United States Department of the Interior

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

June 3, 2011

Alfred A. Pantano, Colonel
District Commander
U.S. Army Corps of Engineers
701 San Marco Boulevard, Room 372
Jacksonville, Florida 32207-8175

Service Federal Activity Code:	41420-2006-FA-1500
Service Consultation Code:	41420-2006-F-0674-R001
Corps Application No.:	SAJ-2000-1926 (IP-SB)
Date Received:	May 11, 2010
Formal Consultation Re-Initiation Date:	August 30, 2010
Applicant:	IM Collier Joint Venture
Project:	Mirasol
County:	Collier

Dear Colonel Pantano:

On April 22, 2011, the U.S. Fish and Wildlife Service (Service) provided a Biological Opinion to the U.S. Army Corps of Engineers (Corps) concerning the construction of the Mirasol development project and its effects on the endangered Florida panther (*Puma concolor coryi*) and endangered wood stork (*Mycteria americana*). Upon reviewing the Biological Opinion, the Corps identified that several consultation history dates in the Biological Opinion were incorrect.

The Corp also noted a discrepancy in the acreage of onsite compensation which influences acreage values and Panther Habitat Unit (PHU) calculations throughout the Biological Opinion. Consequently, the Service has coordinated with the applicant to address the Corps concerns.

Based upon new information provided by the Corp and the applicant, the Service has decided to revise our April 22, 2011, Biological Opinion (attached). Please note, the error in acreage calculations is minor; our revised Biological Opinion evaluates a loss of 10.55 acres of panther habitat above that presented in our April 22, 2011, Biological Opinion. To offset this additional loss, the applicant has proposed to purchase and manage an additional 18.31 acres of panther habitat elsewhere in the Panther Primary Zone. As will be seen in the revised Biological Opinion, this minor change does not fundamentally change our conclusion regarding the effects of the project on the Florida panther.

No changes were necessary for our assessment of impacts to the wood stork or other listed species evaluated in the April 22, 2011, Biological Opinion. Should you have further questions

regarding this project, please contact Allen Webb at 772-469-4246. Thank you for your cooperation and effort in protecting fish and wildlife resources.

Sincerely yours,

Spencer Simon
Acting Field Supervisor
South Florida Ecological Services Office

cc: electronic only
Corps, Fort Myers, Florida (Skip Bergman)
EPA, West Palm Beach, Florida (Ron Meidema)
FWC, Naples, Florida (Darrell Land)
FWC, Tallahassee, Florida (FWC-CPS, Mary Ann Poole, Traci Wallace)
FWC, Tallahassee, Florida (Kipp Frohlich)
Service, Atlanta, Georgia (Ken Graham)
Service, Florida Panther NWR, Naples, Florida (Kevin Godsea)

United States Department of the Interior

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

June 3, 2011

Alfred A. Pantano, Colonel
District Commander
U.S. Army Corps of Engineers
701 San Marco Boulevard, Room 372
Jacksonville, Florida 32207-8175

Service Federal Activity Code:	41420-2006-FA-1500
Service Consultation Code:	41420-2006-F-0674-R001
Corps Application No.:	SAJ-2000-1926 (IP-SB)
Date Received:	May 11, 2010
Formal Consultation Re-Initiation Date:	August 30, 2010
Applicant:	IM Collier Joint Venture
Project:	Mirasol
County:	Collier

Dear Colonel Pantano:

This document transmits the Fish and Wildlife Service's (Service) revised Biological Opinion for the construction of the Mirasol development project and its effects on the endangered Florida panther (*Puma concolor coryi*) and endangered wood stork (*Mycteria americana*) in accordance with section 7 of the Endangered Species Act of 1973 as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). The U.S. Army Corps of Engineers (Corps) has requested re-initiation of formal consultation based on the Southern District of Florida Federal Court's determination that the Service's Biological Opinion (BO) dated May 3, 2007, for the construction of the Mirasol residential development was arbitrary and capricious. The Court found the Service's BO failed to analyze the impacts of other Federal projects in the action area when analyzing the environmental baseline and failed to explain the use of fish biomass data for fish less than 8 centimeters (cm) as the basis for determining the density of all fish in all hydroperiods when analyzing effects to the wood stork.

The project as reviewed by the Service is based on information provided by the Corps in their August 9, 2006, Public Notice. In the Public Notice and letter to the Service, the Corps determined the Mirasol project "may affect" the Florida panther and wood stork. The Corps also determined the project "may affect, but is not likely to adversely affect" the threatened eastern indigo snake (*Drymarchon corais couperi*) and the endangered red-cockaded woodpecker (RCW) (*Picoides borealis*). The purpose of the project is to construct a residential golf course community in northern Collier County (Figure 1).

The Corps' 2006 Public Notice presented an application for fill and excavation in 652 acres of wetlands and other surface waters and alteration of 117 acres of uplands, impacting about 769 acres total. The project site is 1,713.45 acres and consists of 1,476.71 acres of jurisdictional wetlands and surface waters and 236.74 acres of uplands. Subsequent information received from the applicant and Corps during consultation indicated the project is actually for fill and excavation in 645.35 acres of wetlands and other surface waters and alteration of 127.62 acres of uplands on the 1,713.45-acre site, for a total project impact of 772.97 acres (Table 1).

The application also referenced the preservation of 940.47 acres, of which 831.35 acres are wetlands and 109.12 acres are uplands. About 54.52 acres of forested wetlands and 2.24 acres of forested uplands, a component of the 940.47 acres, would be enhanced and preserved within the developed portions of the project. The preserve lands outside the development footprint total 903.66 acres and will form a contiguous preserve with adjacent preserved lands. The 903.66 acres include 794.54 acres of wetlands and 109.12 acres of uplands. The proposed preserve lands are situated to the south and west of the National Audubon Society Corkscrew Swamp Sanctuary (Corkscrew Sanctuary) and are connected by other preservation lands the Corkscrew Regional Ecosystem Watershed (CREW). To provide mitigation for wetland impacts and panther compensation, the applicant will also purchase 27.68 wetland credits (equivalent to 82.21 acres) from PIMB and 2,329.67 PHUs of primary zone lands (equivalent to 291.10 acres), for an additional 373.31 acres (82.21+291.10=373.31) of off site preservation. The total preservation proposed by the applicant is 1,313.78 acres.

Restoration of wetlands and uplands in the Mirasol preserve will consist of the removal of exotic vegetation, currently averaging 65 to 70 percent coverage, and the planting of areas with appropriate native communities. The preserve will be placed under a conservation easement granted to the South Florida Water Management District (District).

The majority of the project site was historically used for cattle and pasture. Land use and habitat cover types include 219.92 acres of pine (*Pinus* spp.) flatwood uplands, 11.90 acres of Brazilian pepper (*Schinus terebinthifolius*) uplands, 4.92 acres of road right-of-way, 4.29 acres of wet prairie, 0.27 acre of cattle pond, 1.43 acres of flag (*Iris* sp.) pond, 3.59 acres of Brazilian pepper wetlands, 1.39 acres of mixed hardwood forest, 383.64 acres of melaleuca (*Melaleuca quinquernervia*),819.01 acres of pine flatwood wetlands, 140.88 acres of cypress **(***Taxodium distichum*), and122.21 acres of mixed cypress/pine flatwoods. The invasive exotic, melaleuca, has encroached into the entire project site, with large portions of the site supporting densities greater than 75 percent coverage. Over 85 percent of the project site has melaleuca densities of greater than 50 percent coverage. Total project footprint is 1,713.45 acres, with 940.47 acres of preservation and 772.97 acres of development (Table 1).

When the Service reinitiates a consultation, the analysis of project related effects to listed species must incorporate the best and most current information on the project proposal, site footprint, and changes in the environmental baseline. The Service must also include and consider the best and most current information on listed species that may be affected by the proposed action. The Service, in correspondence to the Corps dated August 8, 2010, requested updated information necessary to meet the requirements of 50 CFR §402.14 (c). On August 30, 2010, the Service received from the applicant sufficient information to re-initiate formal consultation and concur

with the Corps' determination that the proposed project "may affect" the Florida panther and the wood stork. The Service also concurs with the Corps' determinations that the project "may affect, but is not likely to affect" the endangered RCW and the threatened eastern indigo snake.

Consultation History

The previous project was circulated under a Public Notice on May 25, 2001. The proposal was to construct an upscale residential golf course community with an external flow way, as required by the District, to convey excess flood waters from upstream, around the project, to the Cocohatchee Canal. The previous proposal was to impact 659 acres of wetlands, which were heavily infested with exotics. During the permitting process, the applicant offered onsite restoration and preservation of 792 acres of wetlands and 105 acres of uplands as mitigation for the proposed impacts.

