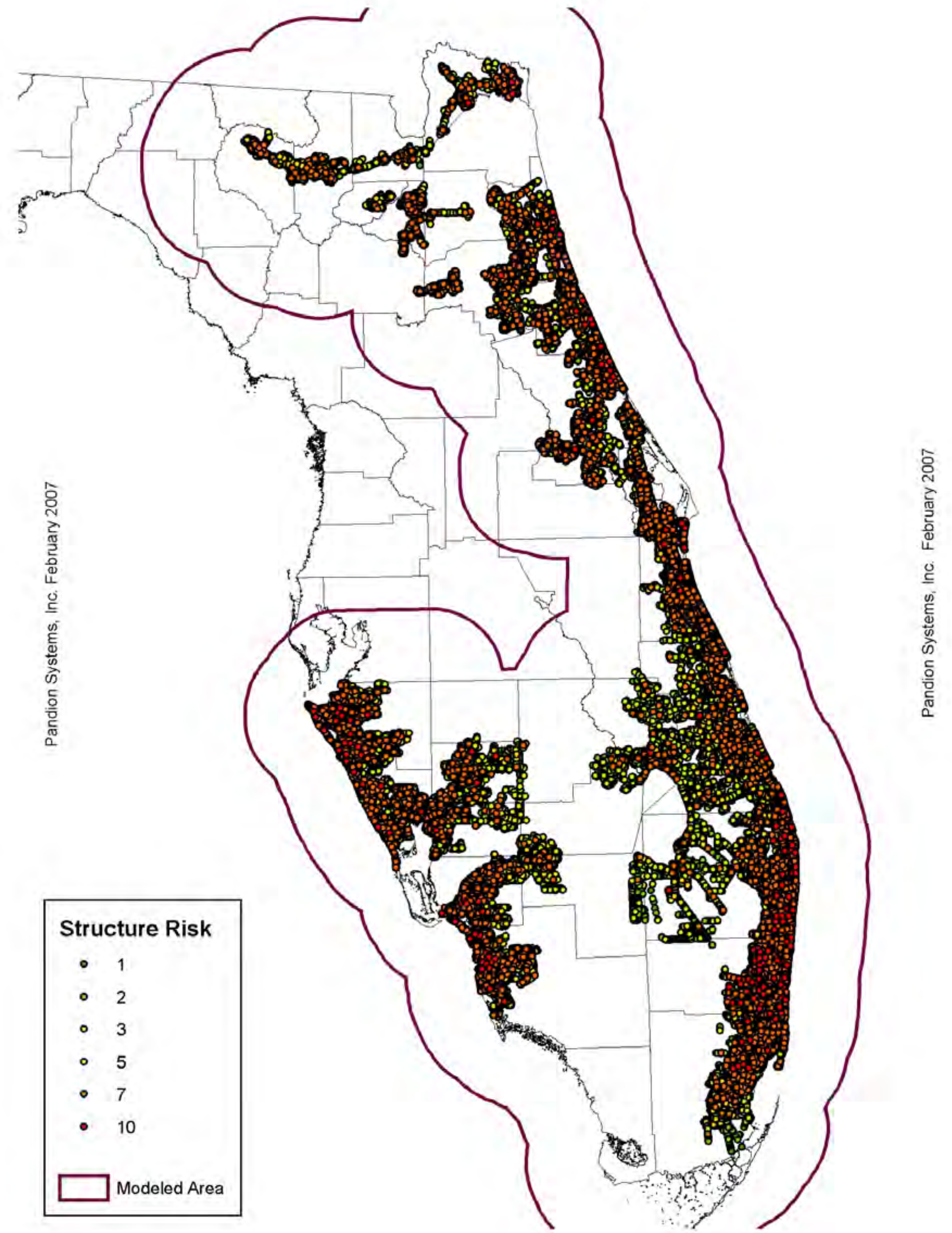


Figure 11. Structural Risk for regions of distribution structures.

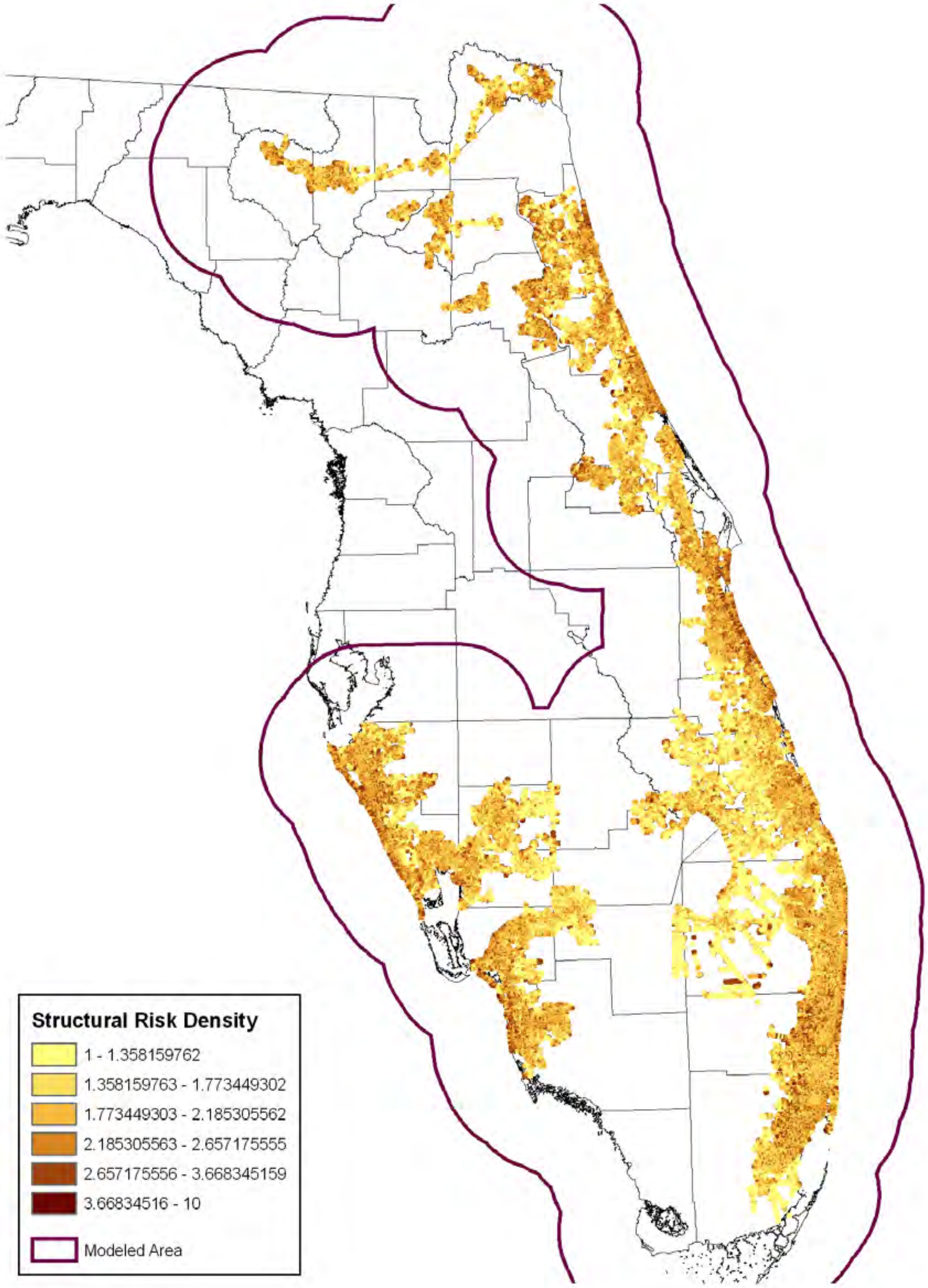


Figure 12. Cumulative Electrocution Risk version with individual structures

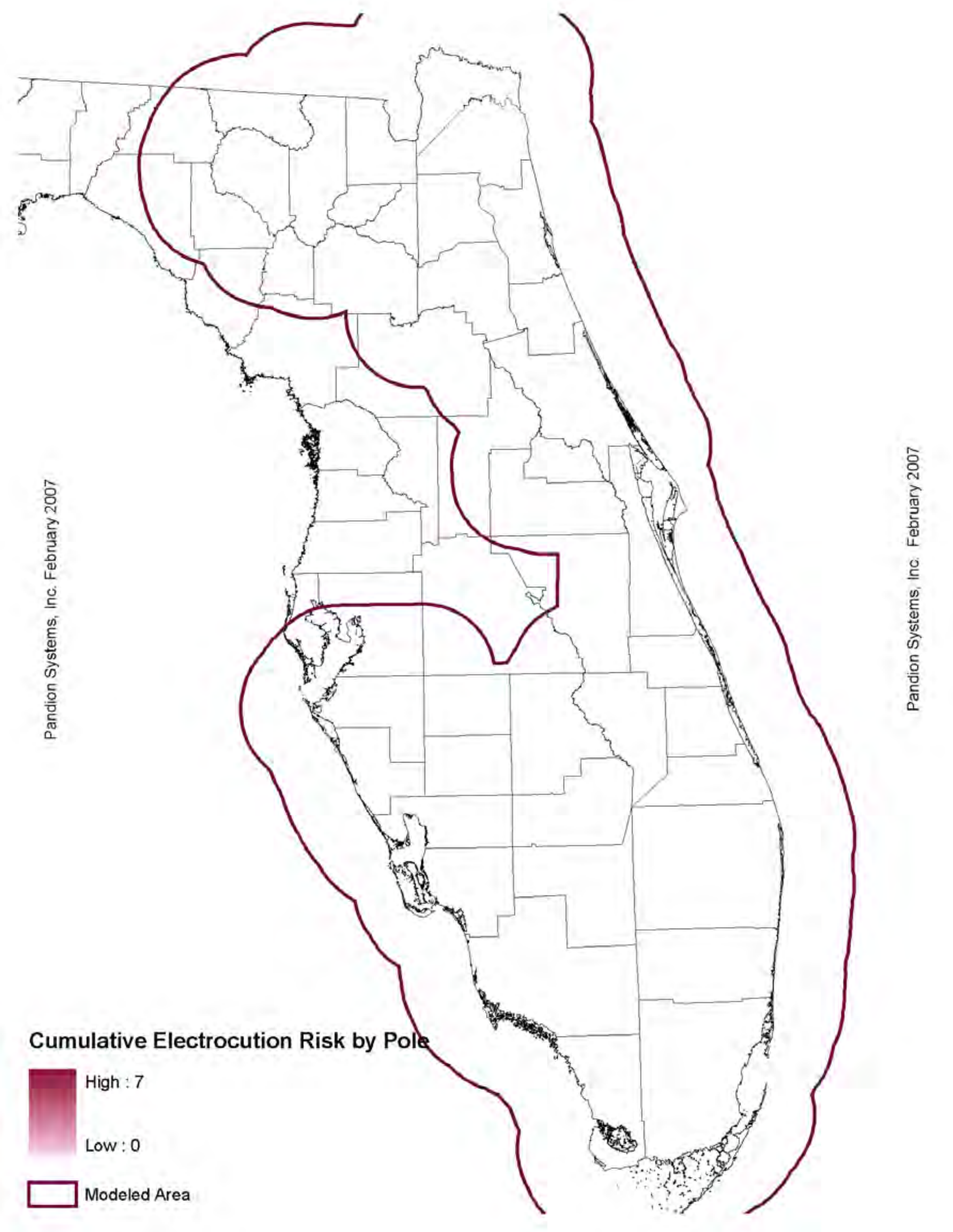
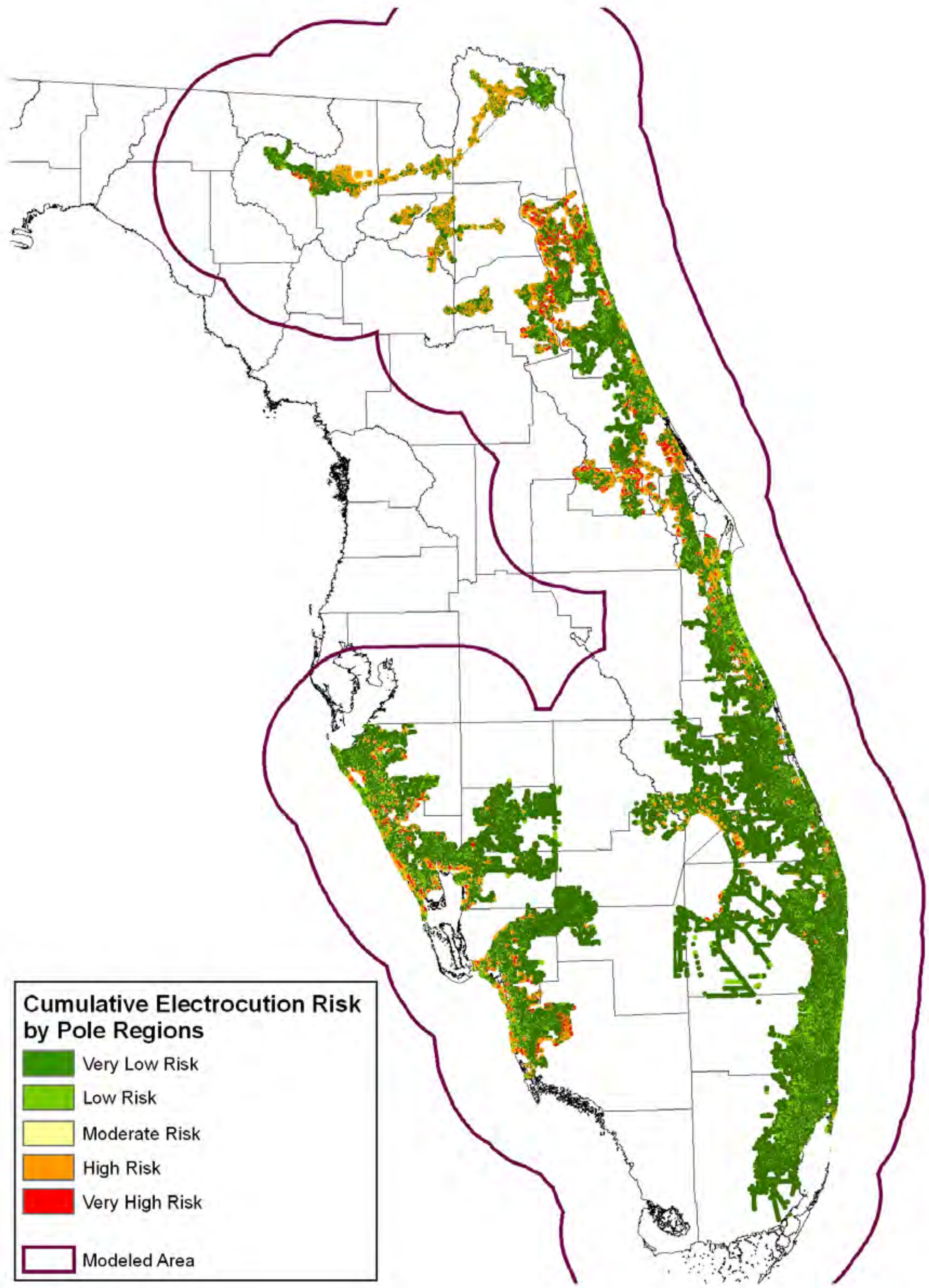


Figure 13. Cumulative Electrocution Risk version with regions of structures



V. SUMMARY

The bald eagle risk analysis and model and it supporting sub-models are utilized by FPL as part of their overall approach to reduce avian mortality associated with utility structures. Specifically, FPL has used this model to identify high and medium risk areas. Based on this information, FPL has been able to determine the highest priority areas to retrofit existing equipment.

In addition, this model has been integrated into the FPL GIS data sets to be used as a proactive assessment tool during the siting process. These higher risk areas can then be avoided through the siting process, or avian friendly standards can be used when constructing these new structures in high risk areas. The combination of these measures is anticipated to reduce avian mortality and improve service reliability.

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VII. APPENDIX A. FILE LIST OF THE BASE GIS LAYERS USED FOR THE RISK MODEL.

Layer Name	Layer Description	Source of Layer	Currency Date of Layer	Layer accuracy/ resolution	Modeled layers it was used for	Data Problems
County	County boundaries				Reference layer	
State	State boundary				Reference layer	
Pole.shp	point feature layer containing Distribution poles for the entire FL service area. There are 1,422,500 records, each with a unique pole ID.	FPL	Provided by FPL in November 2005	Not provided	structure	
Oh_primary.shp	line feature layer containing Distribution lines for the entire FPL service area. There are 699,059 records, each with the number of phases.	FPL	Provided by FPL in November 2005	Not provided	Structure	Not spatially accurate and thus not associated with the poles that they connect to. Many lines are missing
Pole_equip.dbf	equipment database table contains the equipment type that is on each distribution pole and a unique pole ID. There are 1660271 records.	FPL	Provided by FPL in November 2005	Not provided	structure	

Layer Name	Layer Description	Source of Layer	Currency Date of Layer	Layer accuracy/ resolution	Modeled layers it was used for	Data Problems
Eagle2003_pub _alb	The bald eagle nest locations is a point layer with associated data. It was provided by the Florida Fish and Wildlife Conservation Commission	Florida Fish and Wildlife Conserva tion Commiss ion	All eagle nests known from the early 1970s through the 2003 breeding season	Not provided	Biology	
fl_veg03	Digital vegetation and land cover data set for Florida derived from 2003 Landsat Enhanced Thematic Mapper satellite imagery.	Florida Fish and Wildlife Conserva tion Commiss ion	2003	3 meter cell size	Biology	

STATUS OF THE SPECIES/CRITICAL HABITAT – Everglade snail kite (*Rostrhamus sociabilis plumbeus*)

Legal Status

The Everglade snail kite was listed under the Endangered Species Preservation Act in 1967 and the Endangered Species Conservation Act in 1969. The Everglade snail kite was then listed as "endangered" under the Act in 1973. Listing was warranted due to the small number of birds remaining in the population.

Critical habitat for the Everglade snail kite was designated on September 22, 1977 (Federal Register Volume 42, Number 184). About 841,635 ac (340,600 ha) of critical habitat are located within nine critical habitat units (Figure 1) that include the littoral zone of Lake Okeechobee, and portions of the Water Conservation Areas (WCA) and Everglades National Park (Table I). In recent years, use of the originally designated critical habitat units by snail kites has decreased significantly. As discussed below, large numbers of snail kites no longer occur within Lake Okeechobee and WCA-3A. Snail kites have also been documented to use areas not originally designated as critical habitat, such as the Kissimmee Chain of Lakes (KCOL; i.e., Lake Tohopekaliga, East Lake Tohopekaliga, Lake Kissimmee, Lake Hatchineha, Lake Istokpoga, and Lake Jackson) in central Florida.

Species Description

Appearance/Morphology

The Everglade snail kite is a medium-sized raptor, with a total body length ranging from 14 inches (in) (35.56 centimeters [cm]) to 15.5 in (36.37 cm) and a wingspan ranging from 43 in (109.2 cm) to 46 in (116.8 cm)(Sykes et al. 1995). In both sexes, the tail is square-tipped and contains a distinctive white patch on the rump. The paddle-shaped wings are bowed downward or cupped when in flight (Sykes et al. 1995). Adults have red eyes and juveniles have brown eyes (Brown and Amadon 1976; Clark and Wheeler 1987). Adult males have a uniformly slate gray plumage, and the adult female plumage is brown dorsally and pale white to cream ventrally, with dark streaking on the breast and belly (Sykes et al. 1995). Immature kites are similar in appearance to adult females, but are more cinnamon-colored, with tawny or buff-colored streaking rather than brown streaking. Females are slightly larger than males, and both sexes possess a slender, curved bill.

Taxonomy

Rostrhamus sociabilis plumbeus is the accepted scientific name of the Everglade snail kite since its listing in 1977 (52 FR 42658), (Brandley et al. 2005; Smith 2005). Rodgers (1996) noted that three sub-species of snail kite, including R. s. sociabilis, were recognized by Amadon (1975), but

Brown and Amadon (1976) stated that these subspecies were doubtfully distinct. We continue to use the scientific name as published in the final listing rule (FR Volume 32, Number 48).

Life History

Everglade snail kites are dietary specialists that feed primarily on Florida apple snails (*Pomacea paludosa*) (Sykes 1987a; Kitchens et al. 2002, Beissinger 1990). Snail kites are also known to prey upon several species of exotic apple snails (*Pomacea* spp.) recently established within various localities in Florida (Takekawa and Beissinger 1983, Cattau et al. 2010). Several morphological adaptations aid in feeding. Long and slender toes allow snail kites to grasp snails, and deeply hooked, sharp-tipped bills are used to extract snails from their shells (Sykes et al. 1995; Beissinger 1990). Unfortunately, these adaptations make it difficult for snail kites to feed on other types of prey (Beissinger 1990). Nevertheless, prey such as musk turtles (*Sternotherus odoratus*), mud turtles (*Kinosternon* spp.), freshwater snails (*Viviparus georgianus*) crayfish (*Procambarus* spp.), black crappie (*Pomoxis nigromaculatus*), and small snakes are occasionally caught and consumed (Beissinger 1990, Sykes et al. 1995).

Prey is located from perches or while flying from about 5 ft (1.524 m) to 33 ft (10.06 m) above the water's surface (Sykes 1987a; Sykes et al. 1995). The feet are used to grasp prey items and capture of prey normally occurs while snail kites are in flight. Apple snails can be gleaned from wetland vegetation up to 6 in (15.24 cm) below the water surface. Snail kites may concentrate hunting in a specific area, returning to the same area as long as foraging conditions are favorable (Cary 1985). Using field data from 1995 to 2004, Darby et al. (2006) estimated that apple-snail densities less than 0.14 individuals per square-meter are unable to support kite foraging.

Several factors may affect snail kite foraging success. For example, too much or too little precipitation can result in the temporary or permanent loss of apple snail habitat with a concomitant reduction in apple snail numbers. Excessive precipitation, coupled with water management practices that maintain high water levels within wetlands for extended periods, can result in the death of emergent vegetation required by apple snails for successful feeding and reproduction. Conversely, apple snails may not be able to survive in wetlands that remain dry for extended periods during droughts (*i.e.*, > 12 weeks of dry conditions), and juvenile apple snails appear to be less tolerant of dry conditions than adult snails (Darby et al. 2008). Ambient temperature also seems to affect the ability of snail kites to successfully capture apple snails. Capture rates of apple snails were documented to be higher in summer than in winter (Cary 1985), and successful captures of apple snails by snail kites were not been observed at air temperatures less than 10°C (50°F).

The breeding season of the Everglade snail kite in Florida varies from year to year and is probably affected by rainfall and water levels (Sykes et al. 1995). Nesting usually occurs from December through July, although eggs can be laid as early as August and as late as November

(Sykes 1987c; Beissinger 1988; Snyder et al. 1989). Sykes (1987 c) reported about 80 percent of observed egg clutches were laid from January through April. Snail kites will often re-nest following either the successful rearing of a clutch or a failed nesting attempt (Beissinger 1986; Snyder et al. 1989). However, the mean number of clutches produced by an individual female snail kite per breeding season has not been determined (Sykes et al. 1995).

The chronology of snail kite nesting is described as follows. Pair bonds are established prior to egg-laying and typically last from nest initiation through most of the nestling stage (Beissinger 1986; Sykes et al. 1995). Male snail kites select nest sites and conduct most nest-building, a behavior likely related to courtship (Sykes 1987c; Sykes et al. 1995). Unlike most raptors, snail kites do not defend large territories and frequently nest in loose colonies or in association with wading bird nesting colonies (Sykes 1987b; Sykes et al. 1995). Kites actively defend small territories extending about 4 miles around the nest (Sykes 1987b). Copulation may occur from the early stages of nest construction, through egg-laying, and during early incubation if the clutch is not complete. Egg-laying usually begins soon after completion of the nest, but may be delayed a week or more (Sykes 1987c). The clutch size ranges from one to six eggs, with three eggs being most frequent (Sykes 1987c; Beissinger 1988; Snyder et al. 1989). Following deposition of the first egg, the remaining eggs in the clutch are laid approximately every 2 days thereafter, and the laying of a 3-egg clutch is completed in about 6 days (Sykes et al. 1995). Incubation may begin after the first egg is laid, but generally commences after the second egg is laid (Sykes 1987c). In Florida, the incubation period lasts 24 to 30 days (Sykes 1987c). Incubation of eggs is conducted by both sexes, but the amount of time spent incubating among the male and female is variable (Beissinger 1987). Hatching success varies from year-to-year and among nesting localities, but generally averages about 2.3 chicks per nest (Sykes 1987c). After hatching, both parents participate in feeding young (Beissinger 1987). Fledging occurs about 23 to 34 days following hatching and fledging dates vary about 5 days among chicks (Sykes et al. 1995). Following fledging, young are fed by one or both adults until they are 9 to 11 weeks old (Beissinger 1987). In total, snail kites have a nesting cycle that lasts about 4 months from initiation of nest-building through independence of young (Beissinger 1986; Sykes et al. 1995).

Snail kites in Florida exhibit a mating system known as “ambisexual mate desertion.” The male or female snail kite may abandon the nest during the nestling stage (Beissinger 1986, 1987). This behavior usually occurs when prey is abundant, and it may be an adaptation to maximize productivity during favorable conditions. Following abandonment, the remaining parent continues to feed and attend chicks through independence (Beissinger 1986). Abandoning birds presumably form a pair bond with another snail kite and initiate a new nesting attempt. Snail kites mature early compared with many other raptors and can breed successfully the first spring after they hatch at about 8 to 10 months old. However, not all kites breed at this age. Bennett et al. (1998) reported that all 23 adults greater than 1 year of age tracked during their study attempted to breed while only 3 out of 9 of tracked snail kites less than 1 year of age attempted to breed. Of the 23 adult kites, 15 attempted to breed once, 7 attempted to breed twice, and 1 individual attempted to breed 3 times. Only one adult kite successfully fledged two clutches (Bennett et al. 1998). Adult kites generally attempt to breed every year except during drought years (Sykes et al. 1995).

Snail kites are considered nomadic, and this behavior likely occurs in response to changing hydrologic conditions (Sykes 1979). During the breeding season, kites remain close to their nest sites until the young fledge or the nest fails. Following fledging, adults may remain near the nest for several weeks until the young are fully independent. Outside of the breeding season, snail kites regularly travel long distances (> 150 miles [241 km] in some cases) within and among wetland systems in southern Florida (Bennetts and Kitchens 1997). Most movements are likely searches for more suitable foraging sites in response to droughts or other unfavorable environmental conditions. However, kites may also move away from wetlands when conditions are seemingly favorable. Currently, there is no evidence suggesting that snail kites undertake trans-oceanic movements (*e.g.*, Florida to Cuba) and interbreed and with snail kites located in other countries (Sykes 1979; Beissinger et al. 1983).

Snail kites are gregarious outside of the breeding season and may roost in groups of up to 400 or more individuals (Bennetts et al. 1994). Roosting sites are usually located over water. In Florida, communal roosts have been documented primarily in stands of willows, and in some cases melaleuca and pond cypress. Sykes (1985) found snail kites roosting in willows use stand sizes ranging from 0.05 ac (0.2023 ha) to 12.35 ac (4.998 ha), and roost at heights ranging from 5.9 ft (1.798 m) to 20.0 ft (60.96 m). Roosts observed in melaleuca or pond cypress stands occurred in tree heights ranging from 13 ft (3.962 m) to 40 ft (12.19 m) (Sykes 1985).

Habitat

Everglade snail kites prefer to forage in freshwater marshes and the shallow-vegetated littoral zones along the edges of lakes where apple snails occur in relatively high abundance. Suitable foraging habitat consists of areas of clear, open water (0.6 feet [ft] [0.183 meter (m)] to 4.3 ft [1.311 m] in depth) interspersed with patches of emergent marsh vegetation less than 6.5 ft (1.981 m) in height (Sykes et al. 1995; Kitchens et al. 2002). Emergent vegetation must be tall enough to allow apple snails to reach the water surface to breathe when the oxygen concentration of the water is low. Emergent vegetation must also be sparse enough to allow snail kites to locate and capture apple snails (Kitchens et al. 2002). Plant species that commonly occur within suitable kite foraging habitat include: spike rush (*Eleocharis cellulosa*), maidencane (*Panicum hemitomon*), sawgrass (*Cladium jamaicense*), bulrush (*Scirpus* spp), cattail (*Typha* spp), white water lily (*Nymphaea odorata*), arrowhead (*Sagittaria lancifolia*), pickerel weed (*Pontederia lanceolata*), and floating heart (*Nymphoides aquatica*). Periphyton growth on the submerged substrate provides a food source for apple snails, and submergent aquatic plants, such as bladderworts (*Utricularia* spp.) and eelgrass (*Vallisneria* spp), may contribute to favorable conditions for apple snails while not preventing kites from detecting snails (Sykes et al. 1995).

Nests are built almost exclusively over water in order to deter predation (Sykes 1987b). The snail kite's nest is a large (28 cm to 58 cm in diameter), loosely woven structure of dry sticks and other dry plant materials that is elongate to globose in shape, flat rimmed, and open at the top (Bessinger 1987, Sykes 1987b). Suitable nest sites consist of a single tree, shrubs, or small clumps of trees and shrubs within or adjacent to an extensive area of suitable foraging habitat. Trees used for nesting are usually less than 32 ft (9.8 m) tall and include willow (*Salix* spp.), bald cypress (*Taxodium distichum*), pond cypress (*Taxodium ascendens*), melalueca (*Melaleuca quinquenervia),* sweetbay (*Magnolia virginiana*), swamp bay (*Persea borbonia*), pond apple (*Annona glabra*), and dahoon holly (*Ilex cassine*). Shrubs used for nesting include wax myrtle (*Myrica cerifera*), cocoplum (*Chrysobalanus icaco*), buttonbush (*Cephalanthus occidentalis*), *Sesbania* sp, elderberry (*Sambucus simpsonii*), and Brazilian pepper (*Schinus terebinthifolius*). Nesting also can occur in herbaceous vegetation, such as sawgrass, cattail, bulrush, and reed (*Phragmites australis*) (Sykes et al. 1995). Nests are often observed in herbaceous vegetation in the littoral zones of Lake Kissimmee and Lake Okeechobee during periods of low water, when dry conditions beneath the willow stands prevent snail kites from nesting in woody vegetation. However, nests constructed in herbaceous vegetation are more vulnerable to collapse from wind and wave action, and are more likely to be exposed to disturbance by humans (Chandler and Anderson 1974; Sykes and Chandler 1974; Sykes 1987b; Beissinger 1986, 1988; Snyder et al. 1989).