On July 11, 2002, the Service concurred with the Corps' determination that the proposed project "may affect, but is not likely to adversely affect" the RCW and eastern indigo snake.

The Service issued their Biological Opinion on project impacts to wood storks and panthers in February 2003.

After revisions to the panther assessment methodology and the collection of additional site-specific forage fish production data, the Corps reinitiated consultation with the Service and received a revised biological opinion on March 9, 2005. The Service concluded the project was not likely to jeopardize the survival and recovery of the Florida panther or wood stork.

On December 7, 2005, the Corps denied a Department of the Army permit for the project.

The applicant modified the project purpose and further reduced wetland impacts by eliminating the external flow way, amending the development footprint, and relocating golf holes to be adjacent to the wetland preserve. Flood plain impacts would be mitigated by an internal pass-through system of lakes that maintain the upstream stage at predevelopment levels during a 25 year, 3-day storm event. The modified project plan would reduce wetland impacts and increase the size of the wetland preserves.

On August 9 and August 24, 2006, the Corps issued public notices for a residential community to be known as "Mirasol."

On February 5, 2007, the Service received a revised species and habitat analysis for the wood stork.

On March 1, 2007, the Service provided the Corps with a Biological Opinion evaluating project effects to the wood stork and Florida panther. Following issuance of the Biological Opinion, the Service noted that the levels of incidental take associated with the endangered wood stork needed clarification. The Service also noted text associated with wet and dry fish biomass calculations, National Wetland Inventory and Florida Land Use Codes and Forms Classification Systems, and prey size selection of wood storks also needed clarification. Consequently, the Service provided a revised BO dated May 3, 2007.

On October 11, 2007, the Corps issued Permit SAJ-2000-1926 to J.D. Nicewonder, Jr. (permit transferred to IM Collier Joint Venture , March 10, 2008), for fill and excavation in 645.35 acres of wetlands and other surface waters and alteration of 127.62 acres of uplands on the 1,713.45-acre site, for a total project impact of about 772.97 acres.

On April 2, 2008, the National Wildlife Federation, Conservancy of Southwest Florida, Collier County Audubon Society, Florida Wildlife Federation, and National Audubon Society (jointly referenced as Plaintiffs) filed a complaint for declaratory and injunctive relief in the United States District Court for the Southern District of Florida (Case Number: 09-14115-CIV-Martinez-Lynch) against the Service and Corps (collectively referenced as the Defendants). The complaint alleged violation of the Act; Clean Water Act, 33 U.S.C. § 1251 (CWA); National Environmental Policy Act, 42 U.S.C § 4332 (NEPA); and the Administrative Procedure Act, 5 U.S.C. § 701 (APA).

On October 23, 2009, the Court found the APA, Act, and NEPA had been violated. The Court declared:

- The Mirasol BO is invalid and is remanded to the Service to prepare a complete and adequate biological opinion,
- The Mirasol environmental assessment is invalid and is remanded to the Corps to prepare a complete and adequate environmental assessment, and
- The section 404(b) permit issued by the Corps for the Mirasol project is revoked and declared invalid.

On May 11, 2010, the Corps, in compliance with the Court order, requested re-initiation of formal consultation with the Service.

On August 8, 2010, the Service in correspondence to the Corps, requested additional information necessary to meet the requirements of 50 CFR §402.14 (c). The Service requested specific information on project effects to the endangered Florida panther, wood stork, and RCW, and the threatened eastern indigo snake and threatened Audubon's crested caracara (*Caracara cheriway*).

On August 30, 2010, the Service received sufficient information to re-initiate formal consultation.

The Service has reviewed all information received and concurs with the Corps' determination that the proposed project "may affect" the Florida panther and the wood stork. The Service also concurs with the Corps' determinations that the project "may affect, but is not likely to adversely affect" the RCW and eastern indigo snake. The Service also reviewed the information provided on project affects to the Audubon's crested caracara and believes the project "may affect, but is not likely to adversely affect" this species. Should the Corps conclude this determination, the Service concurs.

On April 22, 2011, the Service provided the Corps with a BO that addressed project impacts on the development of 772.97 acres and the preservation of 940.47 acres onsite and 355 acres off site for a total of 1,295.47 acres. The Corps confirmed preservation onsite of 940.47 acres, with an off site preservation of 373.31 acres, not 355 acres as noted in the Service's April 22, 2011 BO. The corrected acreages include project impacts to 772.97 acres; preservation of 940.47 acres onsite; and preservation of 373.31 acres off site. In summary, the project will impact 772.97 acres and provide preservation over 1,313.78 acres. Based this information, the Service has decided to revise our April 22, 2011, BO.

The Service is providing this biological opinion in conclusion of formal consultation for the endangered Florida panther and wood stork.

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

The applicant's project design will impact 645.35 acres of wetlands and other surface waters and alter 127.62 acres of uplands on the 1,713.45-acre site, for a total project impact of about 772.97 acres. The applicant proposes to construct an upscale residential golf course community to be known as "Mirasol." The proposed development would consist of residential areas (234 acres), lakes (148 acres), road rights-of-way (52 acres), clubhouse/maintenance/sales buildings (22 acres), 36-hole golf course and paths (222 acres), open space within the development (95 acres), and preserves (940.47 acres). The project site is 1,713.45 acres and consists of 1,476.71 acres of jurisdictional wetlands and 236.74 acres of uplands. Jurisdictional areas consist of melaleuca, disturbed hydric pine, pine-cypress, and cypress communities. Over 85 percent of the project site has melaleuca densities of greater than 50 percent coverage (Appendix 2A and 2B).

The project is bounded on the north by a series of farms and agricultural fields and a residential development known as Bonita Beach Road RPD; on the west by the proposed Parklands and Terafina developments; and on the southwest by an existing development called Olde Cypress. The southern property boundary abuts the Cocohatchee or Immokalee Road Canal. The northeast property boundary is undeveloped while the southeast boundary is adjacent to numerous small farms and out-parcels. Immediately to the east of these out-parcels is a former rock and gravel mine known as Mule Pen Quarry that has been converted into a residential development known as Heritage Bay (Figure 2).

The project development footprint is 829.73 acres and includes 26.26 acres of internal lake buffer preserves, 30.50 acres of golf course buffer preserves, and 772.97 acres of development. The project will result in the direct loss of 809.83 acres of habitat available for occasional use for stalking of prey and dispersal by the Florida panther (645.35 acres of wetlands, 127.62 acres of uplands, and 36.86 onsite preserves=809.83) (Table 1a). The Service considers about 10.60 acres of golf course preserve lands, the 26.26 acres of internal preserve lands, and the 772.97-acre development lands as not available for occasional use by the Florida panther. The remaining 19.95 acres of golf course buffer preserve lands and the adjacent 883.71 acres of the project site will be enhanced and preserved. Total onsite preserved acreage available to the Florida panther is 903.66 acres (883.71+19.95=903.66).

The habitat loss represents 3,884.12 Panther Habitat Units (PHUs) with a proposed compensation of 9,710.30 PHUs (see discussion under Panther Habitat Assessment Methodology and Table 16). The project is within the Florida panther Primary Zone (Kautz et al. 2006) (Figure 3) and within the Service's Panther Focus Area (Figure 4). The applicant proposes to provide onsite compensation for project effects to the panther through the restoration and preservation of 903.66 acres (19.95 acres of golf course buffer lands and the adjacent 883.71-acre onsite preserve). The applicant is also proposing to purchase and protect about 291.10 acres (the equivalent of

2,329.67 PHUs) within the panther Primary Zone, and the purchase of 27.68 wetland credits (about 82.21 acres representing 708.88 PHUs) at the Panther Island Mitigation Bank (PIMB) in Collier County. All compensation sites are in the panther Primary Zone. The total compensation proposal including both onsite and offsite properties provide protection and restoration is about 1,276.97 acres of panther habitat in areas surrounded by restored and protected panther habitat (903.66 acres onsite, 82.21 acres in PIMB, and 291.10 acres in the primary zone).

The proposed compensation plan provides habitat preservation and restoration within and near the project area, and benefits the survival and recovery of the Florida panther as referenced in the Panther Recovery Plan (Service 2008) goal 1.1.1.2.3. This goal recommends habitat preservation and restoration within the Primary Zone be provided in situations where land use intensification can not be avoided. The applicant has proposed eufficient habitat protection and restoration to compensate for habitat loss.

The project will also result in loss of 645.35 acres of wetlands available for foraging by the wood stork (Table 1b). The remaining 831.35 acres of onsite wetlands (54.52 acres within the development and 776.83 acres in the adjacent preserve) will be enhanced and preserved. The habitat impact represents a loss of 190.06 kilograms **(**kg) of wood stork foraging biomass, of which 166.80 (kg) represent short hydroperiod biomass loss and 23.26 kg represent long hydroperiod biomass loss (see discussion under Wood Stork Habitat Assessment Methodology and Table 32). The applicant proposes to provide onsite compensation for project effects to the wood stork through the restoration and preservation of 831.35 acres on the project site (54.52 acres within project development and 776.83 acres within adjacent onsite preserve).

The onsite compensation provides an increase of 2,181.87 kg of biomass following restoration, of which 1,106.37 kg represent short hydroperiod wetland biomass and 1,075.50 kg represent long hydroperiod biomass. The net change, following project construction, is an increase of 1,991.81 kg of foraging biomass (2,181.87-190.06=1,991.81). This change represents an increase of 939.57 kg of short hydroperiod biomass and 1,052.24 kg of long hydroperiod biomass. Based on individual hydroperiod biomass changes, hydroperiod 2 wetland impacts indicate a loss of 17.98 kg of biomass. All other hydroperiod biomass changes are positive (see Table 32).

Although not evaluated as a component of the Service's wood stork assessment, the applicant is also proposing to purchase 27.68 wetland credits (about 82.21 acres) at PIMB in Collier County and an acreage of lands equivalent to about 2,329.67 PHUs (about 291.10 acres) in the panther primary zone. Although the location of the 291.10 acres of panther primary zone lands has not been finalized, these lands may also provide wetland foraging biomass to the wood stork.

Action Area - Florida Panther

The Service's Panther Focus Area includes lands in Charlotte, Glades, Hendry, Lee, Collier, Palm Beach, Broward, Miami-Dade, and Monroe Counties, as well as the southern portion of Highlands County (Figure 4). Developed urban coastal areas in eastern Palm Beach, Broward, and Miami-Dade Counties, and in western Charlotte, Lee, and Collier Counties were excluded because they contain little or no panther habitat and it is unlikely that panthers would use such areas.

Movements of Florida panthers are much larger than the project site and, therefore, the Service's action area is larger than the proposed action area identified by the Corps' public notice. The action area, which is a subset of the current panther range, includes those lands where the Service believes panthers may experience direct and indirect effects from the proposed development. Maehr et al. (1990a) monitored five solitary panthers continuously for 130-hour periods seasonally from 1986 to 1989, rarely observing measurable shifts in location during the day, but nocturnal shifts in location exceeding 20.0 kilometers (km) (12.4 miles) were not unusual. Maehr et al. (2002a) in a later report documented a "mean maximum dispersal distance" of 68.4 km (42.5 miles) for subadult males and 20.3 km (12.6 miles) for subadult females. In the same report Maehr et al. (2002a) documented an "average effective dispersal distance" of 37.3 km (23.2 miles) for subadult males. Comiskey et al. (2002) documented a "mean dispersal distance" for subadult male panthers as an average distance of 40 km (24.9 miles) from their natal range, which is similar to the dispersal distances referenced by Maehr et al. (2002).

Therefore, for both direct and indirect effects, the Service defined the action area (Figure 5) as all lands within a 25-mile radius of the Mirasol project, which is slightly greater than the mean dispersal distance for subadult males. This action area does not include urban lands or lands west of I-75. This action area includes areas anticipated to sustain direct and indirect effects, such as roadways experiencing increased traffic, areas with increased human disturbance (project area and periphery of project), and areas in which habitat fragmentation and intraspecific aggression may be felt.

Action Area - Wood Stork

The Service has determined the action area for the wood stork is larger than the proposed action area identified in the Corps' public notice. We note the project site is located within 18 miles of three active wood stork nesting colonies. Two of these colonies are located within the Corkscrew Sanctuary about 7.8 miles and 8.9 miles northeast of the project site. The third wood stork nesting colony is located about 17.6 miles east of the project site, just north of the Fakahatchee Strand State Preserve. Coulter and Bryan (1993) found that 85 percent of wood stork foraging occurs within 12.5 miles of the nesting colony. Furthermore, the Florida Fish and Wildlife Commission (FWC) considers the area within 18.6 miles of the nesting colony as the Core Foraging Area (CFA) for wood storks. For the purposes of this biological opinion, the action area is considered to include the project site and the CFAs of the three wood stork nesting colonies described above. The action area encompasses 1,621.1 square miles of Collier, Lee, and Hendry Counties (Figure 6).

STATUS OF THE SPECIES AND CRITICAL HABITAT

Florida Panther

Status: The Florida panther is the last subspecies of *Puma* (also known as mountain lion, cougar, painter, or catamount) still surviving in the eastern United States. Historically occurring throughout the southeastern United States (Young and Goldman 1946), today the panther is restricted to less than 5 percent of its historic range in one breeding population of about 100 animals, located in south Florida.

When Europeans first came to this country, pumas roamed most of North, Central, and South America. Early settlers attempted to eradicate pumas by every means possible. By 1899 it was believed Florida panthers had been restricted to peninsular Florida (Bangs 1899). By the late 1920s to mid 1930s it was thought by many that the Florida 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 has confirmed that a breeding panther population occurs in southern Florida south of the Caloosahatchee River, and no survey since then has been able to confirm a panther population outside of southern Florida.

Attempts to eradicate panthers and a decline in panther prey (primarily white-tailed deer [*Odocoileus virginianus*]) resulted in a panther population threatened with extinction. Prior to 1949, panthers could be killed in Florida at any time of the year. In 1950, the Florida Game and Freshwater Fish Commission (now FWC) designated 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 Florida panther as endangered (32 Federal Register 4001) throughout its historic range, and these animals received Federal protection under the passage of the Act in 1973. Also, the Florida Panther Act (State Statute 372.671), a 1978 Florida State law, made killing a panther a felony. The Florida panther is listed as endangered by the States of Florida, Georgia, Louisiana, and Mississippi.

Since the panther was designated as an endangered species prior to enactment of the Act, there was no formal listing package identifying threats to the species as required now by section 4(a)(1) of the Act. However, the Florida Panther Recovery Plan, third revision, addressed the five factor threats analysis (Service 2006b, 2008).

No critical habitat has been designated for the panther.

Taxonomy: The Florida panther was first described by Charles B. Cory in 1896 as *Felis concolor floridana* (Cory 1896). The type specimen was collected in Sebastian, Florida. Bangs (1899), however, believed that the Florida panther was restricted to peninsular Florida and could not intergrade with other *Felis* spp. Therefore, he assigned it full specific status and named it *Felis coryi* since *Felis floridana* had been used previously for a bobcat (*Lynx rufus*).

The taxonomic classification of the *Felis concolor* group was revised and described by Nelson and Goldman (1929) and Young and Goldman (1946). These authors differentiated 30 subspecies using geographic and morphometric (measurement of forms) criteria and reassigned the Florida panther to subspecies status as *Felis concolor coryi.* This designation also incorporated *F. arundivaga*, which had been classified by Hollister (1911) from specimens collected in Louisiana, into *F. c. coryi*. Wozencraft (1993) promoted the subgenera of the old genus *Felis* to full generic status and placed a number of former *Felis* species, including the puma, in monotypic genera (Nowell and Jackson 1996). The taxonomic classification of the puma is now considered to be *Puma concolor* (Wozencraft 1993), making the accepted name for the Florida panther *P. c. coryi*.

Culver et al. (2000) examined genetic diversity within and among the described subspecies of *P. concolor* using three groups of genetic markers and proposed a revision of the genus to include only six subspecies, one of which encompassed all puma in North America including the Florida panther. However, Culver et al. (2000) determined that the Florida panther was one of several smaller populations that had unique features. Specifically, the number of polymorphic microsatellite loci and amount of variation were lower, and it was highly inbred (eight fixed loci). The degree to which the scientific community has accepted the results of Culver et al. (2000) and the proposed change in taxonomy is not resolved at this time (Service 2008). The Florida panther remains listed as a subspecies and continues to receive protection pursuant to the Act.