Distribution

The Everglade snail kite (*R. sociabilis plumbeus*) is one of three subspecies of snail kites that occur primarily in lowland freshwater marshes from Florida, Cuba, and Mexico south through portions of Central and South America to northern Argentina. The range of the Everglade snail kite is limited to Florida in the United States of America, and portions of Cuba including Isla de la Juventud.

In Florida, the historic range of the snail kite was larger than its current range and snail kites were known to occur from the southern tip of the Florida peninsula to as far north as Crescent Lake and Lake Panasoffke in north-central Florida and as far west as the Wakulla River (Howell 1932; Sykes 1984). The current distribution of the snail kite in Florida is limited to freshwater ecosystems within the central and southern portions of the State. Important areas currently utilized by the snail kite include: the Upper St. Johns marshes, KCOL, Lake Okeechobee, Loxahatchee Slough, the Everglades, and the Big Cypress basin, the East Orlando Wilderness Park, the Blue Cypress Water Management Area, the St. Johns Reservoir, and the Cloud Lake, Strazzulla, and Indrio impoundments, and the Blue Cypress Water Management Area (Beissinger and Takekawa 1983; Sykes 1984; Rodgers et al. 1988; Bennetts and Kitchens 1992; Rumbold and Mihalik 1994; Sykes et al. 1995; Martin et al. 2005 and 2006).

Historically, the extensive littoral marshes of Lake Okeechobee located within Fisheating Bay and near the inflow of the Kissimmee River were used by snail kites for foraging and nesting (Martin et al. 2006). However, a significant decline in foraging and nesting occurred from 1996 through 2006, and Lake Okeechobee made only minor contributions to the snail kite population during this time (Cattau et al. 2008). The reduction in foraging and nesting has been attributed to habitat degradation resulting from the hurricanes that occurred during 2004 (Cattau et al. 2008) and the water management practices that occurred during this time period (Bennetts and Kitchens 1997). Water management actions have resulted in more water being retained in the lake with a concomitant increase in water levels. High water levels in the 1990s resulted in a significant loss of emergent herbaceous and woody vegetation in Lake Okeechobee's emergent wetlands. The loss of emergent vegetation reduced the abundance of apple snails (the snail kite's chief prey item) because snails require emergent vegetation for feeding and egg-laying. The reduction of trees and shrubs in the littoral zone has reduced nesting and perching sites available to the snail kite. Drought conditions from 2006 through 2008 also made much of the habitat in the Lake Okeechobee's littoral zone unsuitable for snail kite nesting and foraging. Nesting was not been observed from 2007 to 2009 and only limited nesting was documented in 2010 within portions of the lake located outside of the historic nesting areas (*i.e.*, emergent marsh located near the Kissimmee River, Eagle Bay Island, and Observation Island). Moderating water levels observed on Lake Okeechobee in 2011 and 2012 were correlated with an increase in snail kite nesting. A total of 39 nest attempts produced 16 successful nests and 26 nestlings in 2011 and 76 nest attempts resulting in 23 successful nests and 43 nestlings in 2012. Okeechobee accounted for 25 percent of the range-wide nesting effort and produced 21 percent of the fledglings in 2012 (Cattau et al. 2012). Data have not yet been verified for 2013, but indications are that nesting attempts and success were similar to of 2012.

The Everglades, specifically WCA-3A, is another formerly productive snail kite habitat that has experienced reduced use by kites in recent years (Cattau et al. 2009). Snail kite reproduction decreased significantly after 1998 and successful reproduction was not documented in WCA-3A during 2001, 2005, 2007, 2008, and 2010. In 2012, only one successful nest that fledged one young was observed. As discussed for Lake Okeechobee, current water management practices in the WCAs are also thought to have degraded habitat quality for the snail kite. In 2013, an increase in snail kite nesting within WCA-3A was documented with 68 nesting attempts producing 18 successful nests and 27 fledged young. It is unclear at this time whether this represents the beginning of a long-term trend of increased nesting in WCA-3A or merely an outlier due to favorable hydrologic and climatic conditions experienced during 2013. An increase in exotic apple snail abundance in lower WCA-3A may also be affecting snail kite nesting in WCA-3A.

Because of the habitat degradation in Lake Okeechobee and WCA-3, snail kites have recently focused much of their foraging and breeding activities within the KCOL (Cattau et al. 2009) in central Florida. The KCOL now supports the greatest number of snail kites in Florida and accounted for 52, 12, 89, 72, and 61 percent of the successful nesting attempts range-wide in 2005 through 2009, respectively (Cattau et al. 2009). Lake Tohopekaliga accounted for 41 percent of all successful nests and 57 percent of all fledged young that were documented on a range-wide basis from 2005-2010. In 2012, Lake Tohopekaliga accounted for 25 percent and 24 percent of all successful nests and fledged young, respectively. Additionally, in 2011 and 2012, East Lake Tohopekaliga, accounted for 27 percent and 30 percent of all successful nests and fledged young, respectively. A small number of nests have also been documented on Lake Hatchineha, Lake Istokpoga, and Lake Jackson within recent years.

Other localities providing suitable snail kite habitat include the Loxahatchee Slough region of Palm Beach County. Snail kites have been documented in the Loxahatchee National Wildlife Refuge (also known as WCA-1) and throughout the remaining marshes in the vicinity including the City of West Palm Beach's GWP. Snail kites may occur within nearly all remaining wetlands of the Everglades region, with recent nesting occurring within WCA-2B, WCA-3A, WCA-3B, and Everglades National Park (ENP) (Martin et al. 2006). Within the Big Cypress basin, snail kites may occur within most of the non-forested and sparsely forested wetlands. Although nesting has not been regularly documented in this area in recent years, some nesting likely occurs.

In addition to the areas discussed above, there are numerous records of snail kite occurrences and nesting within isolated wetlands throughout its current range. In the 1990's, Sykes et al. (1995) observed snail kites using smaller, more isolated wetlands including the Savannas State Preserve in St. Lucie County, Hancock Impoundment in Hendry County, and Lehigh Acres in Lee County. Takekawa and Beissinger (1989) identified 35 areas consisting of lakes, canals and marsh in Alachua, Duval, Glades, Hendry, Indian River, Lake, Martin, Miami-Dade, Okeechobee, Osceola, Palm Beach, and Volusia counties they considered drought refugia that may provide kite foraging habitat when conditions in the larger more traditionally occupied wetlands are unsuitable. Radio tracking of snail kites has also revealed that the network of habitats used by the species includes many smaller, widely dispersed wetlands within this overall range (Bennetts and Kitchens 1997). Snail kites may use nearly any wetland within southern Florida under some conditions and during some portions of their life history. For example, 2010 snail kite nesting surveys documented nesting in surprisingly high numbers in peripheral areas such as Harns Marsh, in Lehigh Acres, and Stormwater Treatment Area 5 in Hendry County. A kite nest and juveniles were also observed for the first time in the S-332D detention area in eastern ENP, also known as the Frog Pond.

Population Dynamics

Population Size: Historically, the Everglade snail kite was abundant in the wetlands and marshes of central and southern Florida. Several authors (Nicholson 1926; Howell 1932; Bent 1937) reported that groups of up to 100 birds were commonly observed. A decline in the snail kite population occurred during the 1940s and 1950s, and surveys suggested that as few as 6 to 100 individuals remained (Sykes 1979). In 1965, only 10 birds were observed (8 in WCA-2A, and 2 at Lake Okeechobee). The population size of the Everglade snail kite was thought to be extremely small when the species was listed as endangered in 1967, and a survey during that year documented only 21 individuals in WCA-2A (Stieglitz and Thompson 1967).

The reported decline of the Everglade snail kite population has been well documented in the literature (Beissinger 1986; Beissinger 1995; Martin et al. 2006; Cattau et al. 2008). However, it is unclear whether the observed decline in the snail kite population discussed above was entirely due to a decrease in snail kite numbers or in part an artifact of the survey effort. Historically, researchers were not aware snail kites moved in response to unfavorable hydrologic conditions (Sykes 1979), and it is possible surveys documented the absence of snail kites from their expected locations, including Lake Okeechobee and the headwaters of the St. John's marsh (Sykes 1979), rather than an actual reduction of the snail kite's population throughout its range. In addition, limited resources were available at that time for researchers to survey other potential snail kite habitats. As such, the resulting low level of survey effort may have biased the snail kite population estimates to some extent. Rodgers et al. (1988) stated it is unknown whether decreases in reported snail kite numbers in the annual surveys were due to mortality, dispersal into areas not surveyed, decreased productivity, or a combination of these factors. However, based on the significant loss of wetland habitats and range reduction that occurred prior to listing, the snail kite was unequivocally endangered at the time of its listing.

Other sources of variability existed in the past survey effort for the snail kite. Prior to 1969, the snail kite population was monitored only through sporadic and inconsistent surveys (Sykes 1979, 1984). However, an annual quasi-systematic mid-winter count of snail kites was conducted from 1969 to 1994 (Sykes 1979; Sykes 1983a; Beissinger 1986; Bennetts et al. 1999), and the number of snail kites observed ranged from 65 snail kites in 1972 to 996 snail kites in 1994. Bennetts et al. (1993, 1994) noted the 1993 and 1994 counts included many snail kites that were birds radio-tagged, and this likely increased the total count because these individuals could be easily located and often led researchers to roosts that had not been previously surveyed. Bennetts et al. (1999) analyzed the sources of variation in the count surveys and determined count totals were influenced by differences in observers, survey effort, hydrologic conditions, and site effects. Bennetts and Kitchens (1997) recommended data from count surveys not be used for snail kite population estimates or used to infer demographic parameters such as survival or recruitment. Although significant sources of error were identified in the count survey method, count data can still provide a crude indication of snail kite population trends if all influences of detection rates had been adequately taken into account. The sources of variation in the counts should be recognized prior to using these data in subsequent interpretations, especially in estimating population viability and extinction risk.

Beginning in 1997, population estimates for the Everglade snail kite were generated using a mark-recapture method that incorporated detection probabilities (Drietz et al. 2002). This method of population estimation increases the validity of comparing population estimates among years because it allows for the determination of confidence intervals. Estimates of the snail kite population in Florida from 1997 through 2012 from Cattau et al. (2012) are presented in Figure 2. From 1997 through 1999, the snail kite population contained approximately 3,000 birds (Dreitz et al. 2002). From 1999 through 2003, the snail kite population declined each year to about 1,400 birds in 2002 and 2003, and increased slightly to about 1,700 birds in 2004 and 2005 (Martin et al. 2006). The snail kite population exhibited another steep decline during 2007, 2008, and 2009 with estimates of 1,204, 685, and 662 birds. An overall increase in snail kite numbers were observed from 2010 to 2015 with estimates of 826, 925, 1,218 (Cattau et al. 2012), 1,198, 1,754 and 2,127 birds (M. Hamilton, personal communication), respectively.

Snail kite numbers are thought to be influenced by environmental conditions (*e.g.*, rainfall, drought, water management practices etc.) that affect their wetland habitats (Sykes 1979; Beissinger 1989, 1995; Sykes et al. 1995). Environmental conditions directly affect the hydrologic conditions of wetlands and ultimately the productivity and availability of the apple snail, the primary food source of the snail kite. Therefore, changes in hydrology that affect the survival and productivity of the apple snail, and their availability to snail kites, have a direct effect on the survival and productivity of the snail kite (Mooij et al. 2002). Beissinger (1986) reported that under favorable environmental conditions snail kites exhibit higher reproductive rates (Beissinger 1986) and juvenile survival rates.

As indicated above, a significant overall decrease in the snail kite population was observed from the late 1990s to 2013 (Figure 1). The population of the Everglade snail kite decreased by more than half from about 3000 birds in 1996 through 1998 to about 1,198 birds in 2013. The observed declines in the snail kite population from 1999 to 2003 coincided with a regional drought that affected central and south Florida during 2000 to 2001. During this period, estimates of nest success and juvenile survival estimated were generally low (Martin et al. 2006). Adult survival also declined during 2000 and 2001 (Figure 3) (Martin et al. 2006). A slight increase in the snail kite population was observed from 2004 through 2006 and this coincided with the improved hydrological conditions and more favorable nesting conditions that were observed from 2002 through 2006. Snail kite numbers again dropped in 2007 and 2008 and coincided with a serve drought 2007. The overall drop in snail kite numbers cannot be attributed entirely to adverse environmental conditions. Environmental conditions of wetland habitats during this time varied from drought to periods of normal or above normal precipitation that resulted in conditions favorable for snail kite feeding and reproduction. Consequently, the reasons for the recent decrease in the snail kite population remain unclear. However, recent studies suggest low recruitment of young and a decline in the apple snail population as factors in the decline (Cattau et al. 2008). The 2015 population estimate (2,127) indicates the snail kite population is still precariously small and highly endangered.

Population viability: Populaton Viability Analysis (PVA) is a statistical modelling technique that uses ecological and demographic parameters to estimate the probability that a population of a species will become extinct within a given number of years. A PVA was conducted for the Everglade snail kite population in Florida in 2010 (Cattau et al. 2012). The results of the PVA predict a 95 percent probability that the snail kite population will become extinct within the next 40 years. Cattau et al. (2012) noted that the results of the PVA are especially concerning because they indicate an increased risk of extinction when compared to results of a previous PVA conducted in 2006.

Threats

There are a variety of threats that can affect nesting, foraging, and survival of the Everglade snail kite. Threats include loss and degradation of wetland habitats, changes in hydrologic conditions, and impacts to the prey base.

The principal threat to the snail kite is the loss, fragmentation, and degradation of wetlands in central and southern Florida resulting from residential, commercial, and agricultural development and alterations to wetland hydrology through ditching, impoundment, and water level management. Nearly half of the Everglades have been drained for agriculture and residential and commercial development (Davis and Ogden 1994; Corps 1999). The Everglades Agricultural Area (EAA) alone eliminated 3,100 square-miles of the original Everglades and the urban areas in Miami-Dade, Broward, and Palm Beach Counties have contributed to the reduction of habitat. North of ENP the remaining marsh has been fragmented into shallow impoundments (*i.e.*, WCAs).

The Corps' Central and Southern Florida (CS&F) Project encompasses 18,000 square-miles from Orlando to Florida Bay and includes about 994 miles each of canals and levees, 150 water control structures, and 16 major pump stations. This system, originally designed and constructed for flood control and water supply, has disrupted the volume, timing, direction, and velocity of freshwater flow and has resulted in habitat loss and degradation in the WCAs and other portions of the historic Everglades. Drainage of Florida's interior wetlands has reduced the extent and quality of habitat for both the apple snail and the snail kite (Sykes 1983b). Widespread drainage has permanently lowered the water table in some areas and permitted development in areas that were once snail kite habitat.

Habitat loss and fragmentation are also factors influencing the snail kite's survival during droughts, despite the species' dispersal ability (Martin et al. 2006). As was discussed previously, the snail kite may use almost any wetland within southern Florida during some portion of its life.

In dry years, snail kites depend on water bodies that are suboptimal and not normally used for feeding, such as canals, impoundments, or small marshes (Beissinger and Takekawa 1983; Bennetts et al. 1988; Takekawa and Beissinger 1989). The fragmentation or loss of wetland habitat significantly limits the snail kites' ability to be resilient to disturbance such as droughts. As wetland habitats become more fragmented, the dispersal distances for snail kites become greater and this increases stress on dispersing kites that may not be able to replenish energy supplies.

Degradation of the water quality of wetland habitats through runoff of phosphorus and nitrogen from agricultural and urban sources (cultural eutrophication) can adversely affect the snail kite by altering the composition and structure of wetland plant communities. Nutrient enrichment leads to growth of dense stands of emergent (*e.g.*, cattail), and floating vegetation (primarily water hyacinth [*Eichhornia crassipes*] and water lettuce [*Pistia stratiotes*]) that limit the ability of snail kites to find prey and effectively forage within the wetland (Service 2007). The Everglades was historically an oligotrophic system, but major portions have become eutrophic due to storm water runoff from agricultural lands north of Lake Okeechobee, and adjacent to the Kissimmee River, Taylor Slough, and Nubbin Slough (Federico et al. 1981). Cultural eutrophication also is also occurring in limnetic environments such as the KCOL. Appropriate regulation of water levels in lakes and the WCAs is particularly important to maintain the types of vegetative communities that provide suitable habitat for the snail kite.

The management of wetland plant communities can have adverse effects on snail kites. Attempts to control, reduce, and eliminate invasive (*e.g.*, cattail and bulrush) and exotic plant species through mechanical removal and spraying by government agencies has resulted in the destruction of snail kite nests (Rodgers et al. 2001) and the loss of apple snail habitat. Nonetheless, impacts to snail kite nesting habitat and apple snails from vegetation management activities in Lake Okeechobee and the KCOL have been greatly reduced through improved communication and cooperation between the Service and agencies undertaking vegetation management actions. The Service has also expanded our efforts to notify aquatic plant management agencies of the locations of active snail kite nests (Service 2006) to assist them in avoiding these sites during the snail kite nesting season.

Past management of water levels in WCAs and Lake Okeechobee has had adverse effects on snail kite nesting, foraging, and ultimately the population size of the snail kite (Sykes 1983a; Beissinger and Takekawa 1983; Beissinger 1986; Dreitz et al. 2002; Martin et al. 2007; Cattau et al. 2008). Storage of water in these areas has increased water levels and hydroperiods. Consequently, large sections of the WCAs have been converted from wet prairie habitats to slough-type habitats, and herbaceous and woody vegetation within the littoral areas of Lake Okeechobee has been eliminated or reduced significantly. Changes in vegetation have:
(1) reduced apple snail populations that the snail kite relies upon for food (Darby et al., 2006);

(2) reduced the snail kites' ability to forage and nest; and (3) and reduced the availability of woody plants that snail kites uses for nesting and perching. The maintenance of appropriate seasonal water levels is needed to restore snail kite habitat within Lake Okeechobee and the WCAs. The recovery of the snail kite is unlikely without the restoration of habitat in these areas.

Additional potential threats to snail kites include exposure to accumulated contaminants in their prey, the proliferation of exotic snails, and naturally occurring but extreme weather conditions. Copper, used in fungicide applications and commonly found in disturbed areas of Everglades wetlands, has been shown to accumulate in the tissues of apple snails and may lead to birth defects in snail kite nestlings (Frakes et al. 2008). Uptake of copper through sediments and diet has been demonstrated, with uptake from the latter as the primary exposure route for the Florida apple snail (Frakes et al. 2008; Hoang et al. 2008a). The ability of Florida apple snails to accumulate copper in their tissues has implications for the survival and recruitment of the Florida apple snail and its predator, the snail kite. However, there is still uncertainty regarding the amount of copper that is actually ingested and accumulated by snail kites. The areas of greatest concern are the stormwater treatment areas and water reservoirs created in association with Everglades restoration projects. Additional information on Florida apple snail bioaccumulation of copper, copper availability, and average exposure patterns of snail kites under various environmental conditions may be necessary to identify the risk to the snail kite posed by these contaminants.

In addition to concerns regarding low abundances of native Florida apple snails, the introduction of exotic apple snails (*Pomacea* spp.) may adversely affect the survival of the snail kite, most notably through decreased juvenile recruitment. Snail kites, limpkins (*Aramus guarauna*), and other predators have been observed eating the exotic island apple snail, although young kites have difficulty handling mature exotic snails due to their large size (Cattau et al. 2010). The snail kite may be relatively well-adapted to capture and consume non-native *Pomacea* species, but preliminary information suggests that snail kites may only be able to successfully extract the flesh from a small portion of the exotic snail *P. haustrom* due to its large size. Cattau et al. (2010) documented that the consumption rate of the exotic snails versus native snails was significantly lower, and that juvenile snail kites experienced a lower net daily energy intake when feeding on exotic snails. As such, juvenile kites that are reliant on these non-native snails may not be able to sustain themselves, despite the fact that snails are abundant (Cattau et al. 2010). Further research is needed to determine the effects of exotic apple snails on juvenile snail kites and the snail kite population (SEI 2007 a,b).

Finally, inclement weather conditions can affect snail kite nesting success and survival. Wind storms have caused toppling of nests, particularly on Lake Okeechobee and Lake Kissimmee due to the long wind fetch across these large lakes. Cold ambient temperatures can also produce nest failure, either through decreased availability of apple snails or mortality of young due to exposure. Abandonment of nests before egg-laying is also common, particularly during drought or following passage of a cold front.

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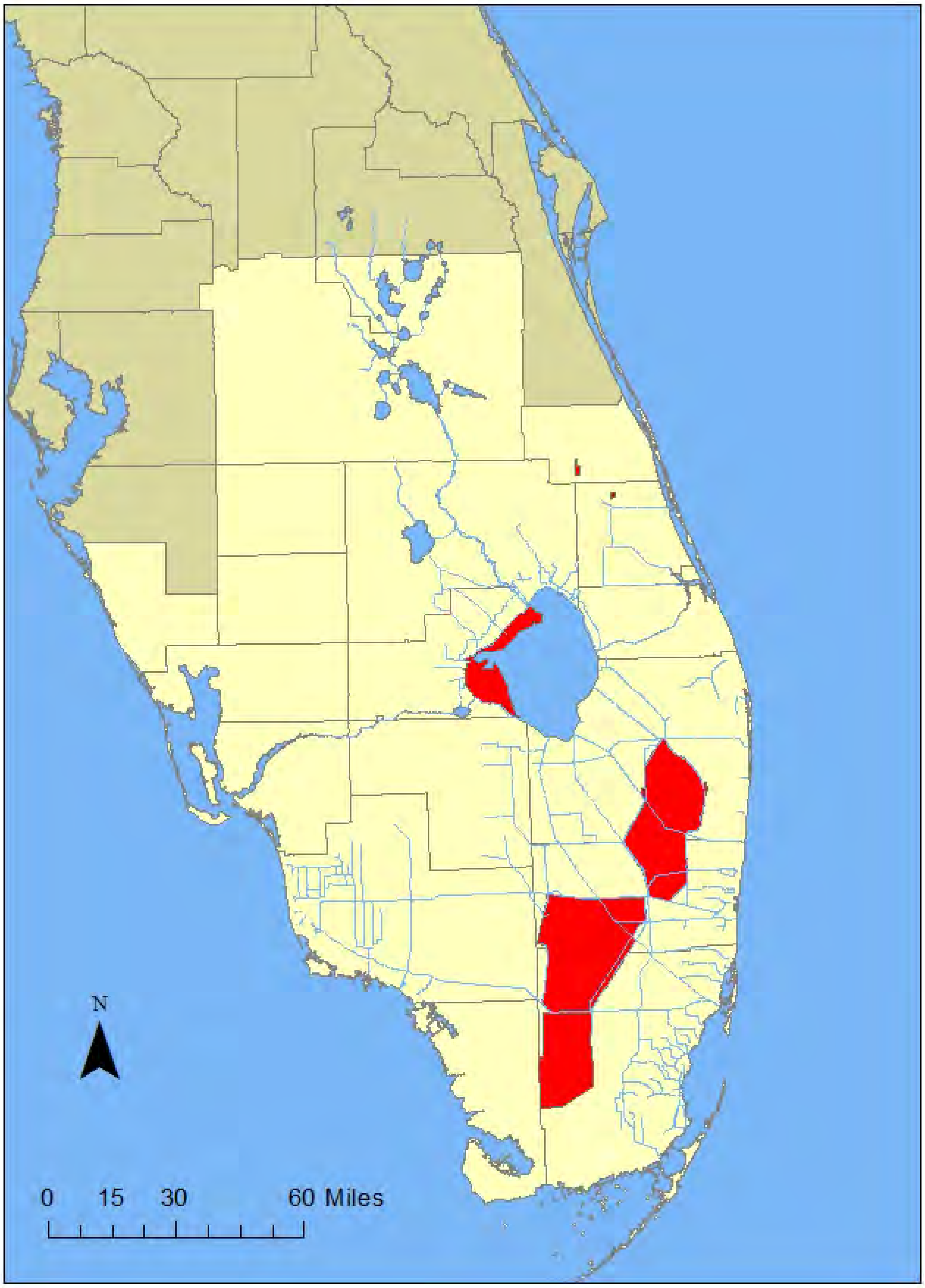

Figure 1. Map of Critical Habitat (areas shaded in red) designated for the Everglade snail kite in Florida.

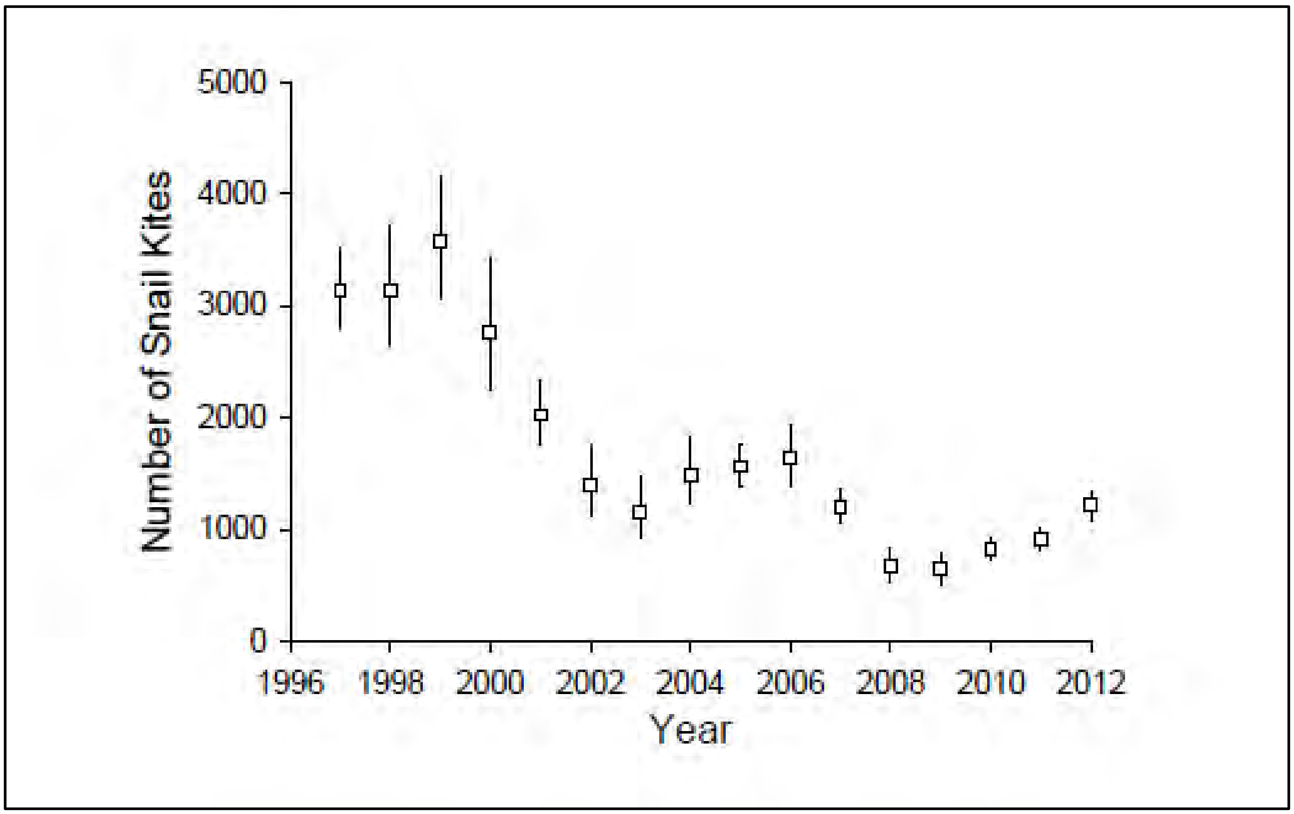

Figure 2. Estimated snail kite population size from 1997 through 2012 (Cattau et al. 2012).

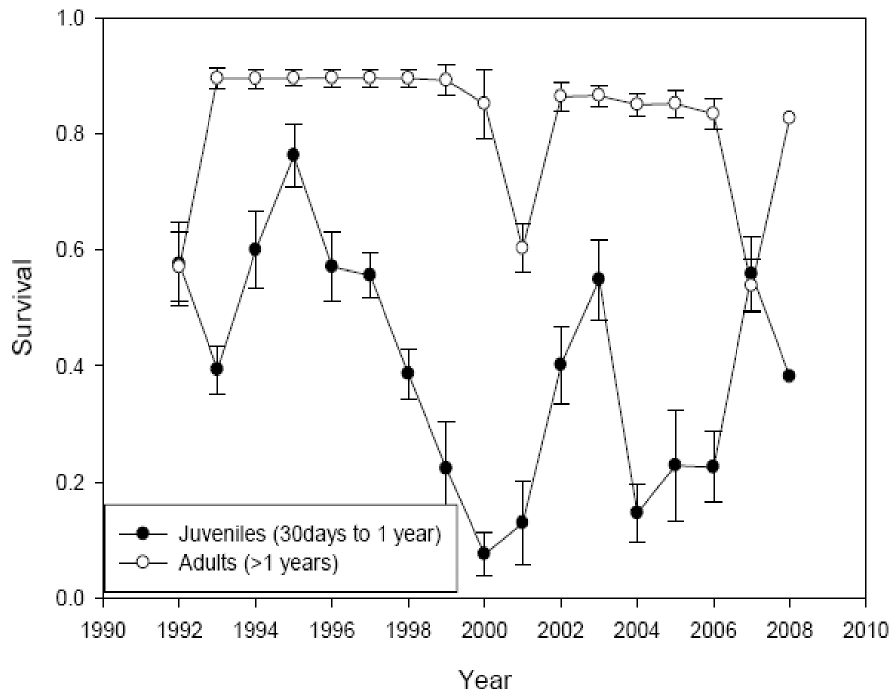

Figure 3. Model-averaged estimates of adult (white circles) and juvenile (black circles) survival from 1992 to 2008 (Cattau et al. 2009). Error bars correspond to 95 percent confidence intervals.

Table 1. Everglade snail kite critical habitat units and acreage.

Critical Habitat Unit Description	**Acres**
St. Johns Reservoir, Indian River County	2,075
Cloud Lake and Strazzula Reservoirs, St. Lucie County	816
Western Lake Okeechobee, Glades and Hendry Counties	85,829
Loxahatchee NWR, Palm Beach County	140,108
WCA-2A, Palm Beach and Broward Counties	106,253
WCA-2B, Broward County	28,573
WCA-3A. Broward and Miami-Dade Counties	319,078
ENP, Miami-Dade County	158,903
Total	841,635

STATUS OF THE SPECIES – Florida panther (*Puma concolor coryi*)

Legal Status – On March 11, 1967, the Service listed the panther as endangered (32 FR 4001) throughout its historic range, and they received Federal protection under the passage of the Act in 1973. In addition, the Florida Panther Act (Florida Statute 372.671), a 1978 Florida State law, made killing a panther a felony. The panther is listed as endangered by the States of Florida, Georgia, Louisiana, and Mississippi in addition to its Federal listing. Critical habitat has not been designated for the panther.