Species Description

An adult Florida panther is unspotted and typically rusty reddish-brown on the back, tawny on the sides, and pale gray underneath. There has never been a melanistic (black) puma documented in North America (Tinsley 1970, 1987). Adult males can reach a length of 7 feet (ft) (2.1 meters [m]) from their nose to the tip of their tail and may exceed 161 pounds (lbs) (73 kg) in weight; but, typically adult males average around 116 lbs (52.6 kg) and stand about 24-28 inches (in) (60-70 centimeters [cm]) at the shoulder (Roelke 1990). Female panthers are smaller with an average weight of 75 lbs (34 kg) and length of 6 ft (1.8 m) (Roelke 1990). The skull of the Florida panther is unique in that it has a broad, flat, frontal region, and broad, high-arched or upward-expanded nasal bones (Young and Goldman 1946).

Florida panther kittens are gray with dark brown or blackish spots and five bands around the tail. The spots gradually fade as the kittens grow older and are almost unnoticeable by the time they are 6 months old. At this age, their bright blue eyes slowly turn to the light-brown straw color of the adult (Belden 1988).

Three external characters – a right angle crook at the terminal end of the tail, a whorl of hair or cowlick in the middle of the back, and irregular, white flecking on the head, nape, and shoulders – not found in combination in other subspecies of *Puma* (Belden 1986), were commonly observed in Florida panthers through the mid-1990s. The kinked tail and cowlicks were considered manifestations of inbreeding (Seal 1994); whereas the white flecking was thought to be a result of scarring from tick bites (Maehr 1992; Wilkins et al. 1997). Four other abnormalities prevalent in the panther population prior to the mid-1990s were cryptorchidism (one or two undescended testicles), low sperm quality, atrial septal defects (the opening between two atria in the heart fails to close normally during fetal development), and immune deficiencies; and these were also suspected to be the result of low genetic variability (Roelke et al. 1993a).

A plan for genetic restoration and management of the Florida panther was developed in September 1994 (Seal 1994) and eight non-pregnant adult female Texas panthers (*Puma concolor stanleyana*) were released in five areas of south Florida from March to July 1995. Since this introgression, rates of genetic defects, including crooked tails and cowlicks, have dramatically decreased (Mansfield and Land 2002, Land et al. 2004, Onorato et al. 2010, Johnson et al. 2010). The last of these females was removed in 2003.

Distribution and Trends

The Florida panther once ranged throughout the southeastern United States from Arkansas and Louisiana eastward across Mississippi, Alabama, Georgia, Florida, and parts of South Carolina and Tennessee (Young and Goldman 1946). Historically, the panther intergraded to the north with *P. c. cougar*, to the west with *P. c. stanleyana*, and to the northwest with *P. c. hippolestes* (Young and Goldman 1946).

Although generally considered unreliable, sightings of panthers regularly occur throughout the southeast. However, no reproducing populations of panthers have been found outside of south Florida for at least 30 years, despite intensive searches to document them (Belden et al. 1991; McBride et al. 1993; Clark et al. 2002). Survey reports and more than 70,000 locations of radio-collared panthers recorded between 1981 and 2004 clearly define the panther's current breeding range. Reproduction is known only in the Big Cypress Swamp and Everglades physiographic region in Collier, Lee, Hendry, Miami-Dade, and Monroe Counties, south of the Caloosahatchee River (Belden et al. 1991). Although the breeding segment of the panther population occurs only in south Florida, panthers have been documented north of the Caloosahatchee River over 125 times since February 1972. This has been confirmed through field signs (*e.g.*, tracks, urine markers, scats), camera-trap photographs, seven highway mortalities, four radio-collared animals, two captured animals (one of which was radio collared), and one skeleton. From 1972 through 2004, panthers have been confirmed in 11 counties (Flagler, Glades, Highlands, Hillsborough, Indian River, Okeechobee, Orange, Osceola, Polk, Sarasota, Charlotte, and Volusia) north of the river (Belden et al. 1991; Belden and McBride 2005). However, no evidence of a female or reproduction has been documented north of the Caloosahatchee River since 1973 (Nowak and McBride 1974; Belden et al. 1991; Land and Taylor 1998; Land et al. 1999; Shindle et al. 2000; McBride 2002; Belden and McBride 2005).

Puma are wide ranging, secretive, and occur at low densities. However, their tracks, urine markers, and scats are readily found by trained observers, and resident populations are easily located. Van Dyke et al. (1986a) determined that all resident puma, 78 percent of transient puma, and 57 percent of kittens could be detected by track searches in Utah. During 2 month-long investigations – one late in 1972 and early 1973 and another in 1974 – funded by the World Wildlife Fund to determine if panthers still existed in Florida, McBride searched for signs of panthers in portions of south Florida. In 1972, McBride authenticated a road-killed male panther in Glades County and a female captured and released from a bobcat trap in Collier County (R. McBride, Livestock Protection Company, personal communication 2005). In 1973, McBride captured one female in Glades County (Nowak and McBride 1974). Based on this preliminary evidence, Nowak and McBride (1974) estimated the "population from the Lake Okeechobee area southward to be about 20 or 30 individuals." In 1974, McBride found evidence of only two additional panthers in the Fakahatchee Strand and suggested that "there could be as few as 10 individuals panthers in the area around Lake Okeechobee and southward in the State" (Nowak and McBride 1975). This initial survey, while brief in nature, proved that panthers still existed in Florida and delineated areas where a more exhaustive search was warranted. After this initial investigation, more comprehensive surveys on both public and private lands were completed (Reeves 1978; Belden and McBride 1983; Belden et al. 1991).

Using a population genetics approach, Culver et al. (2008) estimated that to reduce the microsatellite variation to that seen in the Florida panther, a very small bottleneck size of about two animals (N_e) for several generations and a small effective population size in other generations would be necessary. Using demographic data from Yellowstone pumas, Culver et al. (2008) estimated the ratio of effective (N_e) to census (N) population size to be 0.315 (N_e)/N). Using this ratio, they determined that for the Florida panther, the census population size necessary to explain the loss of microsatellite variation was about 41 for the non bottleneck generations and 6.2 for the two bottleneck generations.

Minimum Population Counts: 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 was increasing 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 a corresponding census populations (N) of 26 and 102, respectively. The corresponding N_e /N ratios were 0.631 and 0.314 (Johnson et al. 2010). The deterministic annual growth rate (λ) for pre-1995 panthers was 0.952 ± 0.026 (SE), suggestive of a shrinking population (Hostetler et al. 2009). However, the λ for the overall population now is 1.052 ± 0.023 suggestive of a growing population (Hostetler et al. 2009).

The population has tripled since 1995 (McBride et al. 2008, Johnson et al. 2010), reaching a high of 117 by 2007 (mortalities not subtracted) (McBride et al. 2008). Data reported in McBride (2000, 2001, 2004, 2006, 2007, and 2008), McBride et al. (2008), Johnson et al. (2010), and FWC (2002, 2003) 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, and 113 in 2009. Table 2 provides a yearly tabulation of the population counts with the annual mortalities also shown. The mortality data is recorded by the FWC and reported to the Service.

Population Density: Maehr et al. (1991) provide an estimate of population density of 1 panther per 27,520 acres based on 17 concurrently radio-collared and 4 uncollared panthers. They extrapolated this density to the area occupied (1,245,435 acres) by radio-collared panthers during the period 1985 to 1990 to achieve a population estimate of 46 adult panthers for southwest Florida (excluding ENP, eastern BCNP, and Glades and Highlands Counties). Beier et al. (2003), however, argued that this estimate of density, although "reasonably rigorous," could not be extrapolated to other areas because it was not known whether densities were comparable in those areas. Kautz et al. (2006) provided a density estimate of 1 panther per 31,923 acres by dividing the

panther count at that time (67) by the area within the Primary Zone. However, panther densities are variable across the landscape. Using an average of the 2007 to 2009 panther counts in the eight survey units of McBride et al. (2008) and Kautz et al. (2006) primary zone land within these survey units, density estimates range from a low of 1 panther per 81,479 acres to a high of 1 panther per 7,850 acres.

The FWC (2010b) provided an upper bound population estimate of 0.0177 panthers per square-kilometer (km^2) or 1 panther per 13,929 acres. Applying this density estimate to the Primary Zone (9,189 km^2)(2,270,652 acres) yields an upper estimate of 163 adult panther. FWC's lower boundary limit is 100 panthers (1.09 panthers per 100 km^2 or 1 panther per 22,707 acres) and is based on annual verified panther sign data (McBride et al. 2008) and minimum number of panthers known to be alive (Darrell Land - FWC 2010b). Applying the four densities to the primary zone would yield a population from Kautz et al.'s density estimate of 71 panthers (1 panther per 31,923 acres). Maehr et al.'s (1991) estimate would yield a population of 83 panthers (1 panther per 27,520 acres) and FWC's (2010b) estimate would yield a low of 100 panthers (1 panther per 22,707 acres) and a high of 163 panthers (1 panther per 13,929 acres). For our evaluations however, the Service is continuing to use the average densitities provided by Kautz et al. (2006) of one panther per 12,919 ha (31,923 acres) or one panther per 129 km^2.