Species Description

Appearance/Morphology

An adult panther is unspotted and typically rusty reddish-brown on the back, tawny on the sides, and pale gray underneath. Adult males can reach a length of 7 feet (ft) (2.1 meters [m]) from their nose to the tip of their tail and may exceed 161 pounds (lbs) (73 kg) in weight; but, typically adult males average around 116 lbs (52.6 kg) and stand about 24 to 28 inches (in) (60 to 70 centimeters [cm]) at the shoulder (Roelke 1990). Female panthers are smaller with an average weight of 75 lbs (34 kg) and length of 6 ft (1.8 m) (Roelke 1990). Panther kittens are gray with dark brown or blackish spots and five bands around the tail. The spots gradually fade as the kittens grow older and are almost unnoticeable by the time they are 6 months old. At this age, their bright blue eyes slowly turn to the light-brown straw color of the adult (Belden 1988).

Three external characteristics: a right angle crook at the terminal end of the tail, a whorl of hair or cowlick in the middle of the back, and irregular, white flecking on the head, nape, and shoulders – not found in combination in other subspecies of *Puma* (Belden 1986), were commonly observed in panthers through the mid-1990s. The kinked tail and cowlicks were considered manifestations of inbreeding (Seal 1994); whereas the white flecking was thought to be a result of scarring from tick bites (Maehr 1992). Four other abnormalities prevalent in the panther population prior to the mid-1990s were cryptorchidism (one or two undescended testicles), low sperm quality, atrial septal defects (the opening between two atria in the heart fails to close normally during fetal development), and immune deficiencies; and these were suspected to be the result of low genetic variability (Roelke et al. 1993).

Taxonomy

The panther was first described by Charles B. Cory in 1896 as *Felis concolor floridana* (Cory 1896). The type specimen was collected in Sebastian, Florida. Bangs (1899), however, believed the panther was restricted to peninsular Florida and could not intergrade with other *Felis* sp. Therefore, he assigned it full specific status and named it *Felis coryi* since *Felis floridana* had been used previously for a bobcat (*Lynx rufus*).

Culver et al. (2000) examined genetic diversity within and among the described subspecies of *Puma concolor* using three groups of genetic markers and proposed a revision of the genus to include only six subspecies, one of which encompassed all puma in North America including the panther. They determined the panther was one of several smaller populations that had unique features. Specifically, the number of polymorphic microsatellite loci and amount of variation were lower, and it was highly inbred. The degree to which the scientific community accepted the results of Culver et al. (2000) and the proposed change in taxonomy is not resolved (Service 2008). The panther remains listed as a subspecies, and continues to receive protection pursuant to the Act.

Life History

Male panthers are polygynous, maintaining large, overlapping home ranges containing several adult females and their dependent offspring. Breeding activity peaks from December to March (Shindle et al. 2003). Litters (n = 82) are produced throughout the year, with 56 to 60 percent of births occurring between March and June (Jansen et al. 2005; Lotz et al. 2005). The greatest number of births occurs in May and June (Jansen et al. 2005; Lotz et al. 2005). Average litter size is 2.4 ± 0.91 (standard deviation) kittens. Seventy percent of litters are comprised of either two or three kittens.

Panther dens are usually located closer to upland hardwoods, pinelands, and mixed wet forests and farther from freshwater marsh-wet prairie (Benson et al. 2008). Most den sites are located in dense saw palmetto (*Serenoa repens*), shrubs, or vines (Maehr 1990a; Shindle et al. 2003, Benson et al. 2008). Den sites are used for 6 to 8 weeks by female panthers and their litters from birth to weaning (Benson et al. 2008). Independence and dispersal of young typically occurs at 18 months, but may occur as early as one year (Maehr 1992).

Benson et al. (2009) analyzed survival and cause-specific mortality of subadult and adult panthers. They found that sex and age influenced panther survival, as females survived better than males, and older adults (≥10 years) survived poorly compared with younger adults. Genetic ancestry strongly influenced annual survival of subadults and adults after introgression, as F1 generation admixed panthers survived longer than pre-introgression panthers and non-F1 admixed individuals (Benson et al. 2009).

Mortality records for uncollared panthers have been kept since February 13, 1972, and for radio-collared panthers since February 10, 1981 (FWC 2013, and FWC unpublished data). Through June 25, 2014, 424 mortalities have been documented (FWC 2014). Of the 424 total mortalities, 181 were radio-collared. Intraspecific aggression was the leading cause of mortality for radio-collared panthers, and was more common for males than females (Benson et al. 2009). Older-adult males had significantly higher, and subadult males had marginally higher, mortality due to intraspecific aggression than adult males in their prime (Benson et al. 2009). Most intraspecific aggression occurs between male panthers; but, aggressive encounters between males and females have occurred, resulting in the death of the female. Defense of kittens or of a kill is suspected in half (five of ten) of the known instances through 2003 (Shindle et al. 2003).

Following intraspecific aggression, the greatest causes of mortality for radio-collared panthers was from unknown causes, vehicles, and other (Benson et al. 2009). From February 13, 1972, through June 30, 2014, 215 panthers (radio-collared and uncollared) were hit by vehicles (FWC 2014). These collisions resulted in 203 panther fatalities and 12 non-fatal injuries. The number of panther/vehicle collisions per year is positively correlated with the annual panther count (McBride et al. 2008).

Female panthers are considered adult residents if they are older than 18 months, have established home ranges, and have bred (Maehr et al. 1991). Land et al. (2004) reported 23 of 24 female panthers first captured as kittens survived to become residents and 18 (78.3 percent) produced litters; 1 female was too young to determine residency. Male panthers are considered adult residents if they are older than 3 years and have established a home range that overlaps with females. Thirty-one (31) male panthers were captured as kittens and 12 (38.7 percent) of these cats survived to become residents (Jansen et al. 2005). "Successful male recruitment may depend on the death or home range shift of a resident adult male" (Maehr et al. 1991). Turnover in the breeding population is low with documented mortality in radio-collared panthers being greatest in subadult and non-resident males (Maehr et al. 1991; Shindle et al. 2003).

Den sites of female panthers have been visited since 1992 and the kittens tagged with passive integrated transponder chips. Annual survival of these kittens has been determined to be 0.328 ± 0.072 (SE) (Hostetler et al. 2009). There was no evidence survival rate differed between male and female kittens or was influenced by litter size. Hostetler et al. (2009) found kitten survival generally increased with degree of admixture with introduced Texas pumas and decreased with panther abundance. Kitten survival is lowest during the first 3 months of their lives (Hostetler et al. 2009).

Panther dispersal begins after a juvenile becomes independent from its mother and continues until it establishes a home range. Dispersal distances are greater for males than females. The maximum dispersal distance recorded for a young male was 139.2 mi (224.1 km) over a 7-month period followed by a secondary dispersal of 145 mi (233 km). Comiskey et al. (2002) found males disperse an average distance of 25 mi (40 km) and females typically remain in or disperse short distances from their natal ranges. Female dispersers establish home ranges less than one average home range width from their natal range (Maehr et al. 2002a). Maehr et al. (2002a) reported all female dispersers (n = 9) were successful at establishing a home range whereas only 63 percent of males (n = 18) were successful. Dispersing males usually go through a period as transient (non-resident) subadults, moving through the fringes of the resident population and often occupying suboptimal habitat until an established range becomes vacant (Maehr 1997).

Most panther dispersal occurs south of the Caloosahatchee River. However, panthers have been documented north of the Caloosahatchee River many times since February 1972 through field signs (*e.g.*, tracks, urine markers, scats), camera-trap photographs, carcasses from vehicle-related mortalities, telemetry from radio-collared animals (Land and Taylor 1998; Land et al. 1999; Shindle et al. 2000; Maehr et al. 2002b; Belden and McBride 2005), captured animals (one of which was radio collared), and one skeleton.

The Caloosahatchee River, a narrow (295-328 ft [90-100 m]), channelized river, is probably not a significant barrier to panther movements. Western subspecies of *Puma* are known to cross wide, swift-flowing rivers up to a mile in width (Seidensticker et al. 1973; Anderson 1983). However, the combination of the river, SR 80, and land uses along the river seems to have somewhat restricted panther dispersal northward (Maehr et al. 2002b). Documented physical evidence of at least 15 uncollared male panthers has been confirmed north of the river since 1972, but neither female panthers nor reproduction have been documented in this area since 1973 (Belden and McBride 2005).

Panthers require large areas to meet their needs. Numerous factors influence panther home range size, including: habitat quality, prey density, and landscape configuration (Belden 1988; Comiskey et al. 2002). Home range sizes of six radio-collared panthers monitored between 1985 and 1990 averaged 128,000 ac (51,800 hectares [ha]) for resident adult males and 48,000 ac (19,425 ha) for resident adult females; transient males had a home range of 153,599 ac (62,160 ha) (Maehr et al. 1991). Comiskey et al. (2002) examined the home range size for 50 adult panthers (residents greater than 1.5 years old) monitored in south Florida from 1981 to 2000 and found resident males had a mean home range of 160,639 ac (65,009 ha) and females had a mean home range of 97,920 ac (39,627 ha). Beier et al. (2003) found home range size estimates for panthers reported by Maehr et al. (1991) and Comiskey et al. (2002) to be reliable.

Annual minimum convex polygon home range sizes of 52 adult radio-collared panthers monitored between 1998 and 2002 ranged from 15,360 to 293,759 ac (6,216 to 118,880 ha), averaging 89,600 ac (36,260 ha) for 20 resident adult males and 44,160 ac (17,871 ha) for 32 resident adult females (Land et al. 1999, 2002; Shindle et al. 2000, 2001). The most current estimate of home-range sizes (minimum convex polygon method) for established, non-dispersing, adult, radio-collared panthers averaged 29,056 ac (11,759 ha) for females (n = 11) and 62,528 ac (25,304 ha) for males (n = 11) (Lotz et al. 2005). The average home range was 35,089 ac (14,200 ha) for resident females (n = 6) and 137,143 ac (55,500 ha) (n = 5) for males located at Big Cypress National Preserve (BICY) (Jansen et al. 2005). Home ranges of resident adults tend to be stable unless influenced by the death of other residents.

Activity levels for panthers are greatest at night with peaks around sunrise and after sunset (Maehr et al. 1990b). The lowest activity levels occur during the middle of the day. Female panthers at natal dens follow a similar pattern with less difference between high and low activity periods.

Telemetry data indicate panthers typically do not return to the same resting site day after day, with the exception of females with dens or panthers remaining near kill sites for several days. The presence of physical evidence such as tracks, scats, and urine markers, confirms panthers move extensively within home ranges, visiting all parts of the range regularly in the course of hunting, breeding, and other activities (Maehr 1997; Comiskey et al. 2002). Males travel widely throughout their home ranges to maintain exclusive breeding rights to females. Females without kittens also move extensively within their ranges (Maehr 1997). Panthers are capable of moving large distances in short periods of time. Nightly panther movements of 12 mi (20 km) are not uncommon (Maehr et al. 1990a).

Adult females and their kittens interact more frequently than any other group of panthers. Interactions between adult male and female panthers last from 1 to 7 days and usually result in pregnancy (Maehr et al. 1991). Aggressive interactions between males often result in serious injury or death. Independent subadult males have been known to associate with each other for several days and these interactions do not appear to be aggressive in nature. Based on radio-collared panthers, aggression between males is the most common cause of male mortality (FWC 2014) and an important determinant of male spatial and recruitment patterns based on (Maehr et al. 1991; Shindle et al. 2003).

Primary panther prey species are white-tailed deer and feral hog (*Sus scrofa*) (Maehr et al. 1990b; Dalrymple and Bass 1996). Generally, feral hogs constitute the greatest biomass consumed by panthers north of the Alligator Alley section of I-75, while white-tailed deer are the greatest biomass consumed to the south (Maehr et al. 1990b). Secondary prey species include raccoons (*Procyon lotor*), nine-banded armadillos (*Dasypus novemcinctus*), marsh rabbits (*Sylvilagus palustris*) (Maehr et al. 1990b), and American alligators (*Alligator mississippiensis*) (Dalrymple and Bass 1996). No seasonal variation in diet has been detected. Maehr et al. (1990b) rarely observed domestic livestock in scats or kills of the panther, although cattle were readily available in the study area. In a study of calf depredation on two ranches in southwest Florida (Main and Jacobs 2014), panthers were determined to be the cause of calf mortality for 0.5 percent of calves on one ranch and 5.3 percent of calves on the other ranch.

Little information on the feeding frequency of the panther is available. However, the feeding frequency of the Puma is likely similar to the feeding frequency of the panther. Ackerman et al. (1986) reported a resident adult male puma generally consumes one deer-sized prey every 8 to 11 days. Moreover, a resident female puma will consume one deer-sized prey item every 14 to 17 days, and one deer-sized prey item every 3.3 days for a female with three 13-month-old kittens.

Habitat

Noss and Cooperrider (1994) considered the landscape implications of maintaining viable panther populations. Assuming a male home range size of 137,599 ac (55,685 ha) (Maehr 1990), an adult sex ratio of 50:50 (Anderson 1983), and some margin of safety, they determined a reserve network as large as 15,625 to 23,438 mi^2 (40,469 to 60,703 km^2) would be needed to support an effective population size of 50 individuals (equating to an actual adult population of 100 to 200 panthers [Ballou et al. 1989]). However, to provide for long-term persistence based on an effective population size of 500 individuals (equating to 1,000 to 2,000 adult panthers [Ballou et al. 1989]), could require as much as 156,251 to 234,376 mi^2 (404,687 to 607,031 km^2). This latter acreage corresponds to roughly 60 to 70 percent of the panther's historical range. Although it is uncertain whether this much land is needed for panther recovery, it does provide some qualitative insight into the importance of habitat conservation across large landscapes for achieving a viable panther population (Noss and Cooperrider 1994).

Radio-collar data and ground tracking indicate that panthers use the mosaic of habitats available to them as resting and denning sites, hunting grounds, and travel routes. The majority of telemetry locations (Belden 1986; Belden et al. 1988; Maehr 1990; Maehr et al. 1991; Maehr 1992; Smith and Bass 1994; Kerkhoff et al. 2000; Comiskey et al. 2002, Cox et al. 2006, Kautz et al. 2006, Land et al. 2008) and natal den sites (Benson et al. 2008) were within or close to forested cover types, particularly cypress swamp, pinelands, hardwood swamp, and upland hardwood forests. Global Positioning System data has shown panthers (n = 12) use all habitats contained within their home ranges by selecting for forested habitat types and using all others in proportion to availability (Land et al. 2008).

Kautz et al. (2006) found that the smallest class of forest patches (*i.e.*, 9 to 26 ac [3.6 to 10.4 ha]) were the highest ranked forest patch sizes within panther home ranges. The diverse woody flora of forest edges probably provides cover suitable for stalking and ambushing prey (Belden et al. 1988; Cox et al. 2006). Also, dense understory vegetation comprised of saw palmetto provides some of the most important resting and denning cover for panthers (Maehr 1990; Benson et al. 2008). Shindle et al. (2003) estimated 73 percent of panther dens were in saw palmetto thickets.

Between 1981 and 2010, more than 90,000 locations were collected from more than 180 radio-collared panthers. Belden et al. (1988); Maehr et al. (1991); Maehr and Cox (1995); Maehr (1997); Kerkoff et al. (2000); Comiskey et al. (2002); Cox et al. (2006); and Kautz et al. (2006) provide information on habitat use based on various subsets of these data. Land et al. (2008), investigated habitat selection of 12 panthers in the northern portion of the breeding range using Global Positioning System (GPS) telemetry data collected during nocturnal and diurnal periods, as well as VHF telemetry data collected only during diurnal periods, and found analysis of both types of telemetry data yielded similar results.

Even though some suitable panther habitat remains in south-central Florida, it is widely scattered and fragmented (Belden and McBride 2005). Thatcher et al. (2006) used a statistical model in combination with a geographic information system (GIS) to develop a multivariate landscape-scale habitat model based on the Mahalanobis distance statistic (D^2) to evaluate habitats in south central Florida for potential expansion of the panther population. They identified four potential habitat patches: the Avon Park Bombing Range area, Fisheating Creek/Babcock-Webb Wildlife Management Area (WMA), eastern Fisheating Creek, and the Duette Park/ Manatee County area. These habitat patches are smaller and more isolated compared with the current panther range, and the landscape matrix where these habitat patches exist provides relatively poor habitat connectivity among the patches (Thatcher et al. 2006, 2009). Major highways and urban or agricultural development isolate these habitat patches, and they are rapidly being lost to the same development that threatens southern Florida (Belden and McBride 2005).

Travel and dispersal corridors

In the absence of direct field observations/measurements, Harrison (1992) suggested landscape corridors for wide-ranging predators should be half the width of an average home range size. Following Harrison's (1992) suggestion, corridor widths for panthers would range from 6.1 to 10.9 mi (9.8 to17.6 km) depending on whether the target animal was an adult female or a transient male. Beier (1995) suggested that corridor widths for transient male puma in California could be as small as 30 percent of the average home range size of an adult panther; however, topography in California is dramatically different from that in Florida. Without supporting empirical evidence, Noss (1992) suggests regional corridors connecting larger hubs of habitat should be at least 1.0 mi (1.6 km) wide. Beier (1995) makes specific recommendations for very narrow corridor widths based on short corridor lengths in a California setting of wild lands completely surrounded by urban areas; he recommended corridors with a length less than 0.5 mi (0.8 km) should be more than 328 ft (100 m) wide, and corridors extending 0.6 to 4 mi (1 to 7 km) should be more than 1,312 ft (400 m) wide. The Dispersal Zone, which connects lands between the Panther Focus Area south of the Caloosahatchee River and the Panther Focus Area north of the Caloosahatchee River, encompasses 44 mi^2 (113 km^2) with a mean width of 3.4 mi (5.4 km) (Figure 5). Although it is not adequate to support a single panther, the Dispersal Zone is strategically located and expected to function as an important landscape linkage to south-central Florida (Kautz et al. 2006). Transient male panthers currently use this zone as they disperse northward into south-central Florida.

Distribution

The panther is the last subspecies of *Puma* (also known as mountain lion, cougar, panther, or catamount) still surviving in the eastern United States. Historically occurring throughout the southeastern United States (Young and Goldman 1946), today the panther is restricted to less than 5 percent of its historic range located in south Florida.

When Europeans first came to this country, pumas roamed most all of North, Central, and South America. Early settlers attempted to eradicate pumas by every means possible. By 1899, it was believed panthers had been restricted to peninsular Florida (Bangs 1899). By the late 1920s to mid-1930s, it was thought by many the panther had been completely extirpated (Tinsley 1970). In 1935, Dave Newell, a Florida sportsman, hired Vince and Ernest Lee, Arizona houndsmen, to hunt for panthers in Florida. They killed eight in the Big Cypress Swamp (Newell 1935). Every survey conducted since then confirmed a breeding panther population in southern Florida south of the Caloosahatchee River, and no survey since then has been able to confirm a reproducing panther population outside of southern Florida.

Although generally considered unreliable, sightings of panthers regularly occur throughout the southeast. Nonetheless, a reproducing population of panthers has not been documented to occur outside of south Florida for at least 30 years despite an extensive search effort (Belden et al. 1991; McBride et al. 1993; Clark et al. 2002). Survey reports and more than 70,000 locations of radio-collared panthers recorded between 1981 and 2004 clearly define the panther's current breeding range. Reproduction is known only in the Big Cypress Swamp and Everglades physiographic region in Collier, Lee, Hendry, Miami-Dade, and Monroe Counties, south of the Caloosahatchee River (Belden et al. 1991). As discussed previously, panthers occasionally disperse north of the Caloosahatchee River. However, these animals are likely all males searching to establish new territories. There is no evidence of female panthers or successful panther reproduction currently occurring north of the Caloosahatchee River (Nowak and McBride 1974; Belden et al. 1991; Land and Taylor 1998; Land et al. 1999; Shindle et al. 2000; McBride 2002; Belden and McBride 2005). In 1973, McBride captured one female in Glades County (Nowak and McBride 1974). This was the last time a female panther was identified north of the Caloosahatchee River.

Population Dynamics

McBride et al. (2008) and McBride (2010) reported minimum population counts (*i.e.*, number known alive) based on physical evidence (*e.g.*, tracks, urine markers, panther treed with hounds, trail-camera photos). They counted adult and subadult panthers, but not kittens at the den. Three rules were used to distinguish individuals: (1) gender was determined by track size or stride length; (2) time (freshness) was determined by known events within the past 24 hours, such as wind or rain; and (3) distance between individual track sets. These rules were used as an exclusionary tool to avoid over-counting (McBride et al. 2008). The number of panthers detected and verified by physical evidence from 1981 to 1994 fluctuated between a high of 30 and a low of 19 adult and juvenile panthers, with the lowest point occurring in 1991 following the removal of seven juveniles and three kittens to initiate a captive breeding program (McBride et al. 2008). In 1995, eight female pumas from Texas were released to address suspected deleterious effects of inbreeding. From 1996 to 2003, the panther population increased at a rate of 14 percent per year with 26.6 kittens being produced annually (Johnson et al. 2010). The effective population size (N_e) rose from 16.4 in 1995 to 32.1 in 2007, with corresponding census populations (N) of 26 and 102, respectively. The population tripled since 1995 (McBride et al. 2008, Johnson et al. 2010), reaching a high of 117 by 2007 (mortalities not subtracted). Data reported in McBride (2000, 2001, 2002, 2003, 2004, 2006, 2007,2008, and 2009), McBride et al. (2010, 2011, 2012, and 2013), and Johnson et al. (2010) noted minimum population counts of 62 panthers in 2000, 78 in 2001, 80 in 2002, 87 in 2003, 78 in 2004, 82 in 2005, 97 in 2006, 117 in 2007, 104 in 2008, 113 in 2009, 115 in 2010, 111 in 2011, 123 in 2012, and 133 in 2013.

Maehr et al. (1991) provide an estimate of population density of 1 panther per 27,520 ac, based on 17 radio-collared and 4 uncollared panthers. They extrapolated this density to the area occupied by radio-collared panthers (1,245,435 ac) during the period 1985 to 1990 to achieve a population estimate of 46 adult panthers for southwest Florida (excluding Everglades National Park [ENP], eastern BICY, and Glades and Highlands Counties). Beier et al. (2003), however, argued this estimate of density, although "reasonably rigorous," could not be extrapolated to other areas because it was not known whether densities were comparable in those areas. Kautz et al. (2006) provided a density estimate of 1 panther per 31,923 ac by dividing the panther count at that time (67) by the area within the Primary Zone. This estimate does not take into account the variability in panther densities across the landscape. Using an average of the 2007 to 2009 panther counts in the eight survey units covered by McBride et al. (2008) and Kautz et al. (2006), the density estimates range from a low of one panther per 81,479 ac to a high of one panther per 7,850 ac for the Primary Zone lands within these survey units.

The FWC (2010) provided an upper bound population estimate of 0.0177 panthers per square-kilometer (km^2) or one panther per 13,929 ac. Applying this density estimate to the Primary Zone (9,189 km^2) (2,270,652 ac) yields an upper estimate of 163 adult panthers. The FWC's lower estimate is 100 panthers (1.09 panthers per 100 km^2 or 1 panther per 22,707 ac) and is based on annual verified panther sign data (McBride et al. 2008) and minimum number of panthers known to be alive (FWC 2010). Applying the four densities to the Primary Zone would yield a population based on Kautz et al.'s (2006) density estimate of 71 panthers (1 panther per 31,923 ac). Maehr et al.'s (1991) estimate would yield a population of 83 panthers (1 panther per 27,520 ac) and the FWC's (2010) estimate would yield a low of 100 panthers (1 panther per 22,707 ac) and a high of 163 panthers (1 panther per 13,929 ac). For our evaluations however, the Service is continuing to use the average densities provided by Kautz et al. (2006) of one panther per 31,923 ac (12,919 ha) or one panther per 129 km^2.

Population Viability Analysis (PVA) has emerged as a key component of endangered species conservation. This process is designed to incorporate demographic information into models that predict if a population is likely to persist in the future. PVAs incorporate deterministic and stochastic events including demographic and environmental variation, and natural catastrophes. PVAs have been criticized as being overly optimistic about future population levels (Brook et al. 1997) and should be viewed with caution; however, they are and have been shown to be surprisingly accurate for managing endangered taxa and evaluating different management practices (Brook 2000).

Shaffer (1981) originally defined a viable population as follows: "a minimum viable population for any given species in any given habitat is the smallest isolated population having a 99 percent chance of remaining extant for 1,000 years despite the foreseeable effects of demographic, environmental and genetic stochasticity, and natural catastrophes." However, the goal of 95 percent probability of persistence for 100 years is the standard recommended by population biologists and is used in management strategies and conservation planning, particularly for situations where it is difficult to accurately predict the future (Shaffer 1978, 1981, 1987).

From 1981 through 2010, 182 panthers were been radio-collared and monitored on public and private lands throughout south Florida (FWC 2010). Radio-collar data were used by researchers to estimate survival rates and fecundity and were incorporated into PVA models previously developed for the panther (Seal and Lacy 1989, 1992; Cox et al. 1994; Maehr et al. 2002b). These models incorporated a range of different model parameters such as sex ratios, kitten survival rates, age distributions, and various levels of habitat loss, density dependence, and intermittent catastrophes or epidemics. The outputs of these models predicted a variety of survival scenarios for the panther and predicted population levels needed to ensure the survival of the species.

Root (2004) developed an updated set of PVA models for the panther based on RAMAS GIS software (Akçakaya 2002). These models were used to perform a set of spatially explicit PVAs. Three single-sex (*i.e.*, females only) models were constructed using demographic variables from Maehr et al. (2002b) and other sources. A conservative model was based on Seal and Lacy (1989), a moderate model was based on Seal and Lacy (1992), and an optimistic model was based on the 1999 consensus model of Maehr et al. (2002b). In each model, first-year kitten survival was set at 62 percent based on information from panther population monitoring (Shindle et al. 2001). All of the models assumed a 1:1 sex ratio, a stable age distribution, 50 percent of females breeding in any year, and an initial population of 41 females (82 individuals), which was the approximate population size in 2001 and 2002 (McBride 2001, 2002).

The basic versions of each model incorporated no catastrophes or epidemics, no change in habitat quality or amount, and a ceiling type of density dependence. The basic versions of the models incorporated a carrying capacity of 53 females (106 panthers with a 50:50 sex ratio). The models were run with differing values for density dependence, various levels of habitat loss, and intermittent catastrophes or epidemics. Each simulation was run with 10,000 replications for a 100-year period. The minimum number of panthers needed to ensure a 95 percent probability of persistence for 100 years was estimated in a series of simulations in which initial abundance was increased until probability of extinction at 100 years was no greater than 5 percent. More detailed information concerning the PVA model parameters appears in Root (2004).

The results of an earlier, conservative PVA model run done by Seal and Lacy (1989) predicted a probability of extinction of 78.5 percent in 100 years with a mean final total abundance of 3.5 females. Also, the probability of a large decline in abundance (50 percent) was 94.1 percent. Later work based on improved panther modeling and a larger sample of monitored panthers produced both a moderate and optimistic scenario (Root 2004). The moderate model resulted in a 5 percent probability of extinction and a mean final abundance of 42.3 females in 100 years. The probability of panther abundance declining by half the initial amount was 20 percent in 100 years under the moderate model. The optimistic model resulted in a 2 percent probability of extinction and mean final abundance of 51.2 females in 100 years. The probability of panther abundance declining by half the initial amount was only 9 percent in 100 years under the optimistic model. These models also provide a probability of persistence (100 percent minus probability of extinction) over a 100-year period of 95 percent for the moderate model and 98 percent for the optimistic model.

Model results were also provided by Root (2004) for probability of extinctions for 1 percent loss of habitat per year, within the first 25 years of the model run, based on both the moderate and optimistic scenarios. The 1 percent loss of habitat equates to essentially all remaining non-urban privately owned lands in the Primary Zone and corresponds to the estimated rate of habitat loss from 1986 to 1996 for the five southwest counties based on land use changes (Root 2004). For the moderate model, the model runs predict a probability of extinction increase of about 1 percent to 6 percent with 1.0 percent habitat loss per year for the first 25 years. For the optimistic model, probability of extinction increased from about 2 percent with no loss of habitat to 3 percent with 1.0 percent habitat loss per year, for the first 25 years. These models also predicted the mean final abundance of females would decrease from 41 to 31 females, a 24.3 percent reduction for the moderate model and from 41 to 38 females, a 7.3 percent reduction for the optimistic model.

The probability of persistence over a 100-year period with a 1 percent loss of habitat changed to approximately 94 percent for the moderate model and 97 percent for the optimistic model. The model runs also predicted a mean final abundance of 62 individuals (31 females and 31 males) for the moderate model and 76 individuals (38 females and 38 males) for the optimistic model.

The results of the PVA lead to the development of population guidelines for the panther. Kautz et al. (2006) developed recommendations for panther population size as it relates to persistence following review of the output of Root's PVA models (2004) and those of other previous PVAs for the panther. These recommendations are: (1) populations of less than 50 individuals are likely to become extinct in less than 100 years; (2) populations of 60 to 70 are barely viable and expected to decline by 25 percent over 100 years; (3) populations of 80 to 100 are likely stable but would still be subject to genetic problems (*i.e.*, heterozygosity would slowly decline); and (4) populations greater than 240 have a high probability of persistence for 100 years and are demographically stable and large enough to retain 90 percent of original genetic diversity. Kautz et al.'s (2006) population recommendations, when applied to the populations predicted by Root's (2004) moderate models, describe the "with habitat loss" population (62 panthers) as barely viable and expected to decline by 25 percent over a 100-year period. The "without habitat loss" population (84 panthers) is likely stable but would still be subject to genetic problems.

The Service believes McBride's verified population of 97 panthers in 2006, 117 panthers in 2007, 104 in 2008, 113 in 2009, 115 in 2010, and 111 in 2011, 123 in 2012, and 133 in 2013 is within Kautz et al.'s (2006) population recommendations representing a population that is likely stable but still may be subject to genetic problems.

The Service also believes the model runs show lands in the Primary Zone are important to the survival and recovery of the panther, and sufficient lands need to be managed and protected in south Florida to provide for a population of 80 to 100 panthers, the population range defined as likely stable over 100 years, but subject to genetic problems.

Critical Habitat

Critical habitat has not been designated for the panther.