Life History

Reproduction: Male Florida panthers are polygynous, maintaining large, overlapping home ranges containing several adult females and their dependent offspring. The first sexual encounters for males normally occur at about 3 years based on 26 radio-collared panthers of both sexes (Maehr et al. 1991). Based on genetics work, some males may become breeders as early as 17 months (W. Johnson, National Cancer Institute, Personal Communication 2005). The 6-month breeding probability (probability of producing a litter) for females was 0.232 ± 0.021 (standard error [SE]) (annual breeding probability 0.410 ± 0.032 SE), and average litter size was 2.596 ± 0.144 (Hostetler et al. 2009). Seventy percent of litters are comprised of either two or three kittens. Litters are produced throughout the year, but the greatest number of births occur from March through July (FWC 2010a). Female panthers have bred as young as 18 months (Maehr et al. 1989) and successful reproduction has occurred up to 11 years old. However, older-adult females (age ≥ 10 years) are less likely to breed than younger females (Hostetler et al. 2009). The mean age of denning females is 4.6 ± 2.1 (standard deviation [sd]) years (FWC 2005). Age at first reproduction for 19 known-aged female panthers averaged 2.2 ± 0.246 (sd) years and ranged from 1.8 to 3.2 years. Mean birth intervals (elapsed time between successive litters) are 19.8 ± 9.0 (sd) months for female panthers (n = 56) (range 4.1 to 36.5 months) (FWC 2005). Females that lose their litters generally produce another more quickly; five of seven females whose kittens were brought into captivity successfully produced another litter an average of 10.4 months after the removal of the initial litter (Land 1994).

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 1990; 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).

Survivorship and Causes of Mortality: Benson et al. (2009) analyzed survival and cause-specific mortality of subadult and adult Florida panthers. They found that sex and age influenced panther survival, as females survived better than males, and older adults (≥10 years or older) survived poorly compared with younger adults. Genetic ancestry strongly influenced annual survival of subadults and adults after introgression, as F_1 generation admixed panthers survived longer than pre-introgression panthers and non-F_1 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. Through March 24, 2011, 309 mortalities have been documented (FWC 2011). Of the 309 total mortalities, 157 were radio-collared panthers that have died since 1981 (FWC 2011). 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 sub-adult males had marginally higher mortality due to intraspecific aggression than prime-adult males (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 and or a kill is suspected in half (5 of 10) of the known instances through 2003 (Shindle et al. 2003). Of the 309 total panther mortalities, 57 were from intraspecific aggression with 55 of the mortalities being collared panthers (FWC 2011).

Following intraspecific aggression, the greatest causes of mortality for radio-collared Florida panthers was from unknown causes, vehicles, and other reasons (Benson et al. 2009). From February 13, 1972, through March 24, 2011, 162 radio-collared and uncollared Florida panthers were hit by vehicles (FWC 2011). Nine of the collisions were not fatal. The number of panther/vehicle collisions per year tracks very closely 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 bred (Maehr et al. 1991). Land et al. (2004) reported that 23 of 24 female panthers first captured as kittens survived to become residents and 18 (78.3 percent) produced litters; one female was too young to determine residency. Male panthers are considered adult residents if they are older than 3 years and have established a home range that overlaps with females. Thirty-one male panthers were captured as kittens and 12 (38.7 percent) of these cats survived to become residents (Jansen et al. 2005; FWC 2005). Successful male recruitment appears to depend on the death or home range shift of a resident adult male (Maehr et al. 1991). Turnover in the breeding population is low with documented mortality in radio-collared panthers being greatest in 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 (PIT) 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).

Dispersal: Panther dispersal begins after a juvenile becomes independent from its mother and continues until it establishes a home range. Dispersal distances are greater for males (n = 18) than females (n = 9) (42.5 mi [68.4 km] verses 12.6 mi [20.3 km], respectively) and the maximum dispersal distance recorded for a young male was 139.2 mi (224.1 km) over a 7-month period followed by a secondary dispersal of 145 mi (233 km) (Maehr et al. 2002a). Males disperse an average distance of 25 mi (40 km); females typically remain in or disperse short distances from their natal ranges (Comiskey et al. 2002). Female dispersers are considered philopatric because they usually establish home ranges less than 1 average home range width from their natal range (Maehr et al. 2002a). Maehr et al. (2002a) reported that all female dispersers (n = 9) were successful at establishing a home range whereas only 63 percent of males (n = 18) were successful. Young panthers become independent at 14 months on average for both sexes, but male dispersals are longer in duration than female dispersals (9.6 months and 7.0 months, respectively) (Maehr et al. 2002a). Dispersing males usually go through a period as transient (non-resident) subadults, moving through the fringes of the resident population and often occupying suboptimal habitat until an established home range becomes vacant (Maehr 1997).

Most panther dispersal occurs south of the Caloosahatchee River with only four radio-collared panthers crossing the river and continuing north since 1981 (Land and Taylor 1998; Land et al. 1999; Shindle et al. 2000; Maehr et al. 2002a; Belden and McBride 2005). Western subspecies of *Puma* have been documented crossing wide, swift-flowing rivers up to a mile in width (Seidensticker et al. 1973; Anderson 1983). The Caloosahatchee River, a narrow (295 to 328 ft [90 to 100 m]), channelized river, probably is not a significant barrier to panther movements, but the combination of the river, SR 80, and land uses along the river seems to have restricted panther dispersal northward (Maehr et al. 2002a). Documented physical evidence of at least 15 other uncollared male panthers have been confirmed north of the river since 1972, but no female panthers nor reproduction have been documented in this area since 1973 (Belden and McBride 2005).

Home Range Dynamics and Movements: Panthers require large areas to meet their needs. Numerous factors influence panther home range size, including: habitat quality, prey density, and landscape configuration (Belden 1988; Comiskey et al. 2002). Home range sizes of six radio-collared panthers monitored between 1985 and 1990 averaged 128,000 acres for resident adult males and 48,000 acres for resident adult females; transient males had a home range of 153,599 acres (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 acres and females had a mean home range of 97,920 acres. 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 acres, averaging 89,600 acres for 20 resident adult males and 44,160 acres for 32 resident adult females (Land et al. 1999; Shindle et al. 2000, 2001; Land et al. 2002). The most current estimate of home range sizes (minimum convex polygon method) for established, non-dispersing, adult, radio-collared panthers averaged 29,056 acres for females (*n* = 11) and 62,528 acres for males (*n* = 11) (FWC 2005). The average home range was 35,089 acres for resident females (*n* = 6) and 137,143 acres (*n* = 5) for males

located at BCNP (Jansen et al. 2005). Home ranges of resident adults tend to be stable unless influenced by the death of other residents; however, several males have shown significant home range shifts that may be related to aging (D. Jansen, NPS, Personal Communication, 2005). Home range overlap is extensive among resident females and limited among resident males (Maehr et al. 1991).

Activity levels for Florida panthers are greatest at night with peaks around sunrise and after sunset (Maehr et al. 1990a). The lowest activity levels occur during the middle of the day. Female panthers at natal dens follow a similar pattern with less difference between high and low activity periods.

Telemetry data indicate panthers typically do not return to the same resting site day after day, with the exception of females with dens or panthers remaining near kill sites for several days. The presence of physical evidence such as tracks, scats, and urine markers confirm that panthers move extensively within home ranges, visiting all parts of the range regularly in the course of hunting, breeding, and other activities (Maehr 1997; Comiskey et al. 2002). Males travel widely throughout their home ranges to maintain exclusive breeding rights to females. Females without kittens also move extensively within their ranges (Maehr 1997). Panthers are capable of moving large distances in short periods of time. Nightly panther movements of 12 mi (20 km) are not uncommon (Maehr et al. 1990a).

Intraspecific Interactions: Interactions between panthers occur indirectly through urine markers or directly through contact. Urine markers are made by piling ground litter using a backwards-pushing motion with the hind feet. This pile is then scent-marked with urine and occasionally feces. Both sexes make urine markers. Apparently males use them as a way to mark their territory and announce presence while females advertise their reproductive condition.

Adult females and their kittens interact more frequently than any other group of panthers. Interactions between adult male and female panthers last from 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. Aggression between males is the most common cause of male mortality and an important determinant of male spatial and recruitment patterns based on radio-collared panthers (Maehr et al. 1991; Shindle et al. 2003). Aggressive encounters between radio-collared males and females also have been documented (Shindle et al. 2003; Jansen et al. 2005).

Food Habits: Primary panther preys are white-tailed deer and feral hog (*Sus scrofa*) (Maehr et al. 1990b; Dalrymple and Bass 1996). Generally, feral hogs constitute the greatest biomass consumed by panthers north of the Alligator Alley section of I-75, while white-tailed deer are the greatest biomass consumed to the south (Maehr et al. 1990b). Secondary prey includes raccoons (*Procyon lotor*), nine-banded armadillos (*Dasypus novemcinctus*), marsh rabbits (*Sylvilagus palustris*) (Maehr et al. 1990b) and alligators (*Alligator mississippiensis*) (Dalrymple and Bass 1996). No seasonal variation in diet has been detected. A resident adult male puma generally consumes one deer-sized prey every 8 to 11 days; this frequency would be 14 to 17 days for a resident female; and 3.3 days for a female with three 13-month-old kittens (Ackerman et al. 1986). Maehr et al. (1990b) documented domestic livestock infrequently in scats or kills, although cattle were readily available on their study area.

Viral Diseases: Feline leukemia virus (FeLV) is common in domestic cats (*Felis catus*), but is quite rare in non-domestic felids. Routine testing for FeLV antigen (indicating active infection) in captured and necropsied panthers was negative from 1978 (when testing began) to the fall of 2002. Between November 2002 and February 2003, however, two panthers tested FeLV antigen positive (Cunningham 2005). The following year, three more cases were diagnosed. All infected panthers had overlapping home ranges in the Okaloacoochee Slough ecosystem.

Three panthers died due to suspected FeLV-related diseases (opportunistic bacterial infections and anemia) and the two others died from intraspecific aggression. Testing of serum samples collected from 1990 to 2005 for antibodies (indicating exposure) to FeLV indicated increasing exposure to FeLV beginning in the late 1990s and concentrated north of I-75. There was apparently minimal exposure to FeLV during this period south of I-75. Positive antibody titers in different areas at different times may indicate that multiple introductions of the virus into the panther population may have occurred. These smaller epizootics were apparently self-limiting and did not result in any known mortalities. Positive antibody titers, in the absence of an active infection (antigen positive), indicate that panthers can be exposed and overcome the infection (Cunningham 2005). Genetic analysis of the panther FeLV determined that the source of this outbreak was a cross-species transmission from a domestic cat (Brown et al. 2008).

Management of the disease includes vaccination (Cunningham et al. 2008) as well as removal of infected panthers to captivity for quarantine and supportive care. As of June 1, 2005, about one-third of the population had received at least one vaccination against FeLV (Cunningham et al. 2008). No new positive cases have been diagnosed since July 2004; however, the potential for reintroduction of the virus remains (Cunningham et al. 2008).

Pseudorabies virus (PRV) (Aujeszky's disease) causes respiratory and reproductive disorders in adult hogs and mortality in neonates, but is a rapidly fatal neurologic disease in carnivores. At least one panther died from PRV infection presumably through consumption of an infected feral hog (Glass et al. 1994). At least one panther has also died of rabies (Taylor et al. 2002). This animal had been radio-collared but not vaccinated against the disease.

Feline immunodeficiency virus (FIV) is a retrovirus of felids that is endemic in the panther population. About 28 percent of Florida panthers were positive for antibodies to the puma lentivirus strain of FIV (Olmstead et al. 1992); however, the prevalence may be increasing. Between November 2004 and April 2005, 13 of 17 (76 percent) panthers tested were positive (M.Cunningham, FWC, unpublished data). There is also evidence of exposure to Feline panleukopenia virus (PLV) in adult panthers (Roelke et al. 1993b) although no PLV-related mortalities are known to have occurred.

Serological evidence of other viral diseases in the panther population includes feline calicivirus, feline herpes virus, and West Nile virus (WNV). However, these diseases are not believed to cause significant morbidity or mortality in the population. All panthers found dead due to unknown causes are tested for alphaviruses, flaviviruses (including WNV), and canine distemper virus. These viruses have not been detected in panthers by viral culture or polymerase chain reaction (FWC, unpublished data).

Other Infectious Diseases: Bacteria have played a role in free-ranging panther morbidity and mortality as opportunistic pathogens, taking advantage of pre-existing trauma or FeLV infections (FWC, unpublished data). Dermatophytosis (ringworm infection) has been diagnosed in several panthers and resulted in severe generalized infection in at least one (Rotstein et al. 1999). Severe infections may reflect an underlying immunocompromise, possibly resulting from inbreeding depression or immunosuppressive viral infections.

Parasites: The hookworm, *Ancylostoma pluridentatum*, is found in a high prevalence in the panther population. Other parasites identified from live-captured or necropsied panthers include: eight arthropod species, eight nematode species, three cestode species, two trematode species, and three protozoa species (Forrester et al. 1985; Forrester 1992; Wehinger et al. 1995; Rotstein et al. 1999; Land et al. 2002). Of these, only an arthropod, *Notoedres felis*, caused significant morbidity in at least one panther (Maehr et al. 1995).

Environmental Contaminants: Overall, mercury in south Florida biota has decreased over the last several years (Frederick et al. 2002). However, high mercury concentrations are still found in some panthers. At least one panther is thought to have died of mercury toxicosis and mercury has been implicated in the death of two other panthers in ENP (Roelke 1991). One individual panther had mercury concentrations of 150 parts per million (ppm) in its hair (Land et al. 2004). Elevated levels of p, p'– DDE were also detected in fat from that panther. The role of mercury and/or p, p'–DDE in this panther's death is unknown and no cause of death was determined despite extensive diagnostic testing. Elevated mercury concentrations have also been found in panthers from FPNWR. Two sibling neonatal kittens from this area had hair mercury concentrations of 35 and 40 ppm. Although other factors were believed to have been responsible, these kittens did not survive to leave their natal den. Other environmental contaminants found in panthers include polychlorinated biphenyls (Arochlor 1260) and organochlorines (p, p'–DDE) (Dunbar 1995; Land et al. 2004).

Habitat Characteristics/Ecosystem: Noss and Cooperrider (1994) considered the landscape implications of maintaining viable panther populations. Assuming a male home range size of 137,599 acres (Maehr 1990), an adult sex ratio of 50:50 (Anderson 1983), and some margin of safety, they determined that a reserve network as large as 15,625 - 23,438 mi^2 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 - 234,376 mi^2. This latter acreage corresponds to roughly 60 to 70 percent of the Florida panther's historical range. Although it is uncertain whether this much land is needed for panther recovery, it does provide some qualitative insight into the importance of habitat conservation across large landscapes for achieving a viable panther population (Noss and Cooperrider 1994).

Between 1981 and 2010, more than 90,000 locations were collected from more than 180 radio-collared panthers (FWC 2010a). The most recent capture and collar event was associated with the capture and collar of a male panther thought to be associated with recent calf depredations in eastern Collier County (FWC 2010c). 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. Since almost all locations from radio

collars have been collected during daytime hours (generally 0700 to 1100), using very high frequency (VHF) aerial telemetry, and because panthers are most active during nocturnal and crepuscular periods (Maehr et al. 1990a), daytime telemetry data may be insufficient to describe habitat use patterns of nocturnal animals (Beyer and Haufler 1994; Comiskey et al. 2002; Beier et al. 2003; Dickson et al. 2005; Beier et al. 2006). However, 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 that analysis of both types of telemetry data yielded similar results.

A landscape-level strategy for the conservation of the panther population in south Florida was developed using a Florida panther potential habitat model based on the following criteria: (1) forest patches greater than 4.95 acres; (2) non-urban cover types within 656 ft of forest patches; and (3) exclusion of lands within 984 ft of urban areas (Kautz et al. 2006). In developing the model, data from radio-collared panthers collected from 1981 through 2000 were used to evaluate the relative importance of various land cover types as panther habitat, thus identifying landscape components important for panther habitat conservation. Those components were then combined with a least cost path analysis to delineate three panther habitat conservation zones for south Florida: (1) Primary Zone – lands important to the long-term viability and persistence of the panther in the wild; (2) Secondary Zone – lands which few panthers use contiguous with the Primary Zone, but given sufficient habitat restoration could accommodate expansion of the panther population south of the Caloosahatchee River; and (3) Dispersal Zone – the area which may facilitate future panther expansion north of the Caloosahatchee River (Kautz et al. 2006) (Figure 7). The Primary Zone is currently occupied and supports the breeding population of panthers. The Secondary Zone could support resident panthers with sufficient restoration. Although panthers move through the Dispersal Zone, it is not currently occupied by resident panthers.