Threats

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

Panthers, because of their wide-ranging movements and extensive spatial requirements, are particularly sensitive to habitat fragmentation (Harris 1984). Mac et al. (1998) defines habitat fragmentation as: “The breaking up of a habitat into unconnected patches interspersed with other habitat which may not be inhabitable by species occupying the habitat that was broken up. The breaking up is usually by human action, as, for example, the clearing of forest or grassland for agriculture, residential development, or overland electrical lines.” The reference to “unconnected patches” is a central underpinning of the definition. For panther conservation, this definition underscores the need to maintain contiguous habitat and protected habitat corridors in key locations in south Florida and throughout the panther’s historic range. Habitat fragmentation can result from road construction, urban development, and agricultural land conversions.

Roads and highways facilitate the movement of people and goods by cars and trucks, and may adversely affect the panther. The construction of new roads and the widening of existing roads can result in the direct loss of wildlife habitat (Forman et al. 2003). In addition, disturbance resulting from motorized vehicles may cause panthers to avoid busy roads. Maher (1990) reported that female panthers are less likely to cross busy highways. Consequently, roads may act as barriers affecting panther movement and fragmenting panther habitat. Panthers can also be injured or killed due to collisions with motorized vehicles when attempting to cross highways, and the potential for collisions increases as traffic increases. Adverse effects resulting from roads and highways represent a potential threat to the existing panther population.

Collisions with motor vehicles on highways are a significant source of mortality for the panther. The FWC documented 165 vehicle-related panther mortalities and 8 vehicle-related panther injuries from 1972 to the present on highways in south Florida. In portions of the panther’s range, the rate of panther vehicle-related mortalities may be increasing. Smith et al. (2006) found that vehicle-related panther mortalities in Collier

County increased by a factor of four from 2000 to 2005, compared to previous decades. This increase in panther mortality is likely related to the increase in traffic from Collier County's population growth. Unfortunately, the effect of vehicle-related mortality on the existing panther population is largely unknown.

Wildlife underpasses, or crossings, can be constructed within highway corridors to reduce the potential for panther injuries and mortalities resulting from vehicle collisions. Underpasses allow panthers and other wildlife to safely cross under busy roadways, and maintain connectivity and gene flow within the panther population. Underpasses usually consist of a bridge, prefabricated concrete box, or culvert (Forman et al. 2003). Effective crossing structures are large enough to allow the passage of panthers and include adequate wing fencing to funnel panthers to the crossing site. Crossings should be designed so panthers have an unobstructed view of habitat on the opposite side of the underpass (Foster and Humphrey 1995). The status of lands adjacent to the crossing site should also be considered when determining the location of a crossing. Unprotected private lands adjacent to the crossing could be developed and render the crossing unviable. Accordingly, lands adjacent to crossings should be acquired or placed under a conservation easement or other protective covenant to ensure the crossing will function in perpetuity. A number of wildlife crossings with associated fencing have already been constructed on major roadways in southwest Florida to benefit the panther and other wildlife species. In 1991, the FDOT finished the construction of 28 wildlife crossings within the I-75 corridor from U.S. Highway 27 to just west of Everglades Boulevard.

The FDOT also constructed six wildlife crossings on SR 29 between Oil Well Road and US 41. Crossings A, B, C, and D are located north of I-75 and Crossings E and F are located south of I-75. Crossings A and B were constructed in 2007, Crossings C and D were constructed in 1995, Crossing E was constructed in 1997, and Crossing F was constructed in 1999. Prior to construction of the SR 29 Crossings, a total of 10 vehicle-related panther mortalities were recorded near the locations of Crossings A and B from 1980 through 2004, and 2 vehicle-related panther mortalities were recorded near the location of Crossings C and D from 1979 through 1990. Vehicle-related panther mortalities have not been recorded in the vicinity of Crossings A, B, C, or D following their installation. A total of two vehicle-related panther mortalities were documented within 3.5 mi of the location of Crossing E prior to construction, and vehicle-related panther mortalities were not observed within 2.5 mi of the location of Crossing F prior to construction. Following construction of Crossings E and F, a total of four vehicle-related panther mortalities have been reported within 3 mi of Crossing E, and two vehicle-related panther mortalities have been documented within 1 mi of Crossing F.

Lee County, Collier County, and other entities have been working with the Service to construct additional needed crossings for the panther. For example, the Collier County Road Department recently constructed two wildlife underpasses and barrier fencing within the Oil Well Road (CR 858) corridor at Camp Keais Strand, in association with the Oil Well Road widening project. Lee County constructed a wildlife underpass and barrier fencing on Corkscrew Road in 2004. Moreover, in 2011, a wildlife underpass and barrier fencing was installed east of Immokalee on County Road (CR) 846 in Collier County, as part of a Habitat Conservation Plan. A wildlife underpass has also been installed on Immokalee Road near CR 951.

Although these wildlife crossings have contributed to minimization of panther-vehicle interactions, more crossings are needed within the major roadways of south Florida to further reduce this threat to the panther and other wildlife species (Smith et al. 2006). Recent studies have been conducted to identify locations for wildlife crossings in south Florida. Swanson et al. (2005) used a Least Cost Pathway (LCP) modeling approach to identify the most likely travel routes for panthers among six major use areas in southwest Florida. LCP modeling takes into consideration elements in the landscape that permit or impede panther movement when traveling. Swanson et al. (2005) identified 20 key highway segments where LCPs intersected improved roadways. Smith et al. (2006) studied the movements of the panther, the Florida black bear, and other wildlife species along SR 29, CR 846 and CR 858 in Collier County, Florida. Data analyzed in the study were obtained from roadkill and track surveys, infra-red camera monitoring stations, existing data provided by the FWC (panther radio telemetry and vehicle mortality reports), and other studies. Smith et al. (2006) recommended new wildlife crossings be considered at various sites along these roadways to reduce vehicle-related mortality of panthers and other wildlife species, and to increase connectivity among wildlife populations. The Service continues to work with the FDOT, county road departments, and other entities to ensure wildlife crossings are installed as needed to promote safe passage of panthers and other wildlife across roadways.

Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Prior to 1949, panthers could be killed in Florida at any time of the year. In 1950, the Florida Game and Fresh Water Fish Commission (now Florida Fish and Wildlife Conservation Commission [FWC]) declared the panther a regulated game species due to concerns over declining numbers. The FWC removed panthers from the game animal list in 1958 and gave them complete legal protection. On March 11, 1967, the Service listed the panther as endangered (32 FR 4001) throughout its historic range, and these animals received Federal protection under the passage of the Act in 1973. In addition, the Florida Panther Act (Florida Statute 372.671), a 1978 Florida State law, made killing a panther a felony. The panther is listed as endangered by the States of Florida, Georgia, Louisiana, and Mississippi in addition to its Federal listing.

Restricted Range

Historically occurring throughout the southeastern United States (Young and Goldman 1946), today the panther is restricted to south Florida in an area that is less than 5 percent of its historic range.

Ongoing Conservation Efforts

Habitat protection has been identified as being one of the most important elements to achieving panther recovery. While efforts have been made to secure habitat, continued action is needed to obtain additions to and inholdings for public lands, assure linkages are maintained, restore degraded and fragmented habitat, and obtain the support of private landowners for maintaining property in a manner that is compatible with panther use. Conservation lands used by panthers are held and managed by a variety of entities including the Service, NPS, Seminole Tribe of Florida, Miccosukee Tribe of Indians of Florida, FWC, Florida Department of Environmental Protection (DEP), Florida Division of Forestry (FDOF), Water Management Districts, non-governmental organizations, counties, and private landowners.

To further refine the land preservation needs of the panther, and to specifically develop a landscape-level program for the conservation of the panther population in south Florida, the Service appointed a Florida Panther Subteam in February 2000. The Subteam was charged with developing a landscape-level strategy for the conservation of the panther population in south Florida. The results of this collaborative effort are partially presented in Kautz et al. (2006). One of the tasks for this subteam was to identify a strategically located set of lands containing sufficient area and appropriate land cover types to ensure the long-term survival of the south Florida population of the panther. Kautz et al. (2006) focused their efforts on the area south of the Caloosahatchee River, where the reproducing panther population currently exists.

Kautz et al. (2006) created an updated panther potential habitat model. The potential habitat map was reviewed in relation to telemetry data, recent satellite imagery (where available), and panther home range polygons. Boundaries were drawn around lands defined as the Primary Zone, the most important area needed to support a self-sustaining panther population. Kautz et al. (2006) referred to these lands as essential; however, as observed in the two previous plans (Logan et al. 1993; Cox et al. 1994), lands within the boundaries of the Primary Zone included some urban areas and other lands not considered to be panther habitat (*i.e.*, active rock and sand mines). The landscape context of areas surrounding the Primary Zone was modeled and results were used to draw boundaries of the Secondary Zone (Figure 5), the area capable of supporting the panther population in the Primary Zone, but where habitat restoration may be needed (Kautz et al. 2006).

Kautz et al. (2006) also identified, through a LCP model, the route most likely to be used by panthers crossing the Caloosahatchee River and dispersing out of south Florida into south-central Florida. Kautz et al. (2006) used GIS-based analysis to construct the LCP models and identify optimum panther dispersal corridor(s). The LCP models operated on a cost surface that ranked suitability of the landscape for use by dispersing panthers with lower scores indicating higher likelihood of use by dispersing panthers. Those dispersal routes connecting lands between the Panther Focus Area south of the Caloosahatchee River and the Panther Focus Area north of the Caloosahatchee River were defined as the Dispersal Zone (Kautz et al. 2006). The preservation of lands within this zone is important for the survival and recovery of the panther, as these lands are the dispersal pathways for expansion of the panther population.

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STATUS OF THE SPECIES/CRITICAL HABITAT – American crocodile (*Crocodylus acutus*)

Legal Status – The American crocodile (*Crocodylus acutus*; crocodile) was listed as endangered throughout its range in 1975 under the authority of the Endangered Species Act of 1973, as amended (40 CFR 44151). Critical habitat for the crocodile was established in 1979 (Figure 1) (44 CFR 75076). In 2007, the U.S. Fish and Wildlife Service (Service) reclassified the distinct vertebrate population segment (DPS) of the crocodile in Florida from endangered to threatened. Downlisting of the DPS was based on available data that indicated that since 1975 the population had more than doubled, and expanded its range

Species Description

The crocodile is a large greenish-gray reptile. At hatching, crocodiles are yellowish-tan to gray in color with vivid dark bands on the body and tail. As they grow older, their overall coloration becomes more pale and uniform and the dark bands fade. All adult crocodiles have a hump in front of the eye, and tough, asymmetrical armor-like scutes (scale-like plates) on their backs. The American crocodile is distinguished from the American alligator (*Alligator mississippiensis*) by a relatively narrow, more pointed snout and by an indentation in the upper jaw that leaves the fourth tooth of the lower jaw exposed when the mouth is closed. Moreover, alligators have two nostrils separated by a bony septum covered in skin, while American crocodiles have two nostrils that touch each other in a single depression on the tip of the snout (Ross 2005). In Florida, the crocodile ranges in total length from 26.0 centimeters (10.3 inches) at hatching to 3.8 meters (m) (12.5 feet [ft]) as adults (Moler 1991a). Larger specimens in Florida were reported in the 1800s (Moler 1991a) and may occur in south Florida currently, and individuals as large as 6 to 7 m (19.7 to 23.0 ft) have been reported outside the United States (Thorbjarnarson 1989).

Life history

Reproductive biology

Female crocodiles reach sexual maturity at approximately 10 to 13 years of age (about 7.38 ft [2.25 m] total length) (Mazzotti 1983; LeBuff 1957). The size and age that male crocodiles reach sexual maturity is not currently known (Ogden 1978).

Courtship and breeding occur in late winter and early spring, and nests are usually built in late April or early May (Moler 1992). Females will only produce one clutch of eggs per year, although it is not known if a female will produce clutches in consecutive years. Nests are constructed on beaches, stream banks, and levees, and many nest sites are used recurrently. Female crocodiles usually dig a hole at the nest site, but may construct a nest mound at the nesting site by scraping together soil. If a mound is constructed, a hole is dug in the middle of the nest mound prior to egg laying. Approximately 30 to 60 eggs are deposited in the nest hole. Following laying, the female covers up the eggs with soil and the eggs incubate at the nest site for approximately 85 to 90 days (Moler 1992). In Florida, female crocodiles have not been observed defending their nest during incubation (Kushlan and Mazzotti 1989). Once the eggs begin hatching, the female usually opens the nest and carries the hatchlings to water in her mouth. Hatchlings are not able to escape the nest cavity without assistance from their mother. Crocodile hatchlings remain together in a loose aggregation for several days to several weeks following hatching. Parental care of young crocodiles has not been observed in Florida, although it has been reported in other parts of the American crocodile's range (Moler 1992).

Foraging

Crocodiles are opportunistic feeders and will eat whatever they can catch and consume. Hatchlings feed largely on small fish but will also eat crabs, snakes, insects, and other invertebrates (Moler 1992). Adult crocodiles are capable of taking large prey but generally do not capture prey larger than a raccoon (*Procyon lotor*) or cormorant (*Phalacrocorax auritus*). The diet of adult crocodiles consists of snakes, fish, crabs, small mammals, turtles, and birds (Moler 1992). Crocodiles usually forage from immediately prior to sunset to just after sunrise (Lang 1975; Mazzotti 1983).

Relationships with other species

Under certain circumstances the crocodile may co-occur with the American alligator in south Florida. Co-occurrence of these species is most likely during the non-nesting season or when salinities are low. Most crocodilians are known to tolerate the presence of other crocodilian species provided food and other habitat requirements are not limiting (Service 1999). However, little is known concerning the interspecific interactions that occur between crocodiles and alligators. Alligators and crocodiles both occur within the vicinity of the 5,900-acre (ac) (2,388 hectare [ha]) Cooling Canal System (CCS) at Turkey Point Power Plant. Anecdotal evidence suggests that crocodiles may aggressively exclude alligators from using a brackish water canal favored by crocodiles known as the Interceptor Ditch (Wasilewski and Lindsay 2004). Nevertheless, crocodiles and alligators have both been reported to construct nests on the same canal berm located in the vicinity of Marco Island in Collier County, Florida (Service 1999).

Crocodiles are most susceptible to predation during incubation and as juveniles. Eggs are taken primarily by raccoons, although depredation rates of crocodile nests are typically low in south Florida. Hatchlings and subadults are known to be taken by a variety of predators including wading birds, gulls, crabs, sharks, alligators (in areas where they co-occur), and adult crocodiles (Service 1999). Adult crocodiles have no known predators other than humans.

Habitat

The crocodile in south Florida occurs primarily in mangrove swamps and along low-energy mangrove-lined bays, creeks and inland swamps (Kushlan and Mazzotti 1989). Deep water habitats (>1.0 m [3.3 ft]) are also known to be an important component of crocodile habitat (Mazzotti 1983). Crocodiles exhibit seasonal differences in habitat use. In the breeding season, during spring and summer, crocodile commonly occur along coastal shorelines and coves.

However, during fall and winter, (the non-breeding season), crocodiles were likely to occur more inland within swamps, bays and creeks (Kushlan and Mazzoti 1989).

Nesting habitat includes sites with sandy shorelines or raised marl creek banks adjacent to deep water (Service 1999). Crocodiles also nest on berms and other sites, such as canal banks where sandy fill has been placed (Dixon 2014). Sites optimal for nesting provide appropriate soils for incubation, are generally protected from wind and wave action, and have access to deeper water (Service 1999).

Distribution

The present distribution of the crocodile includes coastal wetlands and rivers of south Florida, Cuba, Jamaica, and Hispaniola (along the Caribbean coast from Venezuela north to the Yucatan peninsula, and along the pacific coast from Sinaloa, Mexico to the Rio Tumbes of Peru [Moler 1992]).

Within Florida, the crocodile historically occurred as far north as Indian River County on the east coast and Tampa Bay on the west coast, and as far south as Key West (DeSola 1935; Hornaday 1914; Kushlan and Mazzotti 1989; Allen and Neill 1952; Neill 1971). The current range of the crocodile in Florida largely consists of coastal areas of Miami-Dade, Monroe, Collier, and Lee Counties. Crocodiles are regularly observed in the Everglades National Park (ENP) along the shoreline of Florida Bay, in the Florida Keys (primarily on northern Key Largo), and within the CCS and adjacent canals and wetlands at the Florida Power and Light (FPL) Turkey Point Nuclear Power Plant. Crocodiles are still known to occur on the west coast of Florida as far north as Sanibel Island. Sightings of crocodiles are also infrequently reported north of Miami-Dade County on the east coast (a crocodile was documented in Indian River County in October 2004)). Confirmed sightings have been reported with increasing frequency in many of the lower Keys, and the Service suspects that these observations may indicate that crocodiles are expanding their range back into the Keys. A small population of crocodiles (at least 21 individuals) has been observed using wetlands adjacent to the airfield at the Key West Naval Air Station on Stock Island in 2014 (Mazzotti 2014). Moreover, a single crocodile has been commonly observed over the past several years at the Dry Tortugas National Park about 68 miles west of Key West (Parry 2017). Although this individual was relocated to ENP following concerns of human safety at the Dry Tortugas National Park.

The breeding range of the crocodile in Florida is still restricted relative to its reported historic range (Kushlan and Mazzotti 1989), with most breeding occurring on the mainland shore of Florida Bay between Cape Sable and Key Largo (Mazzotti *et al*. 2002). Nesting occurs in three primary locations: Key Largo at the Crocodile Lake National Wildlife Refuge, ENP, and the CCS of the FPL's Turkey Point Power Plant. The observed increase in nesting during the last 30 years (see below) is largely due to increased nesting at the Turkey Point Power Plant site (Tucker *et al.* 2004). Nesting has also been recently documented in the Keys. A crocodile nest has been observed on Lower Matecumbe Key during 2003, 2004, and 2005 (Cherkiss 2005). In 2015, a nest was located in Virginia Key in northern Biscayne Bay (Mazzotti 2015a).

Population Dynamics

The number of crocodiles that occurred historically in south Florida is difficult to determine because many records are anecdotal and observers may have confused crocodiles with alligators. Moreover, the remoteness and inaccessibility of estuarine habitats to humans made obtaining a reliable estimate of the crocodile population problematic. Ogden (1978) estimated a population of 1,000 to 2,000 crocodiles within south Florida during the early 1900s. The crocodile population was depleted due to hunting (crocodiles were legally hunted until 1962), and habitat modification and destruction due to on-going urbanization of south Florida by humans. By the mid-1970s the crocodile population was thought to be reduced to about 100 to 400 animals (not including hatchlings) (Ogden 1978).

In south Florida the crocodile population has increased substantially during the last 40 years. The most recent population estimate suggests that the crocodile population contains 1,200 to 2,000 individuals (not including hatchlings)(Brandt 2017). This estimate was derived using crocodile nesting data and by applying demographic characteristics observed in other crocodilian species (*i.e.*, Nile crocodiles [*Crocodylus niloticus*] and American alligators) suggesting that breeding females make up 4 to 5 percent of the non-hatchling population and about 75 percent of reproductively mature females breed and nest each year. However, Mazzotti (2015b) states that based on his recent observations in the field, he now believes that the crocodile population may now be beginning to decline. The Service will monitor results of crocodile surveys conducted over the next few years closely to determine if a downward trend is occurring.

Nest survey data collected in south Florida also suggest that the crocodile population has increased. Nesting effort has increased from about 20 nests per year in the late 1970s to at least 144 nests in 2014 (Mazzotti *et al.* 2014a, Lindsay 2014). Surveys detect approximately 80 to 90 percent of nests. A single nest site can contain several nests from different females in close proximity to each other (University of Florida, undated). Observers are generally unable to distinguish those nests that contain more than one clutch of eggs without excavating the nests. In some instances, surveyors are able to determine that more than one female has laid eggs at a communal nest by visiting the nest over a series of days and observing hatching of separate nests. Communal nests that are not distinguishable result in a possible underestimation of nests and/or females. Available nesting data for 2016 indicate that at least 128 nests producing 1,266 hatchlings were observed within designated critical habitat for the crocodile (Mazzoti 2016).

In the early 1970s, the construction of the nearly 6,000- ac CCS, associated with the FPL's Turkey Point Nuclear Power Plant, created a system of berms that contained soils favorable for crocodile nesting. The number of nests observed within the CCS increased from 2 nests in the late 1970s to 25 in both 2013 and 2014. However, beginning in 2013 water quality conditions at the CCS deteriorated resulting in warmer temperatures, extreme salinities (> 90 ppm), an outbreak of blue-green algae, and a significant increase in turbidity. The reason for these conditions is unclear, but may have been the cumulative results of FPL's recent increase in power production within nuclear Units 3 and 4, the discharge of vegetative cuttings from berm maintenance into the CCS, and the drought experienced in the region. Adverse conditions in the water of the CCS likely resulted in: (1) the significant reduction in nesting effort observed in the CCS during 2015 and 2016 (*i.e.*, only 9 and 8 nests observed, respectively); (2) the reduction in number of crocodiles observed in the CCS; and (3) the poor condition of some of the crocodiles observed in the CCS (Mazzotti 2015b). FPL is working with the Service to address the adverse conditions in the CCS and return the CCS to high quality nesting habitat for crocodiles. Current efforts seem to be effective and the water quality appears to be improving as of spring 2017. It is unclear how the current conditions in the CCS will affect the overall crocodile population, or if crocodiles that would normally nest in the CCS will attempt to nest in other locations.

Critical Habitat

Critical habitat was designated in one large unit in Miami-Dade County and Monroe County, and includes approximately 768,000 ac (310,799 ha) of lands and waters within coastal south and southeast Florida, and the northern keys (Figure 1). The rule describing critical habitat for the crocodile considered it to include all land and water within the following boundary:

> Beginning at the easternmost tip of Turkey Point, Dade County, on the coast of Biscayne Bay; thence southeastward along a straight line to Christmas Point at the southernmost tip of Elliott Key; thence southwestward along a line following the shores of the Atlantic Ocean side of Old Rhodes Key, Palo Alto Key, Anglefish Key, Key Largo, Plantation Key, Windley Key, Upper Matecumbe Key, Lower Matecumbe Key, and Long Key; thence to the westernmost tip of Middle Cape; thence northward along the shore of the Gulf of Mexico to the north side of the mouth of Little Sable Creek; thence eastward along a straight line to the northernmost point of Nine-Mile Pond; thence northeastward along a straight line to the point of beginning.

Roughly half of this acreage has been protected in perpetuity for conservation purposes in ENP. The number of crocodiles that currently occur within designated critical habitat has not been determined. However, because this area contains much of the known nesting habitat in south Florida, it is reasonable to assume that a large portion of the current crocodile population (estimated to be 1,200 to 2,000 individuals) likely occurs within the designated critical habitat. Available nesting data for 2016 indicate that at least 128 nests producing 1,266 hatchlings were observed within designated critical habitat for the crocodile (Mazzoti 2016).

Physical and biological features of crocodile critical habitat were not described when it was designated. However, the Service considers aquatic foraging habitat and suitable nesting substrate within adjacent uplands to be essential habitat features for the crocodile within designated critical habitat. Aquatic foraging habitat includes areas of coastal and near coastal waters (salt, brackish, and fresh) such as bays, canals, marsh, and mangrove swamps containing an adequate prey base including fish, crustaceans, reptiles, birds, and mammals. Nesting habitat is characterized as uplands adjacent to aquatic habitats with sandy or marl soils such as beaches, raised marl creek banks, and artificial berms that are generally protected from wind and wave action, and have access to deeper water (Service 1999).

Threats

Modification and destruction of nesting habitat was the primary threat to the crocodile during the 20th century. The listing of the crocodile and protection of crocodile habitat was due to significant population declines likely associated with habitat alternations and direct human disturbances to crocodiles and their nests. Nesting habitats that were formerly occupied (*e.g.,* Lake Worth, Palm Beach County, central Biscayne Bay, middle and lower Keys *etc.*) were destroyed or degraded due to urbanization, and the crocodile has been largely extirpated from many of these areas (DeSola 1935; Service 1984). Although, observations of crocodile nesting at Chapman Field Park (Maquire 1998) indicate that crocodiles may be reoccupying portions of their former range in central Biscayne Bay. However, continued habitat loss and degradation reduces the likelihood that crocodiles will be able to persist in these areas.

Disturbance due to human encroachment into crocodile habitat may alter normal behavioral patterns of crocodiles. Observations suggest that repeated human disturbances of crocodiles may cause females to abandoned nests or relocate nest sites (Kushlan and Mazzotti 1989). The rising demand for recreational opportunities (*e.g.,* camping, boating, and fishing) is expected to bring more people into contact with crocodiles. Pressure on Federal and State agencies to provide more recreational opportunities on public lands that provide habitat for crocodiles is also expected to increase. An increase in human disturbance due to recreational activities could adversely affect the crocodile.

Crocodile mortality due to collisions with vehicles has been an ongoing problem along U.S. Highway 1 and Card Sound Road in Miami-Dade and Monroe Counties (Service 1999). This problem has been particularly acute within the segment of U.S. Highway 1 from Florida City to Key Largo where wetlands providing habitat for crocodiles are located on both sides of the roadway. The only structures that allowed movement of crocodiles under this roadway were three small culverts that are usually submerged. Consequently, three to four crocodiles per year have been killed while attempting to cross the roadway (Mazzotti 1983; Moler 1991a). The Florida Department of Transportation reduced vehicle-related crocodile mortality along this section of U.S. Highway 1 by installing a series of wildlife underpasses consisting of large culverts, bridges, and associated fencing. The locations for these structures were determined from discussions with the Service and the Florida Fish and Wildlife Conservation Commission (FWC) and were installed as part of roadway improvements constructed along U.S. Highway 1 from the C-111 Canal to the Lake Surprise Bridge.

Exotic animal species pose a threat to the survival of the crocodile. Specifically, the Burmese python (*Python bivittatus*) and the Argentine black and white tegu (*Salvator merianae* = *Tupinambis merianae*; tegu), two reptile species that have recently been introduced and established in south Florida. The Burmese python is a large constrictor snake (normally 10 to 12 ft [3 to 3.7 m] in total length, or larger), and is native to Southeast Asia. The tegu is a medium size (2 to 3 ft [0.6 to 0.9 m] in total length), heavily bodied lizard, native to South America. Burmese pythons have been documented to feed on a variety of animal species in Florida, including the American alligator. Although predation of crocodiles has not yet been documented, Burmese pythons are certainly capable of killing and consuming hatchling, juvenile, and sub-adult crocodiles. Burmese pythons are also likely to compete with crocodiles for prey. The tegu is known to eat reptile eggs and has been photographed by motion sensitive cameras consuming alligator eggs and loitering at a crocodile nest site (Mazzotti *et al*. 2014b). Both of these exotic species have been documented to occur in or near the CCS at the Turkey Point Power Plant. The Service is concerned that predation on and competition with crocodiles by Burmese pythons and tegus could significantly reduce the current crocodile population, and potentially affect the survival and recovery of the species. The FWC has conducted a monitoring, capture, and eradication programs for the tegu in south Florida near Homestead and captured and euthanized more than 400 tegus. FPL has also agreed to monitor and trap tegus in their Everglades mitigation bank located adjacent to the CCS at their Turkey Point Power Plant. The FWC has also organized public python hunts within south Florida to help control this exotic species.

Natural climatic events also have the potential to affect the crocodile. For example, tropical storms and hurricanes affecting south Florida can result in high winds, large waves, and tidal surges that could result in either direct mortality of adults, and/or the loss of nests, nesting habitat, and other important habitat features (Service 1999). Ogden (1978) suggested hurricanes occurring at regular intervals may serve to regulate the crocodile population in Florida. South Florida infrequently experiences cold fronts where ambient temperatures drop below 0°C. Such temperatures are likely lethal to crocodiles, although the effects of subfreezing temperature are not well known because crocodiles killed during freezes are rarely found (Dimock 1915; Barbour 1923; Mazzotti 1983). Moler (1991b) suggested that a decline in crocodile nesting effort observed in 1989 may have been the result of adult mortality due to a hard freeze that occurred during the previous winter. In 2010, more than 200 crocodiles were estimated to have died from an extreme cold spell that affected south Florida. Drought may also adversely affect crocodiles. Mazzotti and Dunson (1984) suggest that hatchling crocodiles are susceptible to osmotic stress and require access to low salinity water. The freshwater needs of hatchlings are usually met by rainfall depositing a lens of freshwater on the water surface of estuarine environments that may last for days. Hatchlings are likely stressed and occasionally die during periods of low rainfall. Crocodiles greater than 200 grams (0.44 pounds) have sufficient mass to withstand osmoregulatory stress and are not believed to be affected by drought.

Climate change also has the potential to adversely affect the crocodile. Sea level rise associated with climate change may inundate existing crocodile nesting habitat and result in habitat loss. Sea level rise may also result in habitat loss or degrade existing aquatic habitats by changing salinities within existing coastal freshwater and brackish water habitats due to the influx of sea water.

Ongoing Conservation Efforts

As indicated above, construction of the CCS at FPL's Turkey Point Power Plant in the early 1970s created berms with favorable soil conditions for crocodile nesting. Following the discovery of the first nest in 1976, FPL has worked with the Service to initiate a management programs for the crocodile at the CCS since 1983. The management program includes: creation and preservation of suitable nesting and basking habitat for crocodiles; removal of exotic vegetation on the berms of the CCS; the capture and microchip tagging of hatchlings, the construction of freshwater ponds on the CCS berms as refugia for hatchlings, the relocation of hatchlings form the hypersaline waters of the CCS to adjacent lower salinity habitats; and the monitoring of nesting and growth and survival of crocodiles occurring in the CCS. FPL has also instituted an extensive awareness program to educate the public on the status and conservation of the crocodile. Overall, the management program has been very successful and crocodile nesting has increased from 2 nests in 1978 to 20 to 25 nests during the early 2010s, and the site has become an important nesting area for the American crocodile in terms of its recovery, resulting in the production of thousands of hatchlings since it was established. As discussed above, there has been a reduction in nesting at the CCS over the past few years, and FPL is working with the Service to address the adverse environmental conditions in the waters of the CCS that have likely resulted in the nesting decrease and return the nesting productivity at the site to its previous levels.