These zones vary in size, ownership, and land cover composition. The Primary Zone is 2,270,711 acres in size, 73 percent of which is publicly owned (Kautz et al. 2006), and includes portions of the Big Cypress National Preserve (BCNP), Everglades National Park (ENP), Fackahatchee Strand Peserve State Park (FSPSP), Florida Panther National Wildlife Refuge (FPNWR), Okaloacoochee Slough State Forest, and Picayune Strand State Forest (PSSF). This zone's composition is 45 percent forest, 41 percent freshwater marsh, 7.6 percent agriculture lands, 2.6 percent prairie and shrub lands, and 0.52 percent urban lands (Kautz et al. 2006). The Secondary Zone is 812,157 acres in size, 38 percent of which is public land (Kautz et al. 2006). This zone's composition is 43 percent freshwater marsh, 36 percent agriculture, 11 percent forest, 6.1 percent prairie and shrub lands, and 2.3 percent low-density residential areas and open urban lands (Kautz et al. 2006). The Dispersal Zone is 28,160 acres in size, 12 percent of which is either publicly owned or in conservation easement. This zone's composition is 49 percent agriculture (primarily improved pasture and citrus groves), 29 percent forest (wetland and upland), 8.8 percent prairie and shrub land, 7.5 percent freshwater marsh, and 5.1 percent barren and urban lands (Kautz et al. 2006).

As part of their evaluation of occupied panther habitat, in addition to the average density estimate of one panther per 27,181 acres developed by Maehr et al. (1991), Kautz et al. (2006) estimated the average density during the timeframe of the study, based on telemetry and other occurrence data, to average one panther per 31,923 acres. In the following discussions of the number of panthers

that a particular zone may support, the lower number is based on the 31,923 acres value (Kautz et al. 2006) and the higher number is based on the 27,181 acres value (Maehr et al. 1991).

Based on these average densities, the Primary Zone could support 71 to 84 panthers; the Secondary Zone could support 8 to 10 panthers without habitat restoration and 25 to 30 panthers with habitat restoration (existing high quality panther habitat currently present in the Secondary Zone is estimated at 32 percent of the available Secondary Zone lands); and the Dispersal Zone could support 0 panthers. Taken together, the three zones in their current condition have the capacity to support about 79 to 94 Florida panthers.

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, 2009) used a statistical model in combination with a geographic information system to develop a multivariate landscape-scale habitat model based on the Mahalanobis distance statistic (D^2) to evaluate habitats in south-central Florida for potential expansion of the Florida panther population. They identified four potential habitat patches: the Avon Park Bombing Range area, Babcock-Webb Wildlife Management Area, eastern Fisheating Creek Wildlife Management Area, and the Duette Park/Manatee County area. These habitat patches are smaller and more isolated compared with the current Florida panther range, and the landscape matrix where these habitat patches exist provides relatively poor habitat connectivity among the patches (Thatcher et al. 2006, 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).

Panther Habitat Use: 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 panther 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. GPS data has shown that 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 acres [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 that 73 percent of panther dens were in saw palmetto thickets.

Panther habitat selection is related to prey availability (Janis 1999; Dees et al. 2001) and, consequently, prey habitat use. Adequate cover and the size, distribution, and abundance of available prey species are critical factors to the persistence of panthers in south Florida and often determine the extent of panther use of an area. Duever et al. (1986) calculated a deer population of 1,760 in BCNP, based on Harlow (1959) deer density estimates of 1/210 acres in pine forest, 1/299 acres in swamps, 1/1,280 acres in prairie, 1/250 acres in marshes, and 1/111 acres in

hammocks. Schortemeyer et al. (1991) estimated deer densities at 1/49 to 247 acres in three management units of BCNP based on track counts and aerial surveys. Labisky et al. (1995) reported 1/49 acres in southeastern BICP. Using track counts alone, McCown (1994) estimated 1/183 to 225 acres on the FPNWR and 1/133 to 200 acres in the FSPSP.

Hardwood hammocks and other forest cover types are important habitat for white-tailed deer and other panther prey (Harlow and Jones 1965; Belden et al. 1988; Maehr 1990; Maehr et al. 1991; Maehr 1992; Comiskey et al. 1994; Dees et al. 2001). Periodic understory brushfires (Dees et al. 2001) as well as increased amounts of edge (Miller 1993) may enhance deer use of hardwood hammocks, pine, and other forest cover types. Other vegetation types (e.g., marshes, rangeland, and low-intensity agricultural areas) can support high deer densities. In the Everglades, for example, deer appear to be adapted to a mosaic of intergrading patches comprised of wet prairie, hardwood tree islands, and peripheral wetland habitat (Fleming et al. 1994; Labisky et al. 2003). High-nutrient deer forage, especially preferred by females, includes hydrophytic marsh plants, white waterlily (*Nymphaea odorata*), and swamp lily (*Crinum americana*) (Loveless 1959; Labisky et al. 2003). Wetland willow (*Salix spp.*) thickets also provide nutritious browse for deer (Loveless 1959; Labisky et al. 2003). However, the importance of these habitat types to panthers is dependent upon the availability of stalking and ambush cover.

In the absence of direct field observations/measurements, Harrison (1992) suggested that landscape corridors for wide-ranging predators should be half the width of an average home range size. Following Harrison's (1992) suggestion, corridor widths for Florida panthers would range 6.1 to 10.9 mi (9.8 to 17.6 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. For Florida panthers, this would translate to a corridor width of 5.5 mi (8.8 km). Without supporting empirical evidence, Noss (1992) suggests that regional corridors connecting larger hubs of habitat should be at least 1.0 mi (1.6 km) wide. Beier (1995) makes specific recommendations for very narrow corridor widths based on short corridor lengths in a California setting of wild lands completely surrounded by urban areas; he recommended that corridors with a length less than 0.5 mi (0.8 km) should be more than 328 ft (100 m) wide, and corridors extending 0.6 to 4 mi (1 to 7 km) should be more than 1,312 ft (400 m) wide. The Dispersal Zone encompasses 44 mi^2 (113 km^2) with a mean width of 3.4 mi (5.4 km). Although it is not adequate to support even one resident panther, the Dispersal Zone is strategically located and expected to function as a critical landscape linkage to south-central Florida (Kautz et al. 2006). Transient male panthers currently utilize this zone as they disperse northward into south-central Florida.

Panther Management and Conservation

Recovery: The recovery objectives identified in the third revision of the Florida Panther Recovery Plan (Service 2008) are to: (1) maintain, restore, and expand the Florida panther population and its habitat in south Florida and, if feasible, expand the known occurrence of Florida panthers north of the Caloosahatchee River to maximize the probability of the long-term persistence of this metapopulation; (2) identify, secure, maintain, and restore habitat in potential reintroduction areas within the panther's historic range, and to establish viable populations of the panther outside south and south-central Florida; and (3) facilitate panther conservation and recovery through public awareness and education.

Habitat Conservation and Protection: Panthers, because of their wide-ranging movements and extensive spatial requirements, are particularly sensitive to habitat fragmentation (Harris 1984). Mac et al. (1998) defines habitat fragmentation as: "The breaking up of a habitat into unconnected patches interspersed with other habitat which may not be inhabitable by species occupying the habitat that was broken up. The breaking up is usually by human action, as, for example, the clearing of forest or grassland for agriculture, residential development, or overland electrical lines." The reference to "unconnected patches" is a central underpinning of the definition. For panther conservation, this definition underscores the need to maintain contiguous habitat and to protect 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. Since 1984 through 2011, the Service has provided formal consultations for 84 projects and non-formal consultation on 41 projects for the Florida panther where compensation for adverse effects from loss of habitat has been provided. These projects resulted in a loss of 96,157 acres with a corresponding compensation of 42,106 acres. Of the 96,157 acres of impacts, 38,932 acres are due to agricultural conversion and 57,225 acres to development and mining (Table 3). Portions (10,370 acres) of the largest agricultural conversion project, 28,700 acres by U.S. Sugar Corporation, were re-acquired by the Federal Government as a component of the Talisman Land Acquisition (Section 390 of the Federal Agricultural Improvement and Reform Act of 1996 [Public Law 104-127] Farm Bill Cooperative Agreement, FB4) for use in the Comprehensive Everglades Restoration Project. The non-agriculture impacts are permanent land losses, whereas the agricultural conversions may continue to provide some habitat value to panthers, depending on the type of conversion.