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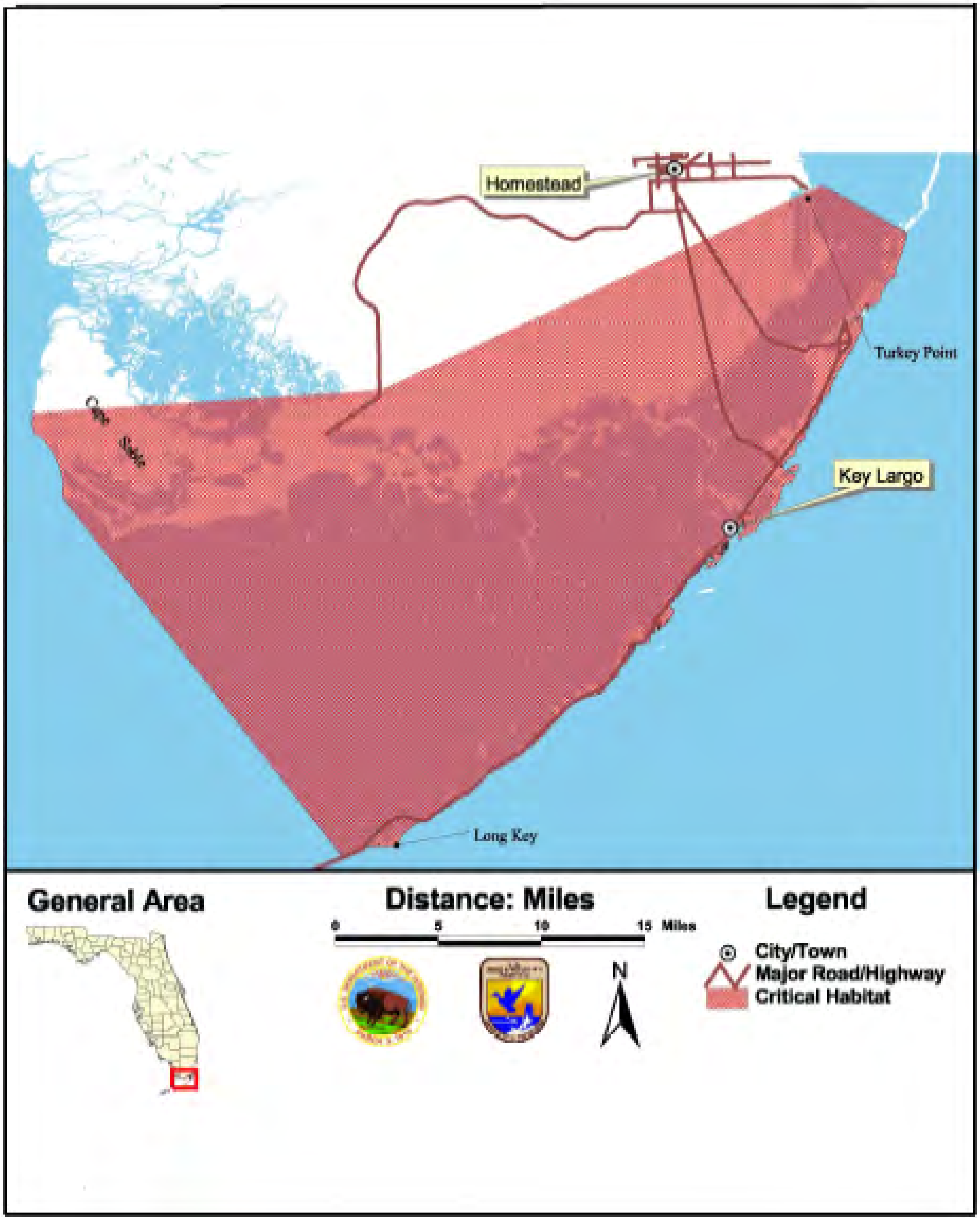

Figure 1. Map of designated critical habitat for the American crocodile.

STATUS OF THE SPECIES – Eastern indigo snake (*Drymarchon corais couperi*)

Legal Status – *threatened*

The U.S. Fish and Wildlife Service (Service) listed the eastern subspecies of indigo snake (*Drymarchon corais couperi*) as threatened under the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 et seq.) in the Federal Register on January 31, 1978. The State of Florida recognizes the eastern indigo snake as Federally-designated Threatened. There is no designated critical habitat.

Species Description

Appearance/Morphology

The eastern indigo snake is the largest native snake species in North America with a maximum recorded length of 8.5 feet (ft) in length (2.6 meters [m]) (Moler 1992) and an unofficial record as having reached 10 ft long in the past (Holbrook 1842). Its color is uniformly lustrous-black, dorsally and ventrally, except for a red or cream-colored suffusion of the chin, throat, and sometimes cheeks. The head is small in proportion to the size of the body, slightly ovular, narrow, and flattened with an elongated snout. The eyes are large relative to the size of the head with black pupil and iris. The vertical plates, frontal plates, and superior orbital are broad with the former being pentagonal in shape. Its scales are large, hexagonal, and smooth in 17 scale rows at mid-body (the central 3 to 5 scale rows are lightly keeled in adult males). Its anal plate is undivided (Holbrook 1842). In the Florida Keys, adult indigo snakes seem to have less red on their faces or throats compared to mainland specimens (Lazell 1989).

Taxonomy

Holbrook (1842) first described all indigo snakes of North America as a monotypic taxon within the Linnaean genus *Coluber* (racers and whipsnakes), *Coluber couperi*. In 1843 Leopoldo Fitzinger moved indigo snakes from genus *Coluber* into their own genus, *Drymarchon.* Over time twelve subspecies of *Drymarchon corais* came to be recognized and at the time of listing the eastern indigo snake was considered one among these twelve subspecies (*Drymarchon corais couperi* [43 FR 4026 4029]). In 1991, Collins elevated this lineage to specific status based on allopatry and diagnosibility. Subsequent taxonomic work based on morphology has supported the designation of *Drymarchon couperi* as a distinct species within the genus (Wuster et al. 2001). Currently, the eastern indigo snake (*Drymarchon couperi*) is accepted by the scientific community as one of three separate species in genus *Drymarchon*, (Crother 2000, ITIS 2016).

Life History

The eastern indigo snake is an apex predator among snakes, eating any vertebrate it can overpower, especially other snakes (Keegan 1944; Belson 2000; Ernst and Ernst 2003, Stevenson et al. 2010).

It is a generalized predator immune to the toxins of the venomous snakes it encounters and is only limited by its gape and ability to overpower its prey. Food items include fish, frogs, toads, snakes, lizards, turtles, turtle eggs, small alligators, birds, and small mammals (Keegan 1944; Babis 1949; Kochman 1978; Steiner et al. 1983).

In south-central Florida, indigo snake breeding extends from June to January, egg-laying occurs from April to July, and hatching occurs during mid-summer to early fall (Layne and Steiner 1996). Young hatch approximately 3 months after egg-laying and there is no evidence of parental care. Indigo snakes in captivity take 3 to 4 years to reach sexual maturity (Speake and Smith 1987). It is possible female indigo snakes can store sperm and delay fertilization of eggs for significant periods of time or are parthenogenetic (Carson 1945). Carson (1945) concluded that sperm storage and delayed fertilization were the most likely explanation for the fertile eggs produced by an indigo snake that he had kept in captivity for more than 4 years. However, there have been several recent reports pathogenesis in other snakes, so it is possible sperm storage may not explain Carson's (1945) example (Moler 1998). There is no information on indigo snake lifespan in the wild, although one captive individual survived 25 years, 11 months (Shaw 1959).

Habitat

Indigo snakes are active and spend a great deal of time foraging for food and searching for mates within their territories, with most activity occurring in the summer and fall (Speake and Smith 1987; Moler 1985a). Adult males have larger home ranges than adult females and juveniles; their home ranges average 554 acres (ac), reducing to 390 ac in the summer (Moler 1985b). In contrast, a gravid female may use from 3.5 to 106 ac (Speake and Smith 1987). In Florida, home ranges for females and males range from 5 to 371 ac and 4 to 805 ac, respectively (Smith and Dyer 2003). At Archbold Biological Station, the average home range size for females was determined to be 46 ac, and overlapping male home range size determined to be 184 ac (Layne and Steiner 1996).

Relative to other snake species, adult eastern indigo snakes have very large activity ranges and can move considerable distances in short periods of time (Service 2008). Habitat use varies seasonally between upland and wetland areas, especially in the more northern parts of the species' range. In southern parts of their range eastern indigo snakes are habitat generalists which utilize most available habitat types. Movements between habitat types in northern areas of their range may relate to the need for thermal refugia (protection from cold and/or heat).

In northern areas of their range indigo snakes prefer an interspersion of tortoise-inhabited sandhills and wetlands (Landers and Speake 1980). In these regions indigo snakes most often use forested areas rich with gopher tortoise burrows, hollowed root channels, hollow logs, or the burrows of rodents, armadillos, or land crabs as thermal refugia during cooler seasons (Lawler 1977; Moler 1985a; Layne and Steiner 1996). The eastern indigo snake in this region is typically classified as a longleaf pine savanna specialist because here, in the northern four-fifths of its range, the indigo snake is typically only found in vicinity of xeric longleaf pine–turkey oak sandhills inhabited by the gopher tortoise (Means 2006).

In the milder climates of central and southern Florida comprising the remaining one fifth of its range thermal refugia such as those provided by gopher tortoise burrows may not be as critical to survival of indigo snakes. Consequently, indigo snakes in these regions use a more diverse assemblage of habitats such as pine flatwoods, scrubby flatwoods, floodplain edges, sand ridges, dry glades, tropical hammocks, edges of freshwater marshes, muckland fields, coastal dunes, and xeric sandhill communities; with highest population concentrations of indigo snakes occurring in the sandhill and pineland regions of northern and central Florida (Service 1999). Indigo snakes have also been found in agricultural lands with close proximity to wetlands (Zeigler 2006).

In extreme south Florida (*i.e.*, the Everglades and Florida Keys), indigo snakes also utilize tropical hardwood hammocks, pine rocklands, freshwater marshes, abandoned agricultural land, coastal prairie, mangrove swamps, and human-altered habitats. Though eastern indigo snakes have been found in all available habitats of south Florida it is thought they prefer hammocks and pine forests since most observations occur there and use of these areas is disproportionate compared to the relatively small total area of these habitats (Steiner et al. 1983).

Distribution

Historically, the eastern indigo snake occurred throughout Florida and in the coastal plain of Georgia, Alabama, and Mississippi (Loding 1922, Haltom 1931, Carr 1940, Cook 1954, Diemer and Speake 1983, Lohoefener and Altig 1983, Moler 1985a). Most, if not all, of the remaining viable populations of the eastern indigo snake occur in Georgia and Florida (Service 2008).

Population Dynamics

Due to their use of subterranean refugia and frequent long-distance dispersal, detectability of eastern indigo snakes is low and estimates of mortality difficult (Hyslop et al. 2012). Consequently, the exact size and viability of the range wide population is unknown (Service 2008). However, there is no information indicating the range of eastern indigo snake has expanded or retracted, so it's presumed the population is stable.

Threats

Throughout the eastern indigo snake's range expanding urban areas are creating barriers to the dispersal of individuals and gene flow between populations, and habitat loss and degradation are a threat to the species (Lawler 1977, Moler 1985b). In northern areas of its range in Georgia and peninsular Florida the species is impacted by a decline in longleaf pine forests, gopher tortoises, and gopher tortoise habitat (Van Lear et al. 2005). In central and southern Florida the eastern indigo snake is less dependent on any one habitat type, but does avoid developed areas (Lawler 1977, Moler 1985a, Hyslop 2007). Throughout Florida developed areas are expanding rapidly with population growth at the expense of wildlife habitat (Cerulean 2008).

At the time of listing, other threats to the eastern indigo snake included commercial collection for the pet trade and mortality during the gassing of gopher tortoise burrows by individuals attempting to drive rattlesnakes out for collection (43 FR 4026 4029). Since their listing additional potential threats to the species have expanded to include disease, road mortality, kills of indigo snakes by land owners and pets, and ATV use in gopher tortoise habitat (Service 2008).

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STATUS OF THE SPECIES – red knot (*Calidris canutus rufa*)

Legal Status - *threatened*

The U.S. Fish and Wildlife Service (Service) listed the *rufa* subspecies of red knot (*Calidris canutus rufa*) as threatened under the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*) in the Federal Register on December 11, 2014 (Service 2014a). The reason for listing was due to loss of both breeding and nonbreeding habitat; likely effects related to disruption of natural predator cycles on the breeding grounds; reduced prey availability throughout the nonbreeding range; and increasing frequency and severity of asynchronies (mismatches) in the timing of the birds' annual migratory cycle relative to favorable food and weather conditions. Critical habitat has not been proposed or designated for the red knot at this time.

Species Description

Appearance/Morphology

The red knot is a medium-sized shorebird about 9 to 11 inches (in) (23 to 28 centimeters [cm]) in length. The red knot is easily recognized during the breeding season by its distinctive rufous (red) plumage (feathers). The face, prominent stripe above the eye, breast, and upper belly are a rich rufous-red to a brick or salmon red, sometimes with a few scattered light feathers mixed in. The feathers of the lower belly and under the tail are whitish with dark flecks. Upperparts are dark brown with white and rufous feather edges; outer primary feathers are dark brown to black (Davis 1983; Harrington 2001). Females are similar in color to males, though the rufous colors are typically less intense, with more buff or light gray on the dorsal (back) parts (Niles *et al.* 2008). Red knots have a proportionately small head, small eyes, short neck, and a black bill that tapers from a stout base to a relatively fine tip. The bill length is not much longer than head length. Legs are short and typically dark gray to black, but sometimes greenish in juveniles or older birds in nonbreeding plumage (Harrington 2001). Nonbreeding plumage is dusky gray above and whitish below. Juveniles resemble nonbreeding adults, but the feathers of the scapulars (shoulders) and wing coverts (small feathers covering base of larger feathers) are edged with white and have narrow, dark bands, giving the upperparts a scalloped appearance (Davis 1983).

Taxonomy

There are six recognized subspecies of red knots (*C. canutus*), and the Service accepts the characterization of *C.c. rufa* as a subspecies because each recognized subspecies is believed to occupy separate breeding areas, in addition to having distinctive morphological traits (*i.e.*, body size and plumage characteristics), migration routes, and annual cycles.

Life History

Breeding birds

Based on estimated survival rates for a stable population, few red knots live for more than about 7 years (Niles *et al.* 2008). Age of first breeding is uncertain, but for most birds it is at least 2 years (Harrington 2001). Red knots nest in the Canadian Arctic in dry, slightly elevated tundra locations, often on windswept slopes with little vegetation. Breeding territories are located inland, but near Arctic coasts, and foraging areas are located near nest sites in freshwater wetlands (Harrington 2001; Niles *et al.* 2008). Breeding occurs in June (Niles *et al.* 2008), and flocks of red knots sometimes arrive at breeding latitudes before snow-free habitat is available. Upon arrival or as soon as favorable conditions exist, male and female red knots occupy breeding habitat, and territorial displays begin (Harrington 2001). In red knots, pair bonds form soon after arrival on the breeding grounds and remain intact until shortly after the eggs hatch (Niles *et al.* 2008). Female red knots lay only one clutch (group of eggs) per season, and, as far as is known, do not lay a replacement clutch if the first is lost (Service 2014b). The usual clutch size is four eggs, though three-egg clutches have been recorded (Service 2014b). The incubation period lasts approximately 22 days from the last egg laid to the last egg hatched, and both sexes participate equally in egg incubation. Young are precocial, leaving the nest within 24 hours of hatching and forage for themselves (Niles *et al.* 2008; Service 2014b). No information is available regarding chick survival rates (Niles *et al.* 2008). Females are thought to leave the breeding grounds and start moving south soon after the chicks hatch in mid-July. Thereafter, parental care is provided solely by the males, but after about 25 days (around August 10) they also abandon the newly fledged juveniles and move south (Service 2014b). Not long after, they are followed by the juveniles (Niles *et al.* 2008).

Breeding success of High Arctic shorebirds such as red knots varies dramatically among years in a somewhat cyclical manner. Two main factors seem to be responsible for this annual variation: weather that affects nesting conditions and food availability, and predation rates which fluctuate annually. Production of shorebird young is sensitive to adverse weather during the breeding season. Red knot chicks grow poorly during cold weather due to higher rates of energy expenditure, shorter foraging periods, and reduced prey availability (Schekkerman *et al.* 2003; Piersma and Lindström 2004). Growth rate of red knot chicks is very high compared to similarly sized shorebirds nesting in more temperate climates and is strongly correlated with weather-induced and seasonal variation in availability of invertebrate prey (Schekkerman *et al.* 2003). Second, successful shorebird reproduction occurs almost exclusively during peak lemming (*Dicrostonyx torquatus* and *Lemmus sibericus*) years when snowmelt is early (Summers and Underhill 1987; Blomqvist *et al.* 2002; Piersma and Lindström 2004; Service 2014b). Arctic fox (*Alopex lagopus*) and snowy owl (*Nyctea scandiaca*) feed largely on lemmings, which are easily caught when their abundance is high. However, in years when lemming numbers are low, the predators turn to alternative prey, such as shorebird eggs, chicks, and adults. Lemming abundance is often cyclical, and the variation in shorebird production closely follows variations in lemming abundance due to their affected predation rates.

Nonbreeding birds

Little information is available about nonbreeding red knots. Unknown numbers of nonbreeding red knots remain south of the breeding grounds during the breeding season, and many, but not all, of these red knots are 1-year-old (*i.e.*, immature) birds (Niles *et al.* 2008). Nonbreeding red knots, usually individuals or small groups, have been reported during June along the U.S. Atlantic and Gulf coasts, with smaller numbers around the Great Lakes and Northern Plains in both the U.S. and Canada (eBird.org 2012). There is also little information on where juvenile red knots spend their winter months (Service and Conserve Wildlife Foundation of New Jersey 2012), and there may be at least partial segregation of juvenile and adult red knots on the wintering grounds. All juveniles of the Tierra del Fuego wintering region are thought to remain in the Southern Hemisphere during their first year of life, possibly moving to northern South America, but their distribution is largely unknown (Niles *et al.* 2008). Because there is a lack of specific information on juvenile red knots, the Service uses the best available data from adult red knots to draw conclusions about juvenile foraging and habitat use.

Migration

The red knot migrates annually between its breeding grounds in the Canadian Arctic and several wintering regions, including the Southeast U.S., the Northeast Gulf of Mexico, northern Brazil, and Tierra del Fuego at the southern tip of South America. Departure from the breeding grounds begins in mid-July and continues through August. Red knots tend to migrate in single-species flocks with departures typically occurring in the few hours before twilight on sunny days. Based on the duration and distance of migratory flight segments estimated from geolocator results, red knots are inferred to migrate during both day and night (Normandeau Associates, Inc. 2011). The size of departing flocks tends to be large (greater than 50 birds) (Niles *et al.* 2008), and females are thought to leave first followed by males and then juveniles (Harrington 2001; Niles *et al.* 2008).

Red knots make one of the longest distance migrations known in the animal kingdom, traveling up to 19,000 miles (mi) annually, and may undertake long flights that span thousands of miles without stopping. As red knots prepare to depart on long migratory flights, they undergo several physiological changes. Before takeoff, the birds accumulate and store large amounts of fat to fuel migration and undergo substantial changes in metabolic rates. In addition, leg muscles, gizzard (a muscular organ used for grinding food), stomach, intestines, and liver all decrease in size, while pectoral (chest) muscles and heart increase in size. Due to these physiological changes, red knots arriving from lengthy migrations are not able to feed maximally until their digestive systems regenerate, a process that may take several days. Because stopovers are time-constrained, red knots require stopovers rich in easily digested food to achieve adequate weight gain (Piersma *et al.* 1999; van Gils *et al.* 2005a, 2005b; Niles *et al.* 2008; Service 2014b) to fuel the next leg of their migratory flight and, upon arrival in the Arctic, to fuel the body transformation to breeding condition (Morrison 2006; Service 2014b). At each stopover during their southbound migration, the adults gradually replace their red breeding plumage with white and gray, but generally they do not molt their flight or tail feathers until they reach their wintering areas (Morrison and Harrington 1992; Niles *et al.* 2008).

During both the northbound (spring) and southbound (fall) migrations, red knots use key staging and stopover areas to rest and feed. Major spring stopover areas along the Atlantic coast include Río Gallegos, Península Valdés, and San Antonio Oeste (Patagonia, Argentina); Lagoa do Peixe (eastern Brazil, State of Rio Grande do Sul); Maranhão (northern Brazil); the Virginia barrier islands (U.S.); and Delaware Bay (Delaware and New Jersey, U.S.) (González 2005; Niles *et al.* 2008; Cohen *et al.* 2009; Service 2014b). Important fall stopover sites include southwest Hudson Bay (including the Nelson River delta), James Bay, the north shore of the St. Lawrence River, the Mingan Archipelago, and the Bay of Fundy in Canada; the coasts of Massachusetts and New Jersey and the mouth of the Altamaha River in Georgia, U.S.; the Caribbean (especially Puerto Rico and the Lesser Antilles); and the northern coast of South America from Brazil to Guyana (Spaans 1978; Morrison and Harrington 1992; Antas and Nascimento 1996; Niles *et al.* 2008; Schneider and Winn 2010; Niles *et al.* 2010; Niles 2012a; Newstead 2013). However, large and small groups of red knots, sometimes numbering in the thousands, may occur in suitable habitats all along the Atlantic and Gulf coasts from Argentina to Canada during migration (Niles *et al.* 2008).

Red knots are restricted to the ocean coasts during winter, and occur primarily along the coasts during migration. However, small numbers of red knots are reported annually during spring and fall migration across the interior U.S. (*i.e.*, greater than 25 mi from the Gulf or Atlantic coasts). Such reported sightings are concentrated along the Great Lakes, but multiple reports have been made from nearly every interior State (eBird.org 2012). For example, Texas red knots follow an inland flyway to and from the breeding grounds, using spring and fall stopovers along western Hudson Bay in Canada and in the northern Great Plains (Skagen *et al.* 1999; Newstead 2013). Some red knots wintering in the southeastern U.S. and the Caribbean migrate north along the U.S. Atlantic coast before flying over land to central Canada from the mid-Atlantic, while others migrate over land directly to the Arctic from the southeastern U.S. coast (Niles *et al.* 2012b). These eastern red knots typically make a short stop at James Bay in Canada, but may also stop briefly along the Great Lakes, perhaps in response to weather conditions (Morrison and Harrington 1992; Niles *et al.* 2008). Thus, red knots from different wintering areas appear to employ different migration strategies, including differences in timing, routes, and stopover areas. However, full segregation of migration strategies, routes, or stopover areas does not occur among red knots from different wintering areas.

Wintering

Red knots occupy all known wintering areas from December to February, but may be present in some wintering areas as early as September or as late as May. In the Southern Hemisphere, these months correspond to the austral summer (*i.e.*, summer in the Southern Hemisphere). Wintering areas for the red knot include the Atlantic coasts of Argentina and Chile (particularly the island of Tierra del Fuego that spans both countries), the north coast of Brazil (particularly in the State of Maranhão), the Northwest Gulf of Mexico from the Mexican State of Tamaulipas through Texas (particularly at Laguna Madre) to Louisiana, and the Southeast U.S. from Florida (particularly the central Gulf coast) to North Carolina (Niles *et al.* 2008; Newstead 2013). Smaller numbers of red knots winter in the Caribbean, and along the central Gulf coast (Alabama, Mississippi), the mid-Atlantic, and the Northeast U.S. Red knots are also known to winter in Central America and northwest South America, but it is not yet clear if those birds are the *rufa* subspecies. Little information exists on where juvenile red knots spend the winter months (Service and Conserve Wildlife Foundation of New Jersey 2012), and there may be at least partial segregation of juvenile and adult red knots on the wintering grounds.

Examples of red knots changing wintering regions do exist, but are few. Generally red knots are thought to return to the same wintering region each year. Re-sightings of marked birds indicate few or no inter-annual movements of red knots between the Brazil and Tierra del Fuego wintering areas, or between the Southeast and Tierra del Fuego wintering areas (Baker *et al.* 2005; Harrington 2005).

Foraging

The red knot is a specialized molluscivore, eating hard-shelled mollusks, sometimes supplemented with easily accessed softer invertebrate prey, such as shrimp- and crab-like organisms, marine worms, and horseshoe crab (*Limulus polyphemus*) eggs (Harrington 2001; Piersma and van Gils 2011; Service 2014b). Mollusk prey are swallowed whole and crushed in the gizzard (Piersma and van Gils 2011; Service 2014b). From studies of other subspecies, Zwarts and Blomert (1992) concluded that the red knot cannot ingest prey with a circumference greater than 1.2 in (30 millimeters). Foraging activity is largely dictated by tidal conditions, as the red knot rarely wades in water more than 0.8 to 1.2 in (2 to 3 cm) deep (Harrington 2001). Due to bill morphology, the red knot is limited to foraging on only shallow-buried prey, within the top 0.8 to 1.2 in (2 to 3 cm) of sediment (Zwarts and Blomert 1992; Gerasimov 2009).

On the breeding grounds, the red knot’s diet consists mostly of terrestrial invertebrates such as insects (Harrington 2001). In non-breeding habitats, the primary prey of the red knot include blue mussel (*Mytilus edulis*) spat (juveniles); *Donax* and *Darina* clams; snails (*Littorina spp*.), and other mollusks, with polycheate worms, insect larvae, and crustaceans also eaten in some locations. A prominent departure from typical prey items occurs each spring when red knots feed on the eggs of horseshoe crabs, particularly during the key migration stopover within the Delaware Bay of New Jersey and Delaware. Delaware Bay serves as the principal spring migration staging area for the red knot because of the availability of horseshoe crab eggs (Morrison and Harrington 1992; Harrington 1996; Harrington 2001; Clark *et al.* 2009; Service 2014b), which provide a superabundant source of easily digestible food.

Red knots and other shorebirds that are long-distance migrants, must take advantage of seasonally abundant food resources at intermediate stopovers to build up fat reserves for the next nonstop, long distance flight (Clark *et al.* 1993). Although foraging red knots can be found widely distributed in small numbers within suitable habitats during the migration period, birds tend to concentrate in those areas where abundant food resources are consistently available from year to year.

Habitat

Migration and wintering habitat

Long-distance migrant shorebirds are highly dependent on the continued existence of quality habitat at a few key staging areas. These areas serve as stepping stones between wintering and breeding areas. Habitats used by red knots in migration and wintering areas are generally coastal marine and estuarine habitats with large areas of exposed intertidal sediments. In many wintering and stopover areas, quality high-tide roosting habitat (*i.e.*, close to feeding areas, protected from predators, with sufficient space during the highest tides, free from excessive human disturbance) is limited. The supra-tidal (above the high tide) sandy habitats of inlets provide important areas for roosting, especially at higher tides when intertidal habitats are inundated (Harrington 2008). In some localized areas, red knots will use artificial habitats that mimic natural conditions, such as nourished beaches, dredged spoil sites, elevated road causeways, or impoundments; however, there is limited information regarding the frequency, regularity, timing, or significance of red knots' use of such artificial habitats.

In South American wintering areas, red knots are found in intertidal marine habitats, especially near coastal inlets, estuaries, and bays. Habitats include sandy beaches, mudflats, mangroves, saltwater and brackish lagoons, and "restinga" formations (an intertidal shelf of densely packed dirt blown by strong, offshore winds) (Harrington 2001; Niles *et al.* 2008). Red knots were recently observed using rice fields in French Guiana (Niles 2012) and in Trinidad (eBird.org 2012). In Suriname in the early 1970s, small numbers of red knots were observed on firm and tough clay banks emerging from the eroding coastline and in shallow lagoons, but knots were never found on soft tidal flats (Spaans 1978). Those observations suggest a deviation from the red knot's typical nonbreeding habitats.

In North America, red knots are commonly found along sandy, gravel, or cobble beaches, tidal mudflats, salt marshes, shallow coastal impoundments and lagoons, and peat banks (Harrington 2001; Truitt *et al.* 2001; Niles *et al.* 2008; Cohen *et al.* 2009; Cohen *et al.* 2010). In Massachusetts, red knots use sandy beaches and tidal mudflats during fall migration. In New York and the coast of New Jersey, red knots use sandy beaches during spring and fall migration (Niles *et al.* 2008). In Delaware Bay, red knots are found primarily on beaches of sand or peat at the mouths of tidal creeks, along the edge of tidal marshes dominated by salt marsh cordgrass (*Spartina alterniflora*) and saltmeadow cordgrass (*S. patens*), and in salt pannes (shallow, high salinity, mud-bottomed depressions on the marsh surface) and shallow coastal ponds or embayments (Burger *et al.* 1979; Meyer *et al.* 1999; Karpanty *et al.* 2006; Niles *et al.* 2008; Cohen *et al.* 2009). In the southeastern U.S., red knots forage along sandy beaches during spring and fall migration from Maryland through Florida. During migration, knots also use tidal mudflats in Maryland and along North Carolina's barrier islands. In addition to the sandy beaches, red knots forage along peat banks for mussel spat in Virginia and along small pockets of peat banks where the beach is eroding in Georgia (Niles *et al.* 2008). In Florida, red knots also use mangrove and brackish lagoons. Along the Texas coast, red knots forage on beaches, oyster reefs, and exposed bay bottoms and roost on high sand flats, reefs, and other sites protected from high tides. Red knots also show some fidelity to particular migration staging areas between years (Harrington 2001; Duerr *et al*. 2011).

Distribution

The red knot's range spans 40 states, 24 countries, and their administrative territories or regions extending from their breeding grounds in the Canadian Arctic to migration stopover areas along the Atlantic and Gulf coasts of North America, to wintering grounds throughout the southeastern U.S., the Gulf coast, and South America (reaching as far south as Tierra del Fuego at the southern tip of South America). In Delaware Bay and Tierra del Fuego, the era of modern surveys for the red knot and other shorebird species began in the early 1980s. Systematic red knot surveys of other areas began later, and for many portions of the red knot's range, available survey data are patchy. Prior to the 1980s, numerous natural history accounts are available, but provide mainly qualitative or localized population estimates. Nonetheless, a consistent narrative emerges across many historical accounts that red knots were extremely abundant in the early 1800s, decreased sharply starting in the mid-1800s, and may have begun to recover by the mid-1900s. Most writers agree the cause of that historical decline was intensive sport and market hunting. It is unclear whether the red knot population fully recovered its historical numbers (Harrington 2001) following the period of unregulated hunting.

The current geographic distribution of the red knot has not changed relative to that recorded in historical writings with the notable exception of Delaware Bay (discussed in detail below). Several early writers reported that red knots breed in the Arctic and winter along the U.S. Gulf coast and in South America including Brazil and Tierra del Fuego (Audubon 1844; Mackay

1893; Shriner 1897; Eaton 1910; Forbush 1912; Ridgway 1919; Bent 1927; Hellmayr and Conover 1948; Lowery 1974). Bent (1927) included Jamaica and Barbados as part of the possible wintering range of red knots, and described knots as "rarely" wintering in parts of Louisiana and Florida. Hellmayr and Conover (1948) noted the use of the West Indies (Jamaica, Barbados, and Trinidad) during migration. Several writers described the red knot as occurring primarily along the coasts with relatively few sightings inland, but interior migration routes through the central U.S. were also known (Audubon 1844; Eaton 1910; Forbush 1912; Ridgway 1919; Bent 1927; Hellmayr and Conover 1948; Lowery 1974). As with the geographic distribution, a number of historical accounts suggest that the timing of the red knot's spring and fall migrations along the Atlantic coast was generally the same in the past as it is today (Wilson 1829; Giraud 1844; Roosevelt 1866; Stearns and Coues 1883; Mackay 1893; Dixon 1895 in Barnes and Truitt 1997; Shriner 1897; Forbush 1912; Bent 1927; Stone 1937; Urner and Storer 1949; Myers and Myers 1979).

Although the large-scale geographic distribution of migration stopover habitats does not seem to have changed, some authors have noted regional changes in the patterns of red knot stopover habitat usage along the U.S. Atlantic coast. For example, based on a review of early literature, Cohen *et al.* (2008) suggest that red knots had a more extensive spring stopover range a century ago than now, with thousands of birds noted in Massachusetts, New York, New Jersey, and Virginia during the spring. Harrington *et al.* (2010a) found changes in the regional patterns of stopover habitat usage in Massachusetts, as well as a shift in the wintering destination of birds stopping in Massachusetts during fall migration.

<u>Delaware Bay</u>

Delaware Bay was not recognized as a major shorebird stopover area until the early 1980s, despite detailed shorebird studies (*e.g.*, Stone 1937; Urner and Storer 1949) in the South Jersey region (Clark *et al.* 1993; Clark in Farrell and Martin 1997; Botton *et al.* in Shuster *et al.* 2003; Clark *et al.* 2009). There were some early anecdotal reports involving horseshoe crabs, as summarized by Botton *et al.* (in Shuster *et al.* 2003). Wilson (1829) noted ruddy turnstones in the bay fed "almost wholly on the eggs, or spawn, of the great king crab," but no similar accounts were made of red knots. Forbush (1912) noted red knots "are fond of the spawn of the horsefoot crab, which, often in company with the Turnstone, they dig out of the sand…" Stone (1937) observed ruddy turnstones and black-bellied plovers regularly feeding on dead horseshoe crabs in Delaware Bay. Stone (1937) also mentions flights of ruddy turnstones across the Cape May Peninsula in the spring, as happens today when they go to roost at night along the Atlantic coastal marshes (Botton *et al.* in Shuster *et al.* 2003). Interestingly, no mention of horseshoe crab eggs as food is found in Stone's (1937) accounts of any shorebird in the Cape May area, or in the decade-long study by Urner and Storer (1949) and Botton *et al.* in Shuster *et al.* (2003). During his early studies of horseshoe crabs in 1951, Shuster observed many shorebirds feeding along Delaware Bay beaches, including red knots. However, another 30 years elapsed before scientists began to study the shorebird/horseshoe crab relationship in detail, and documented the very large numbers of shorebirds using the bay as a stopover (Botton *et al.* in Shuster *et al.* 2003). Lack of earlier scientific documentation cannot be attributed to remoteness. Delaware Bay is located within a few hours' drive of millions of people, and university marine laboratories were established many years ago on both shores of the bay (Botton *et al.* in Shuster *et al.* 2003).

It is unclear if the large magnitude of the shorebird-horseshoe crab phenomenon was simply missed by science until 1981, or if the distribution of the red knot and other shorebird species changed over the period of the historical record. For much of the 20th century, this phenomenon in Delaware Bay may have been much reduced (relative to 1980s levels), and therefore, easier to miss, due to the occurrence of low points in the abundance of both shorebirds (caused by hunting) and horseshoe crabs (caused by intensive harvest) (Clark in Farrell and Martin 1997; Botton *et al.* in Shuster *et al.* 2003). Alternatively, it may be that the red knot did not make extensive use of Delaware Bay prior to its population decline a century ago. Under this scenario, red knots came to rely on Delaware Bay because their populations were recovering at the same time that Atlantic-side stopover habitats in the region were becoming developed and the shorelines stabilized (Cohen *et al.* 2008). We have no means to determine how long shorebirds have been reliant on horseshoe crab eggs in Delaware Bay (Botton *et al.* in Shuster *et al.* 2003) prior to the early 1980s.

Population Dynamics

Localized and regional red knot surveys have been conducted across the subspecies' range with widely differing levels of geographic, temporal, and methodological consistency. Population surveys are available in the November 2014 Rufa Red Knot Background Information and Threats Assessment (Supplemental Document), located at www.regulations.gov under Docket Number FWS-R5-ES-2013-0097. Some general characterizations of the available data are noted as follows:

1. No population information exists for the breeding range because, in breeding habitats, red knots are thinly distributed across a huge and remote area of the Arctic. Despite some localized survey efforts, (*e.g.*, Niles *et al.* 2008; Bart and Johnston 2012), there are no regional or comprehensive estimates of breeding abundance, density, or productivity (Niles *et al.* 2008).
2. Few regular surveys are conducted in the fall because southbound red knots tend to be less concentrated than during winter or spring.
3. Some survey data are available for most wintering and spring stopover areas. For some areas, long-term data sets have been compiled using consistent survey methodology. Because there can be considerable annual fluctuations in red knot counts, longer-term trends are more meaningful. At several key sites, the best available data show that numbers of red knots declined and remain low relative to counts from the 1980s, although the rate of decline appears to have leveled off since the late 2000s.

4. Inferring long-term population trends from various national or regional datasets derived from volunteer shorebird surveys and other sources, Morrison *et al.* (2006) and Andres (2009) concluded that red knot numbers declined, probably sharply, in recent decades.

Wintering areas

Counts in wintering areas are particularly useful in estimating red knot populations and trends because the birds generally remain within a given wintering area for a longer period of time compared to the areas used during migration. This eliminates errors associated with turnover or double-counting that can occur during migration counts.

<u>North American Atlantic coast</u>

Small numbers of wintering red knots have been reported from Maryland, U.S., to Nova Scotia, Canada (BandedBirds.org 2012; Burger *et al.* 2012; eBird.org 2012), but no systematic winter surveys have been conducted in these northern areas. In surveys of five sites within North Carolina's Outer Banks in 1992 and 1993, Dinsmore *et al.* (1998) found over 500 red knots per year.

<u>Southeastern U.S. and Caribbean</u>

Extensive data for Florida are available from the International Shorebird Survey and other sources. However, geographic coverage has been inconsistent, ranging from 1 to 29 sites per year from 1974 to 2004. Statewide annual totals ranged from 5 knots (1 site in 1976) to 7,764 knots (7 sites in 1979). The greatest geographic coverage occurred in 1993 (4,265 knots at 25 sites) and 1994 (5,018 knots at 29 sites) (Niles *et al.* 2008). Harrington *et al.* (1988) reported that the mean count of birds wintering in Florida was 6,300 birds (± 3,400, one standard deviation) based on four aerial surveys conducted from October to January in 1980 to 1982. These surveys covered the Florida Gulf coast from Dunedin to Sanibel-Captiva, sometimes going as far south as Cape Sable. Based on those surveys and other work, the Southeast wintering group was estimated at roughly 10,000 birds in the 1970s and 1980s (Harrington 2005).

Sprandel *et al.* (1997) identified the top 60 sites for wintering shorebirds in Florida and surveyed those areas in 1994. Red knots were found at 27 sites, mainly on the central Gulf coast. Adding the average number of birds counted at each site, these authors estimated a statewide total of 1,452 red knots across 3 sites in the Florida Panhandle, 18 sites in southwest Florida, 4 sites in the Everglades, and 2 sites in Northeast Florida (Sprandel *et al.* 1997). During frequent surveys of nine sites along approximately 55 mi of the central Florida Panhandle, Smith (2010) found a mean of about 84 wintering red knots in the winter of 2007. Smith (2010) covered roughly 25 percent of the Panhandle region as delineated by Sprandel *et al.* (1997), with the survey sites clustered on the eastern end of that region.

Niles (2009) conducted winter aerial and ground counts along Florida's Gulf coast from 2006 to 2010, covering essentially the same area in which Harrington *et al.* (1988) had reported an average of 6,300 red knots (± 3,400) in the winters of 1980 to 1982. As the more recent aerial counts were lower, red knot numbers may have decreased in western Florida, perhaps due to birds shifting elsewhere within the larger Southeast wintering region (Harrington 2005). However, a comparison of the geographic coverage of Sprandel *et al.* (1997) with Niles (2009) suggests red knot numbers did not change much from 1994 to 2010.

Based on re-sightings of birds banded in South Carolina and Georgia from 1999 to 2002, the Southeast wintering population was estimated at 11,700 ± 1,000 (one standard error) red knots. Although there appears to have been a gradual shift by some of the southeastern knots from the Florida Gulf coast to the Atlantic coasts of Georgia and South Carolina, population estimates for the Southeast region in the 2000s were at about the same level as during the 1980s (Harrington 2005). Based on recent modeling using re-sightings of marked birds staging in Georgia in fall, as well as other evidence, the Southeast wintering group may number as high as 20,000, but field survey data are not available to corroborate this estimate.

Two recent winter estimates are available for the central Gulf of Mexico coast. During the International Piping Plover Census in 2006 and 2011, 250 to 500 knots were counted from Alabama to Louisiana. From work related to the Deepwater Horizon oil spill, an estimated 900 red knots were reported from the Florida Panhandle to Mississippi. Older surveys recorded similar numbers from the central Gulf coast, with peak counts of 752 red knots in Alabama (1971) and 40 knots in Mississippi (1979) (Morrison and Harrington 1992). Numbers of red knots wintering in the Caribbean are essentially unknown, but in the course of piping plover surveys in February 2011 in the Bahamas, 70 red knots were observed on the Joulters Cays just north of Andros Island, and 7 red knots were observed on the Berry Islands. In December 2012 (*i.e.,* winter 2013), 52 red knots were observed in the Green Turtle Cay flats in Abaco, Bahamas. Roughly 50 red knots occur annually on Green Turtle Cay (eBird.org 2012).

<u>Northwest Gulf of Mexico</u>

Except for localized areas, there have been no long-term systematic surveys of red knots in Texas or Louisiana, and no information is available about the number of red knots that winter in northeastern Mexico. From survey work in the 1970s, Morrison and Harrington (1992) reported peak winter counts of 120 red knots in Louisiana and 1,440 in Texas, although numbers in Texas between December and February were typically in the range of 100 to 300 birds. Records compiled by Skagen *et al.* (1999) give peak counts of 2,838 and 2,500 red knots along the coasts of Texas and Louisiana, respectively, between January and June over the period 1980 to 1996, but these figures could include spring migrants. Morrison *et al.* (2006) estimated only about 300 red knots wintering along the Texas coast, based on surveys in January 2003 (Niles *et al.* 2008).

Higher counts of roughly 700 to 2,500 red knots have recently been made on Padre Island, Texas, during October, which could include wintering birds (Niles 2009; Newstead 2013).

Foster *et al.* (2009) found a mean daily abundance of 61.8 red knots on Mustang Island, Texas, based on surveys every other day from 1979 to 2007. Similar winter counts were reported by Dey *et al.* (2011a) for Mustang Island from 2005 to 2011. From 1979 to 2007, mean abundance of red knots on Mustang Island decreased 54 percent, but this may have been a localized response to increasing human disturbance, coastal development, and changing beach management practices (Foster *et al.* 2009; Newstead 2013).

There are no current estimates for the size of the Northwest Gulf of Mexico wintering group as a whole (Mexico to Louisiana). The best available current estimates for portions of this wintering region are about 2,000 in Texas (Niles 2012) or approximately 3,000 in Texas and Louisiana, with about half in each State and movement between them.

Spring stopover areas

Records of migrating red knots have been collected at many sites along the Atlantic coast. Not all migration areas are well surveyed, and considerable turnover of individuals occurs as birds migrate through an area. Consequently, using counts of migrating red knots as a basis for population estimates may lead to inaccuracies due to errors associated with turnover or double-counting. However, long-term counts made at a specific location are good indicators of usage trends for that area and, considered together, may reflect trends in the overall population of the red knot.

Virginia

Aerial surveys of the entire chain of barrier island beaches in Virginia have been conducted since 1995 using consistent methods and observers. Although the number of surveys has varied from one to six per year, the aerial survey effort has consistently covered the peak period during the last week of May. Since 2007, Karpenty *et al.* (2012) have estimated total red knots based on ground counts at 100 to 150 randomly selected points throughout Virginia's barrier island beaches including peat banks, with each location visited from one to three times per stopover season. Although the recent ground surveys show an upward trend, the aerial counts have been relatively steady since the mid-1990s. Because of differences in methodology and timing, the two data sets are not comparable.

Delaware Bay

Aerial surveys have been conducted in Delaware Bay since 1981. Methods and observers were consistent from 1986 to 2008. The methodology during this period involved weekly counts; thus, it was possible the absolute peak number of birds was missed in some years. However, since most shorebirds remain in Delaware Bay at least a week, it is likely the true peak was captured in most years (Clark *et al.* 1993). The surveys covered consistent areas of New Jersey and Delaware from the first week of May to the second week of June. All flights were conducted 3 to 4 hours after high tide, a period when birds are usually feeding on the beaches (Clark *et al.* 2009).

Methodologies and observers changed several times from 2009 to 2012. Flights are now flown only during the end of May. In addition, aerial counts for 2010 and 2011 were adjusted with ground counts from Mispillion Harbor, Delaware, to more accurately reflect large concentrations of birds at this key site (Dey *et al.* 2011a). Further, problems in 2009 and 2012 prevented accurate aerial counts, and ground counts have been substituted. Caution should be used in comparing ground and aerial counts (Laursen *et al.* 2008); differences between the two methods may account for markedly higher counts in 2009 and 2012. Although aerial counts had typically been higher than ground counts prior to 2009, this was likely because many areas that could be surveyed by air were inaccessible on the ground. Since 2009, ground survey crews have attempted to minimize the access problem by using boats in remote areas.

As with other stopover areas, it is impossible to separate population-wide trends from trends in usage of a particular spring site. Because birds pass in and out of a stopover area, the peak count for a particular year is lower than the total passage population. Thus, differences in the number of birds in Delaware Bay may reflect stopover patterns rather than (or in addition to) trends in the overall red knot population (Clark *et al.* 1993). Using re-sightings of marked birds, several attempts have been made to estimate the total passage population of Delaware Bay through mathematical modeling. However, the pattern and timing of these declines in Delaware Bay relative to Tierra del Fuego and other stopovers is suggestive of a decrease in the overall population. Comparing four different time periods, average red knot counts in Delaware Bay declined by approximately 70 percent from 1981 to 2012.

<u>Other areas along the U.S. Atlantic coast</u>

Beginning in 2006, coordinated red knot surveys have been conducted from Florida to Delaware Bay during two consecutive days from May 20 to 24. This period is thought to represent the peak of the red knot migration. There has been variability in methods, observers and areas covered. From 2006 to 2010, there was no change in counts that could not be attributed to varying geographic survey coverage (Dey *et al.* 2011a); thus, we do not consider any apparent trends in these data before 2010. Because red knot numbers peak earlier in the Southeast than in the mid-Atlantic, the late-May coast-wide survey data likely reflect the movement of some birds north along the coast, and may miss other birds that depart for Canada from the Southeast along an interior (overland) route prior to the survey window. Thus, greater numbers of red knots may utilize southeastern stopovers than suggested by the data.

Fall stopover areas

Fall peak counts from International Shorebird Survey sites along the U.S. Atlantic coast ranged from 6,000 to 9,000 red knots during the mid- to late-1970s (Morrison and Harrington 1992). In a review of numbers and distribution of red knots on the Massachusetts coast during southward migration, Harrington *et al.* (2010a) found overall red knot numbers increased from the late 1940s to the early 1970s, especially on the mainland (western Cape Cod Bay), with a smaller increase on outer Cape Cod. After 1975, counts declined significantly on the mainland, but increased significantly on outer Cape Cod (Harrington *et al.* 2010b). Evidence suggests both the mainland and the Cape Cod areas were historically used by red knots having Argentina-Chile destinations, but recently the Cape Cod locations have increasingly been used by red knots with wintering destinations in the Southeast U.S., thus, balancing out the declining numbers of red knots with Argentina-Chile wintering destinations (Harrington *et al.* 2010b). By 2008, peak counts of Argentina-Chile red knots in Massachusetts had fallen to about 1,000 birds, while birds from the Southeast group increased to about 800 (Harrington *et al.* 2010a).

No regular counts are currently conducted in Massachusetts, but flocks of over 100 knots are routinely reported from Monomoy National Wildlife Refuge (eBird.org 2012). About 1,500 red knots were present in Avalon on the coast of New Jersey in the fall of 2011 (Service 2011a). Also, on the coast of New Jersey, hundreds of red knots are regularly reported from North Brigantine and Stone Harbor, sometimes in flocks of over 500 (eBird.org 2012). Islands at the mouth of the Altamaha River, Georgia, support the only known late summer and fall staging site on the east coast of the U.S., attracting as many as 12,000 knots at one time (Schneider and Winn 2010).

Summary

After a careful review of available survey data from areas regularly used by substantial numbers of red knots in spring, fall, and winter, the Service has determined:

1. For some areas, available data are insufficient to substantiate any conclusions regarding population trends over time;
2. For other areas, there are apparent trends, but they are associated with relatively low confidence; and
3. For a few key areas, the consistency of geographic coverage, methodologies, and surveyors lead us to greater confidence in apparent trends. Those population data are summarized as follows:
    a. Northwest Gulf of Mexico wintering region: There are insufficient data for trend analysis;
    b. Southeast wintering region: There is an apparent decline on Florida's Gulf coast when comparing aerial surveys from 1980 to 1982, with similar surveys (using different surveyors) of approximately the same area from 2006 to 2010, which are associated with lower confidence because birds may have simply shifted elsewhere

within this large wintering region. The two region-wide survey efforts to date (from the 2006 and 2011 piping plover surveys) are associated with lower confidence inherent in the methodology (red knots are not the focus of this survey), but do tend to support the perception that knots shift from state to state within this region among years. A long-term data set from Georgia, showing wide inter-annual fluctuations, also supports this perception. Data from the Caribbean are insufficient to infer any trends. Comparing ground surveys of Florida's Gulf coast in 1994 to aerial surveys of about this same area from 2006 to 2010, red knot counts were roughly the same over this time period;

c. Virginia barrier islands spring stopover area: There is no apparent trend based on aerial surveys since 1995, which is associated with high confidence. A newer data set based on ground surveys suggests an increase since 2007;
d. Delaware Bay spring stopover area: There is a highly variable data set showing possible declines in the 1990s, and more consistent and substantial declines through the mid-2000s, which are associated with high confidence during the core years of 1986 to 2008. Numbers may have stabilized from 2009 to 2012, but we have lower confidence in trends over this later period due to multiple shifts in methodology and surveyors;
e. Atlantic coast spring window survey: There is an apparent increase from 2010 to 2012, but it is associated with lower confidence because, despite improvements, methodology and geographic coverage are still stabilizing and because only 3 years of (relatively consistent) data are available; and
f. Fall stopover areas: There are insufficient data for trend analysis in most areas. Since the 1970s, there were probable declines in some parts of eastern Canada and changes in red knot usage of Massachusetts (mainland versus Cape Cod, proportion of birds bound for Southeast versus Argentina-Chile wintering destinations).

Threats

In this section, we provide an analysis of threats to red knots and their habitat in their migration and wintering range, with some specific references to their breeding range. Because we lack information on threats to red knots for many countries outside the U.S. (with a few exceptions), this analysis is mainly focused on threats to red knots within the continental U.S. portion of their migration and wintering range, unless otherwise noted.

Aquaculture and agriculture

In some localized areas within the red knot's range, aquaculture or agricultural activities are impacting habitat quality and quantity. Those impacts, however, occur mainly in Canada, Brazil, Río Gallegos (southern Argentina), and Bahía Lomas (Chilean Tierra del Fuego). In the U.S., Luckenbach (2007) found aquaculture of clams (*Mercenaria mercenaria*) in the lower Chesapeake Bay occurs in close proximity to shorebird foraging areas. The current distribution of clam aquaculture in the very low intertidal zone minimizes the amount of direct overlap with shorebird foraging habitats, but if clam aquaculture expands farther into the intertidal zone, more shorebird impacts (*e.g.*, habitat alteration) may occur. However, these Chesapeake Bay intertidal zones are not considered the primary habitat for red knots (Cohen *et al.* 2009), and red knots were not among the shorebirds observed in this study (Luckenbach 2007). Likewise, oyster aquaculture is practiced in Delaware Bay (New Jersey Department of Environmental Protection [NJDEP] 2011), but we have no information to indicate that this activity is affecting red knots.

Asynchronies ("mismatches") in the red knot's annual cycle

The red knot's life history strategy makes this species inherently vulnerable to mismatches in timing between its annual cycle and those periods of optimal food and weather conditions upon which it depends. For unknown reasons, more red knots arrived late in Delaware Bay in the early 2000s, which is generally accepted as a key causative factor (along with reduced supplies of horseshoe crab eggs) behind red knot population declines that were observed over this same timeframe. Thus, the red knot's sensitivity to timing asynchronies has been demonstrated through a population-level response. Both adequate supplies of horseshoe crab eggs and high-quality foraging habitat in Delaware Bay, can serve to partially mitigate minor asynchronies at this key stopover site. However, the factors that caused delays in the spring migrations of red knots from Argentina and Chile are still unknown, and we have no information to indicate if this delay will reverse, persist, or intensify.

Superimposed on this existing threat of late arrivals in Delaware Bay are new threats of asynchronies emerging due to climate change. Climate change is likely to affect the reproductive timing of horseshoe crabs in Delaware Bay, mollusk prey species at other stopover sites, or both, possibly pushing the peak seasonal availability of food outside of the windows when red knots rely on them. In addition, both field studies and modeling have shown strong links between the red knot's reproductive output and conditions in the Arctic including insect abundance and snow cover. Climate change may also cause shifts in the period of optimal Arctic conditions relative to the time period when red knots currently breed.

The red knots' adaptive capacity to deal with numerous changes in the timing of resource availability across its geographic range is largely unknown. A few examples suggest some flexibility in migration strategies. However, available information suggests that the timing of the red knot's annual cycle is controlled at least partly by celestial and endogenous cues, while the reproductive seasons of prey species, including horseshoe crabs and mollusks, are largely driven by environmental cues such as water temperature. These differences between the timing cues of red knots and their prey suggest limitations on the adaptive capacity of red knots to deal with numerous changes in the timing of resource availability across their geographic range. Based on the combination of documented past impacts and a spectrum of ongoing and emerging threats, we conclude that asynchronies (mismatches between the timing of the red knot's annual cycles and the periods of favorable food and weather upon which it depends) are likely to cause deleterious subspecies-level effects.

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 U.S. 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.

The natural history of Arctic-breeding shorebirds makes this group of species particularly vulnerable to global climate change (*e.g.*, Lindström and Agrell 1999; Piersma and Baker 2000; Zöckler and Lysenko 2000; Rehfisch and Crick 2003; Piersma and Lindström 2004; Meltofte *et al.* 2007). Relatively low genetic diversity, which is thought to be a consequence of survival through past climate-driven population bottlenecks, may put shorebirds at more risk from human-induced climate variation than other avian taxa (Meltofte *et al.* 2007); low genetic diversity may result in reduced adaptive capacity as well as increased risks when population sizes drop to low levels.

In the short term, red knots may benefit if warmer temperatures result in fewer years of delayed horseshoe crab spawning in Delaware Bay (Smith and Michaels 2006) or fewer occurrences of late snow melt in the breeding grounds (Meltofte *et al.* 2007). However, there are indications that changes in the abundance and quality of red knot prey are already under way (Jones *et al.* 2010; Escudero *et al.* 2012), and prey species face ongoing climate-related threats from warmer temperatures (Philippart *et al.* 2003; Rehfisch and Crick 2003; Fabry *et al.* 2008; Jones *et al.*

2010), ocean acidification (National Research Council (NRC) 2010), and possibly increased prevalence of disease and parasites (Ward and Lafferty 2004). In addition, red knots face imminent threats from loss of habitat caused by sea level rise (Titus 1990; Galbraith *et al.* 2002; NRC 2010), and increasing asynchronies (''mismatches'') between the timing of their annual breeding, migration, and wintering cycles and the windows of peak food availability on which the birds depend (Baker *et al.* 2004; van Gils *et al.* 2005a; Meltofte *et al.* 2007; McGowan *et al.* 2011; Smith *et al.* 2011).

Several threats are related to the possibility of changing storm patterns. While variation in weather is a natural occurrence and is normally not considered a threat to the survival of a species, persistent changes in the frequency, intensity, or timing of storms at key locations where red knots congregate (*e.g.,* key stopover areas) can pose a threat. Storms impact migratory shorebirds like the red knot both directly and indirectly. Direct impacts include energetic costs from a longer migration route as birds avoid storms, blowing birds off course, and outright mortality (Niles *et al.* 2010). Indirect impacts include changes to habitat suitability, storm-induced asynchronies between migration stopover periods and the times of peak prey availability, and possible prompting of birds to take refuge in areas where shorebird hunting is still practiced (Dey *et al.* 2011b; Nebel 2011; Niles *et al.* 2012b).

With Arctic warming, vegetation conditions in the red knot's breeding grounds are expected to change, causing the zone of nesting habitat to shift and perhaps contract, but this process may take decades to unfold (Kaplan *et al.* 2003; Meltofte *et al.* 2007; Feng *et al.* 2012). That said; ecological shifts (*e.g.,* changes in predation patterns and pressures) in the Arctic may appear sooner than predicted. High uncertainty exists about when and how changing interactions among vegetation, predators, competitors, prey, parasites, and pathogens may affect the red knot, but the impacts are potentially profound (Ims and Fuglei 2005; Meltofte *et al.* 2007; Schmidt *et al.* 2012; Fraser *et al.* 2013).

Due to background rates of sea level rise and the naturally dynamic nature of coastal habitats, we conclude that red knots are adapted to moderate (although sometimes abrupt) rates of habitat change in their wintering and migration areas. However, rates of sea level rise are accelerating beyond those that have occurred over recent millennia. In most of the red knot's nonbreeding range, shorelines are expected to undergo dramatic reconfigurations over the next century as a result of accelerating sea level rise. Extensive areas of marsh are likely to become inundated, which may reduce foraging and roosting habitats. Marshes may be able to establish farther inland, but the rate of new marsh formation (*e.g.*, intertidal sediment accumulation, development of hydric soils, colonization of marsh vegetation) may be slower than the rate of deterioration of existing marsh, particularly under higher sea level rise scenarios. The primary red knot foraging habitats (*i.e.*, intertidal flats and sandy beaches) will likely be locally or regionally inundated, but replacement habitats are likely to reform along the shoreline in its new position. However, if shorelines experience a decades-long period of high instability and landward migration, the formation rate of new beach habitats may be slower than the inundation rate of existing habitats.

In addition, low-lying and narrow islands (*e.g.,* in the Caribbean and along the Gulf and Atlantic coasts) may disintegrate rather than migrate, representing a net loss of red knot habitat. Superimposed on these changes are widespread human attempts to stabilize the shoreline, which are known to exacerbate losses of intertidal habitats by blocking their landward migration. The cumulative loss of habitat across the nonbreeding range could affect the ability of red knots to complete their annual cycles, possibly affecting fitness and survival, and is thereby likely to negatively influence the long-term survival of the red knot.

In summary, climate change is expected to affect red knot fitness and, therefore, survival through direct and indirect effects on breeding and nonbreeding habitat, food availability, and timing of the birds' annual cycle. Ecosystem changes in the Arctic (*e.g.*, changes in predation patterns and pressures) may also reduce reproductive output. Together, these anticipated changes will likely negatively influence the long-term survival of the red knot.

Disease

Red knots are exposed to parasites and disease throughout their annual cycle. Susceptibility to disease may be higher when the energy demands of migration have weakened the immune system. Studying red knots in Delaware Bay in 2007, Buehler *et al.* (2010) found several indices of immune function were lower in birds recovering protein after migration than in birds storing fat to fuel the next leg of the migration. These authors hypothesized fueling birds may have an increased rate of infection or may be bolstering immune defense, or recovering birds may be immuno-compromised because of the physical strain of migratory flight or as a result of adaptive energy tradeoffs between immune function and migration, or both (Buehler *et al.* 2010). A number of known parasites (*e.g.,* sporozoans, hookworms, flatworms, and ectoparasites) and viruses (*e.g.,* avian influenza and avian paramyxovirus) have been documented in red knots, but we have no evidence disease is a current threat to the red knot.

Environmental contaminants

Although red knots are exposed to a variety of contaminants across their nonbreeding range, we have no evidence that such exposure is impacting health, survival, or reproduction at the subspecies level. Exposure risks exist in localized red knot habitats in Canada, but best available data suggest shorebirds in Canada are not impacted by background levels of contamination. Levels of most metals in red knot feathers from the Delaware Bay have been somewhat high, but generally similar to levels reported from other studies of shorebirds. One preliminary study suggests organochlorines and trace metals are not elevated in Delaware Bay shorebirds, although this finding cannot be confirmed without updated testing. Levels of metals in horseshoe crabs are generally low in the Delaware Bay region and not likely impacting red knots or recovery of the crab population.

Horseshoe crab reproduction does not appear impacted by the mosquito control chemical methoprene (at least through the first juvenile molt) or by ambient water quality in mid-Atlantic estuaries. Shorebirds have been impacted by pesticide exposure, but use of the specific chemical that caused a piping plover death in Florida has subsequently been banned in the U.S. Exposure of shorebirds to agricultural pollutants in rice fields may occur regionally in parts of South America, but red knot usage of rice field habitats was low in the several countries surveyed. Finally, localized urban pollution has been shown to impact South American red knot habitats, but we are unaware of any documented health effects or population-level impacts. Thus, we conclude that environmental contaminants are not a threat to the red knot.

Hard structures

Hard shoreline stabilization projects are typically designed to protect property (and its human inhabitants) not beaches (Pilkey and Howard 1981; Kana 2011). Structural development along the shoreline and manipulation of natural inlets upset the naturally dynamic coastal processes and result in loss or degradation of beach habitat (Melvin *et al.* 1991). As beaches narrow, the reduced habitat can directly lower the diversity and abundance of biota (life forms), especially in the upper intertidal zone. Shorebirds may be impacted both by reduced habitat area for roosting and foraging, and by declining intertidal prey resources, as has been documented in California (Dugan and Hubbard 2006; Defeo *et al.* 2009).

In Delaware Bay, hard structures also cause or accelerate loss of horseshoe crab spawning habitat (Botton *et al.* 1988; Botton *et al.* in Shuster *et al.* 2003; CCSP 2009), and shorebird habitat may continue to be lost where bulkheads have been built (Clark in Farrell and Martin 1997). In addition to directly eliminating red knot habitat, hard structures interfere with the creation of new shorebird habitats by interrupting the natural processes of over-wash and inlet formation. Where hard stabilization is installed, the eventual loss of the beach and its associated habitats is virtually assured (Rice 2009) in the absence of beach nourishment, and therefore, may impact red knots as discussed below. Where they are maintained, hard structures are likely to significantly increase the amount of red knot habitat lost as sea levels continue to rise.

In a few isolated locations, however, hard structures may enhance red knot habitat, or may provide artificial habitat. In Delaware Bay, for example, Botton *et al.* (1994) found creek mouths, jetties, and other artificial obstructions can act to concentrate drifting horseshoe crab eggs and thereby attract shorebirds. Another example comes from the Delaware side of the bay, where a seawall and jetty at Mispillion Harbor protect the confluence of the Mispillion River and Cedar Creek. These structures create a low energy environment in the harbor, which seems to provide highly suitable conditions for horseshoe crab spawning over a wider variation of weather and sea conditions than anywhere else in the bay. Horseshoe crab egg densities at Mispillion Harbor are consistently an order of magnitude higher than at other bay beaches (Dey *et al.* 2011a), and this site consistently supports upwards of 15 to 20 percent of all red knots recorded in Delaware Bay (Lathrop 2005). In Florida, red knots have been observed on multiple instances using artificial structures such as docks, piers, jetties, causeways, and construction barriers. The Service does not have any information regarding the frequency, regularity, timing, or significance of this use of artificial habitats.

Harmful algal blooms

A harmful algal bloom (HAB) is the proliferation of a toxic or nuisance algal species (which can be microscopic or macroscopic, such as seaweed) that negatively affects natural resources or humans (Florida Fish and Wildlife Conservation Commission [FWC] 2011). For shorebirds, shellfish are a key route of exposure to algal toxins. When toxic algae are filtered from the water as food by shellfish, their toxins accumulate in those shellfish to levels that can be lethal to animals that eat the shellfish (Anderson 2007).

Algal toxins may be a direct cause of death in seabirds and shorebirds via an acute or lethal exposure, or birds can be exposed to chronic, sub-lethal levels of a toxin over the course of an extended bloom. Sub-acute doses may contribute to mortality due to an impaired ability to forage productively, disrupted migration behavior, reduced nesting success, or increased vulnerability to predation, dehydration, disease, or injury (van Deventer 2007).

Sick or dying birds often seek shelter in dense vegetation; thus, those that succumb to HAB exposure are not often observed or documented. Birds that are debilitated or die in exposed areas are subject to predation or may be swept away in tidal areas. When extensive fish kills occur from HABs, the carcasses of smaller birds such as shorebirds may go undetected. Some areas affected by HABs are remote and rarely visited. Thus, mortality of shorebirds associated with HABs is likely underreported.

To date, direct impacts to red knots from HABs have been documented only in Texas and Florida, although a large die-off in Uruguay may have also been linked to an HAB. We conclude some level of undocumented red knot mortality from HABs likely occurs most years, based on probable underreporting of shorebird mortalities from HABs and the direct exposure of red knots to algal toxins (particularly via contaminated prey) throughout the knot’s nonbreeding range. We have no documented evidence HABs were a driving factor in red knot population declines in the 2000s. However, HAB frequency and duration have increased and do not show signs of abating over the next few decades. Combined with other threats, ongoing and possibly increasing mortality from HABs may affect the red knot at the population level.

Human disturbance

Red knots are exposed to disturbance from recreational and other human activities throughout their nonbreeding range because red knots and recreational users (*e.g.*, pedestrians, offroad vehicles, dog walkers, boaters) are concentrated on the same beaches (Niles *et al.* 2008; Tarr 2008). Recreational activities affect red knots both directly and indirectly. These activities can cause habitat damage (Anders and Leatherman 1987; Schlacher and Thompson 2008), cause shorebirds to abandon otherwise preferred habitats, negatively affect the birds' energy balances, and reduce the amount of available prey. In Florida, the most immediate and tangible threat to migrating and wintering red knots is chronic disturbance (Niles *et al.* 2006, 2008), which may affect the ability of birds to maintain adequate weights in some areas (Niles 2009). These effects are likely to exacerbate other threats to the red knot, such as habitat loss, asynchronies in the annual cycle, and competition with gulls.

Hunting

Since the late 19th century, hunters concerned about the future of wildlife and the outdoor tradition have made countless contributions to conservation. In many cases, managed hunting is an important tool for wildlife management. However, unregulated or illegal hunting can cause population declines, as was documented in the 1800s for red knots in the U.S. While no longer a concern in the U.S., under-regulated or illegal hunting of red knots and other shorebirds is ongoing in parts of the Caribbean and South America.

Inadequacy of existing regulatory mechanisms

There are some conservation efforts and regulatory mechanisms in place throughout the red knot's range that may help reduce threats to the subspecies. In the U.S., the Migratory Bird Treaty Act of 1918 (MBTA) (40 Stat. 755, as amended; 16 U.S.C. 703 et seq.) is the only Federal law currently providing specific protection for the red knot due to its status as a migratory bird by prohibiting the following actions, unless permitted by Federal regulation, to "pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird…or any part, nest, or egg of any such bird." Through issuance of Migratory Bird Scientific Collecting permits, the Service ensures that best practices are implemented for the careful capture and handling of red knots during banding operations and other research activities. However, there are no provisions in the MBTA that prevent habitat destruction unless the activity causes direct mortality or the destruction of active nests, which would not apply since red knots do not breed in the U.S. The MBTA does not address threats to the red knot from further population declines associated with habitat loss, insufficient food resources, climate change, or the other threats discussed in the remainder of the threats section. There are some state wildlife laws that also protect the red knot from direct take resulting from scientific study and hunting.

Reduced food availability at the Delaware Bay stopover site due to commercial harvest of the horseshoe crab is considered a primary causal factor in the decline of the red knot in the 2000s. The Atlantic Coastal Fisheries Cooperative Management Act of 1993 set forth the current role of the Atlantic States Marine Fisheries Commission (ASMFC), which had been established under an interstate compact among all States from Maine to Florida and previously approved by Congress (Public Law 77-539 and 81-721). Under the 1993 law, the ASMFC develops coastal fishery management plans and monitors each State's compliance with the plans. If a State fails to implement and enforce a fishery plan, the National Oceanic and Atmospheric Administration declares a moratorium on the fishery in question within the waters of the non-complying State. The ASMFC adopted a horseshoe crab management plan in 1998, with different provisions for the bait industry versus the biomedical industry. In 2012, the ASMFC adopted Addendum VII to the plan, which utilizes an Adaptive Resource Management (ARM) framework to manage the bait fishery in the Delaware Bay Region (New Jersey, Delaware, and parts of Maryland and Virginia) (ASMFC 2012). Under the ARM, bait harvest levels are tied to red knot populations via scientific modeling. There have been no instances of State noncompliance with the horseshoe crab management plan. In 2008, New Jersey enacted a law (N.J.S.A. 23.2b.21) extending an earlier (2006) statewide moratorium on the bait harvest until specific red knot recovery targets are achieved. Thus, New Jersey does not use its bait harvest quota as allocated by the ASMFC. Although threats to the horseshoe crab egg resource remain, the current regulatory management of the horseshoe crab fishery is adequately addressing threats to the knot's Delaware Bay food supply from direct harvest.

Other Federal laws (*e.g.*, the Sikes Act, the National Park Service Organic Act, and the National Wildlife Refuge System Improvement Act) provide protection for the red knot from habitat loss and inappropriate management on many Federal lands. Although shorebirds are not their focus, some laws do regulate shoreline stabilization and coastal development, including section 404 of the Clean Water Act, the Rivers and Harbors Act, the Coastal Barrier Resources Act, and the Coastal Zone Management Act as implemented by Federal and State regulations. We have limited information regarding State and local regulations regarding beach cleaning or recreational disturbance. Several Federal and State policies are in effect to stem the introductions and effects of invasive species, but collectively these do not provide complete protection for the red knot from impacts to its habitats or food supplies resulting from beach or marine invaders or the spread of harmful algal species. Although we lack information regarding the overall effect of recreation management policies on the red knot, we are aware of only a few locations in which beaches are closed, regulated, or monitored to protect nonbreeding shorebirds. Relatively strong Federal laws likely reduce risks to red knots from oil spills and pesticides, but both have caused documented shorebird mortalities and other impacts in recent decades. Similarly, existing Federal laws and policies are likely to reduce the red knot's collision risks from new wind turbine development, but some level of mortality is expected upon build-out of the Nation's wind energy infrastructure.

Canada also has laws (*e.g.,* Canadian Species at Risk Act and Migratory Birds Convention Act) that provide protections to the red knot and its habitat both on and off Federal lands. We also know that red knots are legally protected from direct take and hunting in several Caribbean and Latin American countries, but we lack information regarding the implementation or effectiveness of those measures. We also lack information for countries outside the U.S. regarding protection or management of red knot habitat, and regarding the regulation of other activities that threaten the red knot such as development, disturbance, oil spills, environmental contaminants, and wind energy development.

Invasive vegetation

A recently identified threat to red knot is the spread of coastal invasive plants into suitable red knot habitat. Like most invasive species, coastal exotic plants reproduce and spread quickly and exhibit dense growth habits, often outcompeting native plant species. If left uncontrolled, invasive plants cause a habitat shift from open or sparsely vegetated sand to dense vegetation, resulting in the loss or degradation of red knot roosting habitat, which is especially important during high tides and migration periods.

Beach vitex (*Vitex rotundifolia*) is a woody vine introduced into the southeastern U.S. as a dune stabilization and ornamental plant (Westbrooks and Madsen 2006). It currently occupies a very small percentage of its potential range in the U.S.; however, it is expected to grow well in coastal communities throughout the southeastern U.S. from Virginia to Florida, and west to Texas (Westbrooks and Madsen 2006).

Unquantified amounts of crowfoot grass (*Dactyloctenium aegyptium*) grow invasively along portions of the Florida coastline. It forms thick bunches or mats that may change the vegetative structure of coastal plant communities and alter shorebird habitat. The Australian pine (*Casuarina equisetifolia*) also changes the vegetative structure of the coastal community in south Florida and islands within the Bahamas. Shorebirds prefer foraging in open areas where they are able to see potential predators, and tall trees provide good perches for avian predators. Australian pines potentially impact shorebirds, including the red knot, by reducing attractiveness of foraging habitat and/or increasing avian predation.

The propensity of these exotic species to spread, and their tenacity once established, make them a persistent threat, partially countered by increasing landowner awareness and willingness to undertake eradication activities.

Mechanical sediment transport

Several types of sediment transport are employed to stabilize shorelines, protect development, maintain navigation channels, and provide for recreation (U.S. Corps of Engineers [Corps] 2002;

Kana 2011; Gebert 2012). The effects of these projects are typically expected to be relatively short in duration, usually less than 10 years, but often these actions are carried out every few years in the same area, resulting in a more lasting impact on habitat suitability for shorebirds. Mechanical sediment transport practices include beach nourishment, sediment back-passing, sand scraping, and dredging. Since the 1970s, 90 percent of the Federal appropriation for shore protection has been for beach nourishment (Corps 2002), which has become the preferred course of action to address shoreline erosion in the U.S. (Greene 2002; Morton and Miller 2005; Kana 2011).

Where shorebird habitat has been severely reduced or eliminated by hard stabilization structures, beach nourishment may be the only means available to replace any habitat for as long as the hard structures are maintained (Nordstrom and Mauriello 2001), although such habitat will persist only with regular nourishment episodes (typically on the order of every 2 to 6 years). In Delaware Bay, beach nourishment has been recommended to prevent loss of spawning habitat for horseshoe crabs (Atlantic States Marine Fisheries Commission [ASMFC] 1998; Carter *et al.* in Guilfoyle *et al.* 2007; Kalasz 2008), and is being pursued as a means of restoring shorebird habitat in Delaware Bay following Hurricane Sandy (Corps 2012; Niles *et al.* 2013). Beach nourishment was part of a 2009 project to maintain important shorebird foraging habitat at Mispillion Harbor, Delaware (Siok and Wilson 2011). However, red knots may be directly disturbed if beach nourishment takes place while the birds are present. On New Jersey's Atlantic coast, beach nourishment has typically been scheduled for the fall, when red knots are present, because of various constraints at other times of year. In addition to causing disturbance during construction, beach nourishment often increases recreational use of the widened beaches that, without careful management, can increase disturbance of red knots. Beach nourishment can also temporarily depress, and sometimes permanently alter, the invertebrate prey base on which shorebirds depend (Peterson *et al.* 2006).

In addition to disturbing the birds and impacting the prey base, beach nourishment can affect the quality and quantity of red knot habitat (Greene 2002). The artificial beach created by nourishment may provide only suboptimal habitat for red knots, as a steeper beach profile is created when sand is stacked on the beach during the nourishment process. In some cases, nourishment is accompanied by the planting of dense beach grasses, which can directly degrade habitat, as red knots require sparse vegetation to avoid predation. By precluding over-wash and Aeolian transport, especially where large artificial dunes are constructed, beach nourishment can also lead to further erosion on the bayside and promote bayside vegetation growth, both of which can degrade the red knot's preferred foraging and roosting habitats (sparsely vegetated flats in or adjacent to intertidal areas). Preclusion of over-wash also impedes the formation of new red knot habitats. Beach nourishment can also encourage further development, bringing further habitat impacts, reducing future alternative management options such as a retreat from the coast, and perpetuating the developed and stabilized conditions that may ultimately lead to inundation where beaches are prevented from migrating (Greene 2002).

Following placement of sediments much coarser than those native to the beach, Peterson *et al.* (2006) found that the area of intertidal-shallow sub-tidal shorebird foraging habitat was reduced by 14 to 29 percent at a site in North Carolina. Presence of coarse shell material armored the substrate surface against shorebird probing, further reducing foraging habitat by 33 percent, and probably also inhibiting manipulation of prey when encountered by a bird's bill (Peterson *et al.* 2006). In addition to this physical change from adding coarse sediment, nourishment that places sediment dissimilar to the native beach also substantially increases impacts to the red knot's invertebrate prey base (Peterson *et al.* 2006).

Many of the effects of sediment back-passing (a technique that reverses the natural migration of sediment by mechanically [via trucks] or hydraulically [via pipes] transporting sand from accreting, downdrift areas of the beach to eroding, up-drift areas of the beach) and beach scraping (mechanically redistributing beach sand from the littoral zone [along the edge of the sea] to the upper beach to increase the size of the primary dune or to provide a source of sediment for beaches that have no existing dune) are similar to those for beach nourishment (Lindquist and Manning 2001; Service 2011b), including disturbance during and after construction, alteration of prey resources, reduced habitat area and quality, and precluded formation of new habitats. Relative to beach nourishment, sediment back-passing and beach scraping can involve considerably more driving of heavy trucks and other equipment on the beach including areas outside the sand placement footprint, potentially impacting shorebird prey resources over a larger area (Service 2011b). In addition, these practices can directly remove sand from red knot habitats, as is the case in one red knot concentration area in New Jersey (Service 2011b). Back-passing and sand scraping can involve routine episodes of sand removal or transport that maintain the beach in a narrower condition, indefinitely reducing the quantity of back-beach roosting habitat.

The common practice of inlet and nearshore dredging can affect red knot habitats. Dredging often involves removal of sediment from sand bars, shoals, and inlets in the near-shore zone, directly impacting optimal red knot roosting and foraging habitats (Winn and Harrington in Guilfoyle *et al.* 2006; Harrington in Guilfoyle *et al.* 2007; Harrington 2008). These ephemeral habitats are even more valuable to red knots because they tend to receive less recreational use than the main beach strand. In addition to causing this direct habitat loss, the dredging of sand bars and shoals can preclude the creation and maintenance of red knot habitats by removing sand sources that would otherwise act as natural breakwaters and weld onto the shore over time (Morton 2003; Hayes and Michel 2008). Further, removing these sand features can cause or worsen localized erosion by altering depth contours and changing wave refraction (Hayes and Michel 2008), potentially degrading other nearby red knot habitats indirectly because inlet dynamics exert a strong influence on the adjacent shorelines. Studying barrier islands in Virginia and North Carolina, Fenster and Dolan (1996) found inlet influences extend 3.4 to 8.1 mi, and that inlets dominate shoreline changes for up to 2.7 mi. Changing the location of dominant channels at inlets can create profound alterations to the adjacent shoreline (Nordstrom 2000).

Oil spills

The red knot has the potential to be exposed to oil spills and leaks throughout its migration and wintering range. Red knots are exposed to large-scale petroleum extraction and transportation operations in many key wintering and stopover habitats including Tierra del Fuego, Patagonia, the Gulf of Mexico, Delaware Bay, and the Gulf of St. Lawrence. To date, the documented effects to red knots from oil spills and leaks have been minimal; however, information regarding any oiling of red knots during the Deepwater Horizon spill has not yet been released. We conclude that high potential exists for small or medium spills to impact moderate numbers of red knots or their habitats, such that one or more such events is likely over the next few decades, based on the proximity of key red knot habitats to high-volume oil operations. Risk of a spill may decrease with improved spill contingency planning, infrastructure safety upgrades, and improved spill response and recovery methods. However, these decreases in risk (*e.g.*, per barrel extracted or transported) could be offset if the total volume of petroleum extraction and transport continues to grow. A major spill affecting habitats in a key red knot concentration area (*e.g.*, Tierra del Fuego, Gulf coasts of Florida or Texas, Delaware Bay, Mingan Archipelago) while knots are present is less likely, but would be expected to cause population-level impacts.

Predation

In wintering and migration areas, the most common predators of red knots are peregrine falcons (*Falco peregrinus*), harrier hawks (*Circus* spp.), accipiters (*Accipiter* spp.), merlins (*Falco columbarius*), short-eared owls (*Asio flammeus*), and greater black-backed gulls (*Larus marinus*) (Niles *et al.* 2008). In addition to greater black-backed gulls, other large gulls (*e.g.*, herring gulls [*Larus* spp.]) are anecdotally known to prey on shorebirds (Breese 2010). Predation by a great horned owl (*B. virginianus*) has been documented in Florida. Nearly all documented predation of wintering red knots in Florida has been by avian, not terrestrial, predators. However in migration areas like Delaware Bay, terrestrial predators such as red foxes (*V. vulpes*) and feral cats may be a threat to red knots by causing disturbance, but direct mortality from these predators may be low (Niles *et al.* 2008).

Raptor predation has been shown to be an important mortality factor for shorebirds at several sites (Piersma *et al.* 1993). However, Niles *et al.* (2008) concluded that increased raptor populations have not been shown to affect the size of shorebird populations. Based on studies of other red knot subspecies in the Dutch Wadden Sea, Piersma *et al.* (1993) concluded that the chance for an individual to be attacked and captured is small, as long as the birds remain in the open and in large flocks so that approaching raptors are likely to be detected. Although direct mortality from predation is generally considered relatively low in nonbreeding areas, predators also impact red knots by affecting habitat use and migration strategies (Stillman *et al.* 2005; Niles *et al.* 2008) and by causing disturbance, thereby potentially affecting red knots' rates of feeding and weight gain.

In wintering and migration areas, predation is not directly impacting red knot populations despite some direct mortality. At key stopover sites, however, localized predation pressures are likely to exacerbate other threats to red knot populations, such as habitat loss, food shortages, and asynchronies between the birds' stopover period and the occurrence of favorable food and weather conditions. Predation pressures worsen these threats by pushing red knots out of otherwise suitable foraging and roosting habitats, causing disturbance, and possibly causing changes to stopover duration or other aspects of the migration strategy.

Although little information is available from the breeding grounds, the long-tailed jaeger (*Stercorarius longicaudus*) is prominently mentioned as a predator of red knot chicks in most accounts. Other avian predators include parasitic jaeger (*S. parasiticus*), pomarine jaeger (*S. pomarinus*), herring gull, glaucous gull (*L. hyperboreus*), gyrfalcon (*F. rusticolus*), peregrine falcon, and snowy owl. Mammalian predators include arctic fox and sometimes arctic wolves (*Canis lupus arctos*) (Committee on the Status of Endangered Wildlife in Canada [COSEWIC] 2007; Niles *et al.* 2008). Predation pressure on Arctic-nesting shorebird clutches varies widely regionally, inter-annually, and even within each nesting season, with nest losses to predators ranging from close to 0 percent to near 100 percent (Meltofte *et al.* 2007), depending on ecological factors. In the Arctic, 3-to 4-year lemming cycles give rise to similar cycles in the predation of shorebird nests. When lemmings are abundant, predators concentrate on the lemmings, and shorebirds breed successfully. When lemmings are in short supply, predators switch to shorebird eggs and chicks (Summers and Underhill 1987; Blomqvist *et al.* 2002; Service 2003; COSEWIC 2007; Meltofte *et al.* 2007; Niles *et al.* 2008).

In addition to affecting reproductive output, these cyclic predation pressures have been shown to influence shorebird nesting chronology and distribution. Studying 12 shorebird species, including red knot, over 11 years at four sites in the eastern Canadian Arctic, Smith *et al.* (2010) found that both snow conditions and predator abundance have significant effects on the chronology of breeding. Higher predator abundance resulted in earlier nesting than would be predicted by snow cover alone (Smith *et al.* 2010). Based on the adaptations of various species to deal with predators, Larson (1960) concluded the distribution and abundance of red knots and other Arctic-breeding shorebirds were strongly influenced by arctic fox and rodent cycles, such that birds were in low numbers or absent in areas without lemmings because foxes preyed predominately on birds in those areas (Fraser *et al.* 2013). Unsuccessful breeding seasons contributed to at least some of the observed reductions in the red knot population in the 2000s. However, rodent-predator cycles have always affected the productivity of Arctic-breeding shorebirds and have generally caused only minor year-to-year changes in otherwise stable populations (Niles *et al.* 2008).

Reduced food availability

Commercial harvest of horseshoe crabs has been implicated as a causal factor in the decline of the red knot populations in the 2000s, by decreasing the availability of horseshoe crab eggs in the Delaware Bay stopover (Niles *et al.* 2008). Due to harvest restrictions and other conservation actions, horseshoe crab populations showed some signs of recovery in the early 2000s, with apparent signs of red knot stabilization (survey counts, rates of weight gain) occurring a few years later (as might be expected due to biological lag times). Since about 2005, however, horseshoe crab population growth has stagnated for unknown reasons. Under the current management framework, the present horseshoe crab harvest is not considered a threat to the red knot. However, it is not yet known if the horseshoe crab egg resource will continue to adequately support red knot populations over the next 5 to 10 years. In addition, implementation of the current management framework could be impeded by insufficient funding.

The causal role of reduced Delaware Bay food supplies in driving red knot population declines shows the vulnerability of red knots to declines in the quality or quantity of their prey. This vulnerability has also been demonstrated in other *C. canutus* subspecies, although not to the severe extent experienced by the *rufa* subspecies. In addition to the fact that horseshoe crab population growth has stagnated, red knots now face several emerging threats to their food supplies throughout their nonbreeding range. These threats include: small prey sizes (from unknown causes) at two key wintering sites on Tierra del Fuego; warming water temperatures that may cause mollusk population declines and range contractions (including the likely loss of a key prey species from the Virginia spring stopover within the next decade); ocean acidification to which mollusks are particularly vulnerable; physical habitat changes from climate change affecting invertebrate communities; possibly increasing rates of mollusk diseases due to climate change; invasive marine species from ballast water and aquaculture; and the burial and crushing of invertebrate prey from sand placement and recreational activities. Although threats to food quality and quantity are widespread, red knots in localized areas have shown some adaptive capacity to switch prey when the preferred prey species became reduced (Musmeci *et al.* 2011; Escudero *et al.* 2012), suggesting some adaptive capacity to cope with this threat. Nonetheless, based on the combination of documented past impacts and a spectrum of ongoing and emerging threats, we conclude that reduced quality and quantity of food supplies is a threat to the *rufa* red knot at the subspecies level, and the threat is likely to continue into the future.

Scientific study

Considerable care is taken to minimize disturbance caused to shorebirds from these research activities. Numbers of birds per catch and total numbers caught over the season are limited, and careful handling protocols are followed, including a 3-hour limit on holding times (Niles *et al.* 2008; Niles *et al.* 2010). Despite these measures, hundreds of red knots are temporarily stressed during the course of annual research, and mortality, though rare, does occasionally occur (Taylor

1981). However, we conclude that these research activities are not a threat to the red knot because evaluations have shown no effects of these short-term stresses on red knot survival. Further, the rare, carefully documented, and properly permitted mortality of an individual bird in the course of well-founded research does not affect red knot populations or the overall subspecies.

Shoreline stabilization and coastal development

Much of the U.S. coast within the range of the red knot is already extensively developed. Direct loss of shorebird habitats occurred over the past century as substantial commercial and residential developments were constructed in and adjacent to ocean and estuarine beaches along the Atlantic and Gulf coasts. In addition, red knot habitat was also lost indirectly, as sediment supplies were reduced and stabilization structures were constructed to protect developed areas. Sea level rise and human activities within coastal watersheds can lead to long-term reductions in sediment supply to the coast. The damming of rivers, bulk-heading of highlands, and armoring of coastal bluffs have reduced erosion in natural source areas and consequently the sediment loads reaching coastal areas. Although it is difficult to quantify, the cumulative reduction in sediment supply from human activities may contribute substantially to the long-term shoreline erosion rate. Along coastlines subject to sediment deficits, the amount of sediment supplied to the coast is less than that lost to storms and coastal sinks (inlet channels, bays, and upland deposits), leading to long-term shoreline recession (Greene 2002; Herrington 2003; Morton 2003; Morton *et al.* 2004; Defeo *et al.* 2009; Climate Change Science Program [CCSP] 2009; Florida Oceans and Coastal Council 2010; Coastal Protection and Restoration Authority of Louisiana 2012).

The mid-Atlantic coast from New York to Virginia is the most urbanized shoreline in the country, except for parts of Florida and southern California. In New York and New Jersey, hard structures and beach nourishment programs cover much of the coastline. The U.S. southeastern coast from North Carolina to Florida is the least urbanized along the Atlantic coast, although both coasts of Florida are urbanizing rapidly. Texas has the most extensive sandy coastline in the Gulf, and much of the area is sparsely developed (Leatherman 1989). Region-wide, about 40 percent of the southeast and Gulf coast is already developed (Rice 2012; Service 2012). Not all of the remaining 60 percent in the ''undeveloped'' category, however, is still available for development because about 43 percent (about 910 mi) of beaches across this region are considered preserved. Preserved beaches include those in public or nongovernmental conservation ownership and those under conservation easements.

Past and ongoing stabilization projects fundamentally alter the naturally dynamic coastal processes that create and maintain beach strand and bayside habitats, including those habitat components that red knots rely upon. Past loss of stopover and wintering habitat likely reduce the resilience of the red knot by making it more dependent on those habitats that remain, and more vulnerable to threats (*e.g.*, disturbance, predation, reduce quality or abundance of prey, increased intraspecific and interspecific competition) within those restricted habitats.

Wind energy development

Within the red knot's U.S. wintering and migration range, substantial development of offshore wind facilities is planned, and the number of wind turbines installed on land has increased considerably over the past decade. The rate of wind energy development will likely continue to increase into the future as the U.S. looks to decrease reliance on the traditional sources of energy (*e.g.,* fossil fuels). Wind turbines can have a direct (*e.g.,* collision mortality) and indirect (*e.g.,* migration disruption, displacement from habitat) impact on shorebirds. We have no information on wind energy development trends in other countries, but risks of red knot collisions would likely be similar wherever large numbers of turbines are constructed along migratory pathways, either on land or offshore.

We are not aware of any documented red knot mortalities at any wind turbines to date, but low levels of red knot mortality from turbine collisions may be occurring now based on the number of turbines along the red knot's migratory routes and the frequency with which red knots traverse these corridors. Based on the current number and geographic distribution of wind turbines, if any such mortality is occurring, it is likely not causing subspecies-level effects. However, as build-out of offshore, coastal, and inland wind energy infrastructure progresses, increasing mortality from wind turbine collisions may contribute to a subspecies-level effect due to the red knot's vulnerability to direct human-caused mortality. We anticipate the threat to red knots from wind turbines will be primarily related to collision or behavioral changes during migratory or daily flights. Unless facilities are constructed at key stopover or wintering habitats, we do not expect wind energy development to cause significant direct habitat loss or degradation or displacement of red knots from otherwise suitable habitats.

Wrack removal and beach cleaning

Wrack on beaches and baysides provides important foraging and roosting habitat for red knots and many other shorebirds on their winter, breeding, and migration grounds. Because shorebird numbers are positively correlated with wrack cover and biomass of their invertebrate prey that feed on wrack (Tarr and Tarr 1987; Dugan *et al.* 2003; Hubbard and Dugan 2003), beach grooming will lower bird numbers (Defeo *et al.* 2009). Beach cleaning or grooming can result in abnormally broad unvegetated zones that are inhospitable to dune formation or plant colonization, thereby enhancing the likelihood of erosion (Defeo *et al.* 2009).

The Service estimates 240 of 825 mi (29 percent) of sandy beach shoreline in Florida are cleaned or raked on various schedules (*i.e.,* daily, weekly, monthly) (Florida Department of Environmental Protection [DEP] 2008). Service biologists estimate South Carolina mechanically cleans approximately 34 of its 187 shoreline mi (18 percent), and Texas mechanically cleans approximately 20 of its 367 shoreline mi (5.4 percent). In Louisiana, beach raking occurs on

Grand Isle (the State's only inhabited island) along approximately 8 mi of shoreline, roughly 2 percent of the State's 397 sandy shoreline mi.

Tilling beaches to reduce soil compaction, as sometimes required by the Service for sea turtle protection after beach nourishment activities, also has similar impacts to removing wrack and disturbing the invertebrate fauna. Recently, the Service improved sea turtle protection provisions in Florida; these provisions now require tilling, when needed, to be above the primary wrack line, not within it, which will reduce the negative effects.

Threats summary

After assessing the best scientific and commercial data available regarding past, present, and future threats to the red knot the Service has identified that the primary threats to the red knot are habitat loss and degradation due to sea level rise, shoreline stabilization, and Arctic warming as well as reduced food availability and asynchronies in the annual cycle. Other threats are moderate in comparison to the primary threats; however, cumulatively, they could become significant when working in concert with the primary threats if they further reduce the species' resiliency. Such secondary threats include hunting, predation, human disturbance, harmful algal blooms, oil spills, and wind energy development, all of which affect red knots across their range. Although conservation efforts (*e.g.*, management of the horseshoe crab population and regulatory mechanisms for the species and its habitat) are being implemented in many areas of the red knot's range and reduce some threats, significant risks to the subspecies remain.

Ongoing Conservation Efforts

We are unaware of any broad-scale conservation measures to reduce the threat of destruction, modification, or curtailment of the red knot's habitat or range. Specifically, no conservation measures are specifically aimed at reducing sea level rise or warming conditions in the Arctic. Shorebird reserves have been established at several key red knot sites in South America, and regional efforts are in progress to develop and implement urban development plans to help protect red knot habitats at some of these sites. For example, a shorebird conservation plan is being implemented for Chiloé Island on the Pacific coast of Chile and work is underway to establish a new national park on the Joulter Cays, a group of small uninhabited islands and flats that support red knots in the Bahamas (Service 2014). In the U.S., the Service is working with partners to minimize the effects of shoreline stabilization on shorebirds and other beach species, and there are efforts in Delaware Bay to maintain horseshoe crab spawning habitat.

At some key U.S. stopovers, including the Atlantic coast of Virginia, Delaware Bay, and Cape Cod, considerable habitat is in public or private conservation ownership. Delaware has improved and increased red knot roosting habitat through impoundment management, and has conducted adaptive planning to increase impoundment resiliency to climate change and sea level rise (Service 2014b). In addition, local or regional efforts are ongoing to control several species of invasive beach vegetation. While additional best management practices could be implemented to address shoreline development and stabilization, beach cleaning, invasive species, agriculture, and aquaculture, we do not have any information that specific, large-scale actions are being taken to address these concerns such that those efforts would benefit red knot populations or the subspecies as a whole.

A few countries where shorebird hunting is legal have implemented voluntary restrictions on red knot hunting, increased hunter education efforts, established “no-shoot” shorebird refuges, and are developing models of sustainable harvest (Service 2014b). Ongoing scientific research has benefitted red knot conservation in general and, through leg-band recoveries, has provided documentation of hunting-related mortality. Research activities continue to adhere to best practices for the careful capture and handling of red knots.

We are unaware of any conservation efforts to reduce disease and predation of the red knot. That said, land managers in some areas of the U.S. have begun to remove peregrine nesting platforms in key locations where they are having the greatest impact on shorebirds (Service 2014b).

Researchers continued efforts conducting wintering surveys and examining the origins of red knots on the wintering grounds and their movement patterns up to the Artic, will provide valuable information as the Service develops a recovery plan for the species.

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STATUS OF THE SPECIES - Wood Stork *(Myceteria americana)*

Species/critical habitat description

The United States breeding population of the wood stork was first listed under the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884;16 U.S.C. 1531 et seq.) as endangered on February 28, 1984. On July 30, 2014, the wood stork was downlisted to threatened. No critical habitat has been designated for the wood stork; therefore, none will be affected by the proposed action.

Species description

The wood stork is a large, long-legged wading bird, with a head to tail length of 33 to 45 inches and a wingspan of 59 to 65 inches (Coulter et al. 1999). Wood storks fly with their neck and legs extended. The plumage is white, except for iridescent black primary and secondary wing feathers and a short black tail. On adults, the rough scaly skin of the head and neck is un-feathered and blackish in color, the legs are dark, and the feet are dull pink. The bill color is also blackish. Immature wood storks, up to the age of about 3 years, have yellowish or straw-colored bills and varying amounts of dusky feathering on the head and neck (Coulter et al. 1999). During courtship and the early nesting season, adults may develop buff or pinkish coloration on the wing linings, fluffy, plume-like under tail coverts, and their toes are bright pink.

Life history

The wood stork is the only stork that breeds in the United States and is found primarily in the southeast region. Storks begin breeding at 3 to 4-years of age, but the average first age of breeding is unknown. Wood storks historical nesting trends began laying eggs in early October in south Florida and into late June in north Florida (Rodgers 1990). However more recently in south Florida, wood storks have begun laying eggs in late January early February (pers. comm. Mark Cook). The wood storks in the northern distribution range (Georgia, South Carolina, North Carolina) begin pair formation in early March/April. A single clutch of two to five eggs (average three) are laid per breeding season, but a second clutch may be laid if a nest failure occurs early in the breeding season (Coulter et al. 1999). There is variation among years in the clutch sizes, and clutch size does not appear to be related to longitude, nest data, nesting density, or nesting numbers, and may be related to habitat conditions at the time of egg-laying. Egg-laying is staggered and incubation, which lasts about 30 days, begins after the first egg is laid. Therefore, the eggs hatch at different times and the nestlings vary in size (Coulter et al. 1999).

Wood storks produce an average of 1.29 fledglings per nest and 0.42 fledgling per egg. Throughout the brooding period, the probability of survival from egg-laying to fledgling decreases as days increases (Rodgers and Schwikert 1997) (Table 1). The greatest losses occur from egg-laying to hatching with a 30 percent loss of the nest productivity. From hatching to nestlings of 2 weeks of age, nest productivity loss is an additional 8 percent. Corresponding losses for the remainder of the nesting cycles are on the average of 6 percent per 2-week increase in age of the nestling (Rodgers and Schwikert 1997). The young fledge in about 8 weeks, but will stay at the nest for 3 to 4 additional weeks to be fed.

Adults feed the young by regurgitating whole fish into the bottom of the nest about 3 to 10 times per day. Feedings are more frequent when the birds are young (Coulter et al. 1999) and less frequent when wood storks must fly great distances to locate food (Bryan et al. 1995). The total nesting period, from courtship and nest-building through independence of young, lasts about 100 to 120 days (Coulter et al. 1999). Within a colony, nest initiation may be asynchronous and, consequently, a colony may contain active breeding wood storks for a period significantly longer than the 120 days required for a pair to raise young to independence. Adults and independent young may continue to forage around the colony site for a relatively short period following the completion of breeding.

Wood storks feed almost entirely on fish from 1 to 10 inches long (Kahl 1964; Ogden et al. 1976; Coulter 1987), but may occasionally consume crustaceans, amphibians, reptiles, mammals, birds, and arthropods. Wood storks generally use a specialized feeding behavior called tactilocation, or grope feeding, but also forage visually under some conditions (Kushlan 1979). Storks typically wade through the water with their beak immersed and open about 2.5 to 3.5 inches. When the wood stork encounters prey within its bill, the mandibles snap shut, the head is raised, and the food swallowed (Kahl 1964). Occasionally, wood storks stir the water with their feet in an attempt to startle hiding prey (Rand 1956; Kahl 1964; Kushlan 1979). This foraging method allows them to forage effectively in turbid waters, at night, and under other conditions when other wading birds that employ visual foraging may not be able to forage successfully.

During the nesting period, storks are dependent on consistent foraging opportunities in wetlands within about 18.6 miles of the nest site with the greatest energy demands occurring during the middle of the nestling period, when nestlings are 23 to 45 days old (Kahl 1964). The average wood stork family requires 443 pounds of fish, crustaceans, and other prey during the breeding season with 50 percent of the nestlings' food requirement occurring during the middle third of the nestling period (Kahl 1964). It is estimated about 110 pounds are needed to meet the foraging needs of the adults and nestling in the first third of the nesting cycle. Receding water levels are necessary in south Florida to concentrate suitable densities of forage fish (Kahl 1964; Kushlan et al. 1975).

Gawlik (2002) characterized wood storks as "searchers" that employ a foraging strategy of seeking out areas of high density prey and optimal (shallow) water depths, and abandoning foraging sites when prey density begins to decrease below a particular efficiency threshold, but while prey was still sufficiently available that other wading bird species were still foraging in large numbers (Gawlik 2002). Wood stork choice of foraging sites was significantly related to both prey density and water depth (Gawlik 2002). Because of this strategy, wood stork foraging opportunities are more constrained than many of the other wading bird species (Gawlik 2002).

Following the completion of the nesting season, both adult and fledgling wood storks generally begin to disperse away from the nesting colony. Fledglings have relatively high mortality rates within the first 6 months following fledging, most likely due to their lack of experience, including the selection of poor foraging locations (Hylton et al. 2006). Post-fledging survival also appears to be variable among years, probably reflecting the environmental variability that affects storks and their ability to forage effectively (Hylton et al. 2006). In southern Florida, both adult and juvenile storks consistently disperse northward following fledging in what has been described as a mass exodus (Kahl 1964). Storks in central Florida also appear to move northward following the completion of breeding, but generally do not move as far (Coulter et al. 1999). Many of the juvenile storks from southern Florida move beyond Florida into Georgia, Alabama, Mississippi, and South Carolina (Coulter et al. 1999; Borkhataria et al. 2004, Borkhataria et al. 2006). Some flocks of juvenile storks have also been reported to move well beyond the breeding range of storks in the months following fledging (Kahl 1964). This post-breeding northward movement appears consistent across years.

Adult and juvenile storks return southward in the late fall and early winter months. In a study employing satellite telemetry, Borkhataria et al. (2006) reported that nearly all storks that had been tagged in the southeastern United States moved into Florida near the beginning of the dry season, including all sub-adult storks that fledged from Florida and Georgia colonies. Adult storks that breed in Georgia remained in Florida until March, and then moved back to northern breeding colonies (Borkhataria et al. 2006). Overall, about 75 percent of all locations of radio-tagged wood storks occurred within Florida (Borkhataria et al. 2006). Preliminary analyses of the range-wide occurrence of wood storks in December, recorded during the annual Christmas bird surveys, suggest the majority of the southeastern United States wood stork population occurs in central and southern Florida. Relative abundance of storks in this region was 10 to 100 times higher than in northern Florida and Georgia (Service 2007). Because of these general population-level movement patterns during the earlier period of the stork breeding season in southern Florida, the wetlands upon which nesting storks depend are also being heavily used by a large portion of the southeastern United States wood stork population, including storks that breed in Georgia and the Carolinas, and sub-adult storks from throughout the stork's range. In addition, these same wetlands support a variety of other wading bird species (Gawlik 2002).

The wood stork life history strategy has been characterized as a "bet-hedging" strategy (Hylton et al. 2006) in which high adult survival rates and the capability of relatively high reproductive output under favorable conditions allow the species to persist during poor conditions and capitalize on favorable environmental conditions. This life-history strategy may be adapted to variable environments (Hylton et al. 2006) such as the wetland systems of southern Florida.

Habitat

Wood stork nesting habitat consists of mangroves as low as 3 feet, cypress as tall as 100 feet , and various other live and dead shrubs or trees located in standing water (swamps) or on islands surrounded by relatively broad expanses of open water (Palmer 1962; Rodgers et al. 1987; Ogden 1991; Coulter et al. 1999). Wood storks generally occupy the large-diameter trees at a colony site because storks nest often in conjunction with other wading bird species (Rodgers et al. 1996). The same colony site will be used for many years as long as the colony is undisturbed and sufficient feeding habitat remains in surrounding wetlands. However, not all storks nesting in a colony will return to the same site in subsequent years (Kushlan and Frohring 1986). Natural wetland nesting sites may be abandoned if surface water is removed from beneath the trees during the nesting season (Rodgers et al. 1996). In response to this type of change to nest site hydrology, wood storks may abandon a site and establish a breeding colony in managed or impounded wetlands (Ogden 1991). Wood storks that abandon a colony early in the nesting season due to unsuitable hydrological conditions may re-nest in other nearby areas (Borkhataria et al. 2004; Crozier and Cook 2004).

Between breeding seasons or while foraging, wood storks roost in trees over dry ground, on levees, or large patches of open ground. Wood storks may also roost within wetlands while foraging far from nest sites and outside of the breeding season (Gawlik 2002). While the majority of stork nesting occurs within traditional stork rookeries, a handful of new stork nesting colonies are discovered each year (Meyer and Frederick 2004; Brooks and Dean 2008). These new colony locations may represent temporary shifts of historic colonies due to changes in local conditions, or they may represent formation of new colonies in areas where conditions have improved.

Wood storks forage in a wide variety of wetland types 31 miles of the colony site, where prey are available and the water is shallow and open enough to hunt successfully (Ogden et al. 1978; Browder 1984; Coulter 1987;Bryan and Coulter 1987), but foraging occurs most frequently within 12.5 miles of the colony (Coulter and Bryan 1993). Maintaining this wide range of feeding site options ensures sufficient wetlands of all sizes and varying hydroperiods are available during shifts in seasonal and annual rainfall and surface water patterns to support nutritional changes. Calm water, about 2 to 16 inches deep and free of dense aquatic vegetation is ideal (Coulter and Bryan 1993). Typical foraging sites include freshwater marshes, ponds, hardwood and cypress swamps, narrow tidal creeks or shallow tidal pools, and artificial wetlands such as stock ponds, seasonally flooded shallow roadside or agricultural ditches, and managed impoundments (Coulter et al. 1999; Coulter and Bryan 1993). Generally, storks use wet prairie ponds early in the dry season then shift to slough ponds later in the dry season, thus following water levels as they recede into the ground (Browder 1984).

Several factors affect the suitability of potential foraging habitat for wood storks. Suitable foraging habitats must provide both a sufficient density and biomass of forage fish and other prey, and have vegetation characteristics that allow storks to locate and capture prey. Hydrologic and environmental characteristics have a strong effect on fish density and these factors may be some of the most significant in determining foraging habitat suitability, particularly in southern Florida. Longer hydroperiod areas generally support more and larger fish (Trexler et al. 2002; Loftus and Eklund 1994; Turner et al. 1999). In addition, nutrient enrichment (primarily phosphorus) within the oligotrophic Everglades wetlands generally results in increased density and biomass of fish in potential stork foraging sites (Rehage and Trexler 2006). Distances from dry-season refugia, such as canals, alligator holes, and similar long hydroperiod sites also affect fish density and biomass. Within the highly modified environments of southern Florida, fish availability varies with respect to hydrologic gradients, nutrient availability gradients, and it becomes very difficult to predict fish density. The foraging habitat for most wood stork colonies within southern Florida includes a variety of hydroperiod classes, nutrient conditions, and spatial variability.

Distribution

The wood stork occurs from northern Argentina, eastern Peru and western Ecuador, north to Central America, Mexico, Cuba, Hispaniola, and the southeastern United States (American Ornithologists Union 1983). Only the population segment that breeds in the southeastern United States is listed as threatened. In the United States, wood storks were historically known to nest in all coastal states from Texas to South Carolina (Wayne 1910; Bent 1926; Howell 1932; Oberholser 1938; Dusi and Dusi 1968; Cone and Hall 1970; Oberholser and Kincaid 1974). Storks are found year-round throughout breeding range, except in South Carolina, North Carolina, and Georgia. Most individuals retreat to Florida and South Georgia during midwinter after breeding season dispersal. Currently, wood stork nesting occurs in Florida, Georgia, South Carolina, and North Carolina. Breeding colonies of wood storks exist in all southern Florida counties, except for Okeechobee County. Additional expansion of the breeding range of wood storks in the southeastern United States has continued, both to the north and to the west along the Gulf Coast (Service 2007).

Population Dynamics

The United States breeding population of wood storks declined from an estimated 20,000 pairs in the 1930s to about 10,000 pairs by 1960 (49 FR 7332). Since the 1960s, the wood stork population has declined in southern Florida and increased in northern Florida, Georgia, and South Carolina (Ogden et al. 1987). The number of nesting pairs in the Everglades and Big Cypress ecosystems (southern Florida) declined from 8,500 pairs in 1961 to 969 pairs in 1995. During the same period, nesting pairs in Georgia increased from 4 to 1,501 and nesting pairs in South Carolina increased from 11 to 829 (Service 1997).

Since listing, annual nest counts have increased significantly in south Florida from 1,245 pairs in 1984 to 2,799 pairs in 2014. Annual nest counts in the vicinity of 2,712 pairs in north and central Florida have not significantly changed during this same time period. From 1991 to 2014 statewide surveys in Florida suggest that the nesting population is increasing and, while colonies are declining in size, the overall number of colonies is also increasing (Frederick and Meyer 2008). Florida's nest counts have also shown an increase from 5,647 to 7,216 pairs since listing. Historically, colonies in the south were associated with extensive wetland systems and predictable patterns of prey availability. Ogden et al. (1987) suggested the population shift was the result of deteriorating feeding conditions in south Florida and better nesting success rates in central-north Florida that compound population growth in that area. Further evidence of a general northern breeding range expansion occurred in 2005 when storks were first documented nesting successfully in North Carolina., and Storks have continued to nest in North Carolina and have increased their nesting pairs to 284 in 2014, from 32 in 2005.

Nest initiation date, colony size, nest abandonment, and fledging success of a wood stork colony varies from year-to-year based on availability of suitable wetland foraging areas, which can be affected by local rainfall patterns, regional weather patterns, and anthropogenic hydrologic management (Service 1997). A colony site may be vacant in years of drought or unfavorable conditions due to inadequate foraging conditions in the surrounding area (Kahl 1964). Storks may abandon traditional colony nesting sites completely when hydrological changes occur such as removing surface water from beneath the colony trees (Service 1997; Coulter et al. 1999). Nesting failures and colony abandonment may also occur if unseasonable rainfall causes water levels to rise when they are normally receding, thus dispersing rather than concentrating fish prey (Kahl 1964; Service 1997; Coulter et al. 1999).

Threats

The primary cause of the wood stork population decline in the United States is loss of wetland habitats or loss of wetland function resulting in reduced prey availability. Dahl (1990) estimates about 38 million acres, or 45.6 percent, of wood stork historic wetlands were lost between the 1780s and the 1980s. However, it is important to note wetlands and wetland losses are not evenly distributed in the landscape. Hefner et al. (1994) estimated 55 percent of the 2.3 million acres of the wetlands lost in the southeastern United States between the mid-1970s and mid-1980s were located in the Gulf-Atlantic Coastal Plain. These wetlands were strongly preferred by wood storks as nesting habitat. Since the 1970s, wood storks have been observed shifting their nest sites to artificial impoundments or islands created by dredging activities (Ogden 1991). The percentage of nests in artificial habitats in central and north Florida has increased from about 10 percent of all nesting pairs in 1959 to 1960 to 60 to 82 percent between 1976 and 1986 (Ogden 1991). Nest trees in these artificially impounded sites often include exotic species such as Brazilian pepper or Australian pine (*Casuarina equisetifolia*). Ogden (1996) has suggested the use of these artificial wetlands indicates wood storks are not finding suitable conditions within natural nesting habitat or they are finding better conditions at the artificial wetlands. The long-term effect of these nesting areas on wood stork populations is unclear.

On the other hand, Ogden and Nesbitt (1979) indicate a reduction in nesting sites is not the cause in the population decline, because the number of nesting sites used from year to year is relatively stable. They suggest loss of an adequate food base is a cause of wood stork declines. Changes in remaining wetland systems in Florida, including drainage and impoundment, may be a larger problem for wood storks than loss of foraging habitat (Ogden and Nesbitt 1979). Almost any shallow wetland depression where fish become concentrated, through either local reproduction or receding water levels, may be used as feeding habitat by the wood stork during some portion of the year, but only a small portion of the available wetlands support foraging conditions (high prey density and favorable vegetation structure) that storks need to maintain growing nestlings. Browder et al. (1976) and Browder (1978) documented the distribution and the total acreage of wetland types (cypress domes and strands, wet prairies, scrub cypress, freshwater marshes and sloughs, and saw grass marshes) occurring south of Lake Okeechobee, Florida, for the period 1900 through 1973 and found these habitat types have been reduced by 35 percent since 1900.

The alteration of wetlands and the manipulation of wetland hydroperiods have also reduced the amount of foraging habitat available to wood storks. The decrease in wood storks nesting on Cape Sable was related to the construction of the drainage canals during the 1920s (Kushlan and Frohring 1986). Water level manipulation can aid raccoon predation of wood stork nests when water is kept too low (alligators deter raccoon predation when water levels are high). Artificially high water levels may retard nest tree regeneration since many wetland tree species require periodic droughts to establish seedlings. Water level manipulation may decrease food productivity if the water levels and length of inundation do not match the breeding requirements of forage fish. Dry-downs of wetlands may selectively reduce the abundance of the larger forage fish species that wood storks tend to use, while still supporting smaller prey fish.

Non-native invasive species

The Burmese python, native to South Asia, is now breeding and expanding its range in the greater Everglades ecosystem increasing concerns among land managers about the potential impacts of this invasive snake. More than 1,400 of the south Asian snakes have been removed from ENP since 2000. Their population numbers are now estimated to be in the thousands in ENP, potentially impacting a wide variety of listed and native species. A growing wild population of pythons has the potential to create a major ecological problem in ENP and threaten successful restoration of the greater Everglades (NRC 2005).

Pythons’ rapid and widespread invasion is facilitated by aspects of their natural history such as diverse habitat use, broad dietary preferences, long lifespan (15 to 25 years), high reproductive output, and ability to move long distances. Burmese python hatchlings are larger than hatchlings of native species and are less susceptible to predators. These multiple advantages may allow pythons to compete with native snakes and other predators for food, habitat, and space. Burmese pythons are generalist predators that consume a wide variety of mammal and bird species, as well as other reptiles, amphibians, and fish (Dove et al. 2011; Snow et al. 2007). Like other constrictors, the Burmese python seizes prey with its teeth and then wraps its body around the animal and kills it by constriction. Pythons in Florida have consumed prey as large as white-tailed deer (*Odocoileus virginianus*) and adult American alligators (Snow et al. 2007). As Burmese pythons expand their range in south Florida, it becomes increasingly important to learn what they are eating in order to assess their impact on native fauna and to predict what species are at risk. Fourteen species of mammals, five species of birds, and one species of reptile have been found in the stomachs of pythons collected and examined in Florida (Snow et al. 2007). Although CSSS have not been documented to have been predated upon by pythons, other bird species have been found in the digestive tracts of Burmese pythons, including pied-billed grebe (*Podilymbus podiceps*), limpkin (*Aramus guarauna*), white ibis (*Eudocimus albus*), American coot (*Fulica americana*), house wren (*Troglodytes aedon),* domestic goose (*Anser* spp.*)*, and a juvenile wood stork. Juveniles of these giant constrictors will climb to remove prey from bird nests and capture perching or sleeping birds. The relative risk of python predation on sparrows, storks or even snail kites is unknown at this time. By preying on native wildlife, and competing with other native predators, pythons have the potential to seriously impact the natural order of south Florida's ecological communities.

Chemical contamination

The role of chemical contamination in the decline of the wood stork is unclear. Pesticide levels high enough to cause eggshell thinning have been reported in wood storks, but decreased productivity has not yet been linked to chemical contamination (Ohlendorf et al. 1978; Fleming et al. 1984). Burger et al. (1993) studied heavy metal and selenium levels in wood storks from Florida and Costa Rica. Adult birds generally exhibited higher levels of contaminants than young birds. Burger et al. (1993) attribute this to bioaccumulation in the adults who may be picking up contaminants at the colony nesting site and while foraging at other locations during the non-breeding season. There were higher levels of mercury in young birds from Florida than young birds or adult birds from Costa Rica. Young birds from Florida also exhibited higher levels of cadmium and lead than young birds from Costa Rica. Though Burger et al. (1993) recommended the lead levels in Florida be monitored; they drew no conclusions about the potential health effects of contaminants to wood storks.

Ongoing conservation efforts (recovery)

Measuring the biological aspect of the recovery of the wood stork is outlined in the Service's recovery plan (1997). The plan's recovery criteria state that reclassification, from endangered to threatened, could be considered when there are 6,000 nesting pairs and annual regional production is greater than 1.5 chicks per nest/year (both calculated over a 3-year average). Delisting could be considered when there are 10,000 nesting pairs calculated over a 5-year period beginning at the time of reclassification and annual regional production is greater than 1.5 chicks per nest/year (calculated over a 5-year average). As a subset of the 10,000 nesting pairs, a minimum of 2,500 nesting pairs must occur in the Everglades and Big Cypress systems in south Florida. In 2001, the Service reinitiated another 5-year synoptic aerial survey effort for wood stork colonies throughout the southeast range of the species (Service 2003), and surveys have been conducted annually since then. Three-year averages calculated from nesting data from 2001 through 2006 indicate that the total nesting population has been consistently above the 6,000 reclassification threshold for nesting pairs, and the averages have ranged from about 7,400 to over 8,700 nesting pairs during this time period. Currently the three-year average calculated from nesting data from 2011 through 2013 shows the total nesting population is 9,692 nesting pairs.

Wood stork nesting in the southeastern United States

The wood stork population is increasing and expanding its overall and breeding range in the southeastern United States (Brooks and Dean 2008). The wood stork population has exceeded 10,000 nesting pairs in multiple years following the 2006 breeding season, but storks still have not met recovery goals (Table 2). The previous period that the nesting population surpassed 10,000 pairs was in the early 1960s. Wood stork nesting continues to be recorded in North Carolina after it was first documented there in 2005. This suggests the northward expansion of wood stork nesting may be continuing. The number of colonies also continues to rise with over 100 nesting colonies reported in 2014 throughout the southeastern United States, which is the highest to date in any 1 year (Brooks and Dean 2008).

**Incomplete data set from Florida as all colonies are not surveyed every year.

Wood stork nesting in the Everglades and Big Cypress Systems

The number of nesting pairs in south Florida's Everglades and Big Cypress ecosystems declined from 8,500 pairs in 1961 to fewer than 500 pairs from 1987 through 1995 (Service 2007). The *South Florida Multi Species Recovery Plan* (Service 1999) defines the Everglades and Big Cypress ecosystems as the area south of Lake Okeechobee from Lee County on the west coast to Palm Beach County on the east coast. Total nesting pairs for colonies in this region have varied from year to year. In a review of nesting data for the Everglades and Big Cypress basin region, wood stork nesting success has shown a significant increase from 2005 with 634 pairs to 2,799 in 2014 (Table 3). The highest peak of nesting occurred in 2009 with over 6,000 nesting pairs. These observed fluctuations in nesting between years and nesting sites have been attributed primarily to variable hydrologic conditions during the nesting season (Note: *Hydrologic condition can be located in the South Florida Wading Bird reports for each breeding season* *from 1996-2014*). Frequent heavy rains during nesting can cause water levels to rise rapidly. The abrupt increase in water levels during nesting may cause nest abandonment, re-nesting, late nest initiation, and poor fledging success. Abandonment and poor fledging success has been reported to affect most wading bird colonies in southern Florida *(Note: information was reported in the South Florida wading bird reports from 1996-2014)*. Optimal foraging conditions in 2006 resulted in high nesting success, but the 2-year drought that followed in 2007 and 2008 resulted in no nesting success in south Florida. The 2007 to 2008 drought was followed by a year with below average rainfall with no reversals, resulting in the kind of hydrology that likely accounted for nesting success in wood storks (Note*: information was reported in the South Florida wading bird reports in 2006,2007, and 2008).*

Since 1996, the annual South Florida Wading Bird Report includes a summarization of nesting patterns for wood storks in the Everglades using a set of parameters to measure the storks' responses to the CERP. These annual summaries are useful for characterizing pre-CERP nesting patterns. The key parameters are number of nesting pairs, location of nesting colonies, timing of stork nesting, and the occurrence and frequency of wood stork "super colonies". The Service has set different recovery goals for wood storks in south Florida than those set for CERP. The Service goals consider a running average of 2,500 nesting pairs per year and a nest production that averages at least 1.5 young per active nest.

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Table 1. Wood stork survival per nesting chronology phases.

Age	**Percent Survival**
Egg-laying to Day 14	80
Egg-laying to Day 28 (hatchling)	70
Egg-laying to Day 42	62
Egg-laying to Day 56	56
Egg-laying to Day79	50
Egg-laying to fledgling	42

Table 2. Wood stork nesting data in southeastern United States.

YEAR	TOTAL		FLORIDA		GEORGIA		SOUTH CAROLINA		NORTH CAROLINA	
	Nesting pairs	**Colonies**	**Nesting pairs**	**Colonies**	**Nesting pairs**	**Colonies**	**Nesting pairs**	**Colonies**	**Nesting pairs**	**Colonies**
1981	4,442	22	4,156	19	275	2	11	1		
1982	3,575	22	3,420	18	135	2	20	1		
1983	5,983	25	5,600	22	363	2	20	1		
1984	6,245	29	5,647	25	576	3	22	1		
1985	5,193	23	4,562	17	557	5	74	1		
1986	5,835	36	5,067	29	648	4	120	3		
1987			**		506	5	194	3		
1988			**		311	4	179	3		
1989			**		543	6	376	3		
1990			**		709	10	536	6		
1991	4,073	37	2,440	25	969	9	664	3		
1992			**		1,091	9	475	3		
1993	6,729	43	4,262	29	1,661	11	806	3		
1994	5,768	47	3,588	26	1,468	14	712	7		
1995	7,853	54	5,523	31	1,501	17	829	6		
1996			**		1,480	18	953	7		
1997	5,166	59	2,870	36	1,379	15	917	8		
1998			**		1,665	15	1,093	10		

1999	9,978	71	8,319	50	1,139	13	520	8		
2000			**		566	7	1,236	11		
2001	5,582	44	3,246	23	1,162	12	1,174	9		
2002	7,855	70	5,463	48	1,256	14	1,136	10		
2003	8,813	78	5,804	49	1,653	18	1,356	11		
2004	8,379	93	4,726	63	1,596	17	2,057	13		
2005	5,560	74	2,304	40	1,817	19	1,407	13	32	1
2006	11,279	82	7,216	48	1,928	21	2,010	13	125	1
2007	4,406	55	1,553	25	1,054	15	1,607	14	192	1
2008	6,118	73	1,838	31	2,292	25	1,839	16	149	1
2009	12,720	86	9,428	54	1,676	19	1,482	12	134	1
2010	8,149	94	3,828	51	2,708	28	1,393	14	220	1
2011	9,579	88	5,292	45	2,160	19	2,031	23	96	1
2012	8,452	77	4,539	39	1,905	17	1,827	19	181	2
2013	11,046	100	6,948	57	1,873	19	2,020	21	205	3
2014	11,238	110	5,511	62	2,942	22	2,501	23	284	3

**Incomplete data set from Florida as all colonies are not surveyed every year.

Table 3. Total number of wood stork nesting pairs within the Everglades and Big Cypress Basins, 1996 to 2014. Note: *Data was retrieved from the South Florida Wading Bird Reports from 1996-2014.*

Year	Nesting pairs	3-Year Running Average
1996	600	-
1997	445	-
1998	475	507
1999	4,549	1,823
2000	3,996	3,007
2001	2,681	3,742
2002	2,880	3,186
2003	2,386	2,649
2004	1,015	2,094
2005	634	1,345
2006	2,710	1,453
2007	770	1,371
2008	704	1,395
2009	6,452	2,642
2010	1,220	2,792
2011	2,131	3,268
2012	1,234	1,528
2013	3,059	2,141
2014	2,799	2,364
Average	**2,108**	**2,195**