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 (Table 4), 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 Service, National Park Service (NPS), Seminole Tribes of Florida, Miccosukee Tribe of Indians of Florida, FWC, Florida Department of Environmental Protection (DEP), Florida Division of Forestry (DOF), Water Management Districts (WMD), non-governmental organizations (NGO), counties, and private landowners.

Conservation lands in south Florida that benefit the panther are listed below and shown in Figure 8:

1. In 1944, Collier County donated 5,475 acres to the State of Florida for what would eventually become the 7,271-acre Collier-Seminole State Park (CSSP), which straddles US 41. About 1,097 acres of the park are located north of US 41, and the majority of the area south of US 41 is mangroves (5,000 acres).

2. In 1947, ENP was established with 1,507,834 acres and in 1989 was expanded with the addition of 104,320 acres.

3. In 1954, the National Audubon Society established the nearly 10,880-acre (4,403-ha) Corkscrew Sanctuary.

4. In 1974, Congress approved the purchase and formation of BCNP, protecting 570,238 acres, they later added 145,919 acres.

5. In 1974, the State of Florida began acquiring land for the FSPSP, which encompasses over 80,000 acres. Efforts are underway to acquire an additional 16,640 acres.

6. In 1985, acquisition of PSSF began with the complex Southern Golden Gate Estates (SGGE) subdivision buyout that now comprises over 76,160 acres. The SGGE buyout through State and Federal funds is complete. The south Belle Meade portion of Picayune Strand is about 90 percent purchased. Mitigation for roadways and other development in Collier County has resulted in the purchase and management of some inholdings and Collier County's Transfer of Development Rights program may secure additional inholdings.

7. In 1989, FPNWR was established and now protects 26,240 acres.

8. In 1989, the CREW Land and Water Trust, a public and private partnership, was established and to date has coordinated the purchase of about 42,037 acres.

9. In 1996, the District purchased the 32,000-acre Okaloacoochee Slough State Forest.

10. In 2002, Spirit of the Wild Wildlife Management Area, consisting of over 7,040 acres, was taken into public ownership by the State of Florida and is managed by FWC.

11. In 2003, Dinner Island Ranch Wildlife Management Area, consisting of 21,760 acres in southern Hendry County, was taken into public ownership by the State of Florida and is managed by FWC.

12. In 2006, the State of Florida in cooperation with Lee and Charlotte Counties and with coordination with the Babcock Ranch family, the Babcock Florida Company, interested environmental advocacy groups, and concerned citizens; acquired 73,476 acres of the 91,362-acre Babcock Ranch. The 73,476-acre acquisition is referred to as the Babcock Ranch Preserve. The remaining 18,206 acres were purchased by the Babcock Ranch Community, an affiliate Babcock Ranch family company. The purchase agreement for the Babcock Ranch Preserve expressly reserved the ability to utilize portions of the property acquired by the State for mitigation of impacts from the Babcock Ranch Community's proposed residential development. These reserved lands are referred to as the Babcock Ranch Mitigation Park and encompass about 16,925 acres

13. Lands of the Seminole Tribes of Florida and Miccosukee Tribe of Indians of Florida encompass over 350,079 acres in south Florida. Of these, 115,840 acres are used by panthers, and comprise 5 percent of the Primary Zone (R. Kautz, personal communication, 2005). In general, these lands are not specifically managed for the panther and are largely in cultivation.

However, in 2007, the Seminole Tribes of Florida reserved about 4,144 acres within the Big Cypress Seminole Indian Reservation Native Area, an area encompassing about 14,724 acres, specifically for the benefit of the Florida panther. The remaining native area, about 10,580 acres, although not specifically managed for the Florida panther, provides high quality value habitat for the Florida panther and panther prey species.

Habitat and Prey Management: Land management agencies in south Florida are implementing fire programs that mimic a natural fire regime through the suppression of human-caused wildfires and the application of prescribed natural fires. No studies have been conducted to determine the effects of invasive plant management on panthers. However invasive vegetation may reduce the panther's prey base by disrupting natural processes, such as water flow and fire, and by significantly reducing available forage for prey (Fleming et al. 1994). All public lands in south Florida have active invasive plant treatment programs. Management for panther prey consists of a variety of approaches such as habitat management and regulation of hunting and OHV (Off-Highway Vehicle) use.

Response to Management Activities: Few studies have examined the response of panthers to various land and habitat management activities. Dees et al. (2001) investigated panther habitat use in response to prescribed fire and found that panther use of pine habitats was greatest for the first year after the area had been burned and declined thereafter. Prescribed burning is believed to be important to panthers because prey species (*e.g.*, deer and hogs) are attracted to burned habitats to take advantage of changes in vegetation structure and composition, including exploiting hard mast that is exposed and increased quality or quantity of forage (Dees et al. 2001). However, depending upon the frequency and effects upon upland habitat communities, prescribed fire may alter the vegetation structure and composition that are necessary for panther den sites (Maehr and Larkin 2004). Responses of puma to logging activities (Van Dyke et al. 1986b) indicate that they generally avoid areas within their home range with intensification of disturbance.

There is the potential for disturbance to panthers from recreational uses on public lands. Maehr (1990) reported that indirect human disturbance of panthers may include activities associated with hunting and that panther use of Bear Island (part of BCNP) is significantly less during the hunting season. Schortemeyer et al. (1991) examined the effects of deer hunting on panthers at BCNP between 1983 and 1990. They concluded that, based on telemetry data, panthers may be altering their use patterns as a result of hunting. Janis and Clark (2002) compared the behavior of panthers before, during, and after the recreational deer and hog hunting season (October through December) on areas open (BCNP) and closed (FPNWR, FSPSP) to hunting. Variables examined were: (1) activity rates, (2) movement rates, (3) predation success, (4) home range size, (5) home range shifts, (6) proximity to OHV trails, (7) use of areas with concentrated human activity, and (8) habitat selection. Responses to hunting for variables most directly related to panther energy intake or expenditure (*i.e.*, activity rates, movement rates, predation success of females) were not detected (Janis and Clark 2002). However, panthers reduced their use of Bear Island, an area of concentrated human activity, and were found farther from Off Road Vehicle trails during the hunting season.

Transportation: Construction of highways in wildlife habitat typically results in loss and fragmentation of habitat, traffic-related mortality, and avoidance of associated human development. Researchers have also shown that female panthers are less likely to cross roads than males (Maehr 1990). The Florida Department of Transportation (FDOT) has constructed a number of wildlife crossings with associated fencing within major roadways in southwest Florida to benefit the panther and other wildlife species (Figure 9). In 1991, FDOT constructed 28 wildlife crossings within the I-75 corridor from U.S. Highway 27 to just west of Everglades Boulevard. A total of five vehicle-related panther mortalities were documented within this corridor prior to construction of the crossings. Following construction of the crossings a total of four vehicle-related panther mortality (all in 2009) were recorded in the corridor from 1991 to the present. For three of these mortalities, it appears the panther had entered the I-75 right-of-way through the gaps in the fence at existing roadway intersections (*i.e.*, SR 29, Snake Road).

The FDOT has also constructed six wildlife crossings on SR 29 between Oil Well Road and US 41 (Figure 9). 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 2 vehicle–related panther mortalities were documented within 3.5 miles of the location of Crossing E prior to construction, and vehicle-related panther mortalities were not observed within 2.5 miles of the location of Crossing F prior to construction. Following construction of Crossings E and F, a total of four vehicle-related panther mortalities have been reported within 3 miles of Crossing E, and two vehicle-related panther mortality has been documented within 1 mile of Crossing F. The observed increase in the number of vehicle-related panther mortalities following the construction of Crossings E and F may be related to the increase in the panther population within recent years.

More recent studies have been conducted to identify locations where wildlife crossings are needed in Collier County to benefit the Florida panther and other wildlife. Swanson et al. (2005) used a least cost path (LCP) modeling approach to identify the most likely travel routes for panthers among six major use areas in southwest Florida. LCP modeling considers elements in the landscape that permit or impede panther movement when traveling. Swanson et al. (2005) identified 20 key highway segments where LCPs intersected improved roadways. Within Collier County, LCPs intersected the following major highways: SR 29, CR 846 (Immokalee Road) and CR 858 (Oil Well Road). Smith et al. (2006) studied the movements of the Florida panther, the Florida black bear, and other wildlife species along SR 29, CR 846 and CR 858 in Collier County. Data analyzed in the study were obtained from roadkill and track surveys, infra-red camera monitoring stations, existing data provided by the FWC (Florida panther radio telemetry and vehicle mortality reports), and other studies. Smith et al. (2006) recommended that new wildlife crossings be considered at various sites along these roadways to reduce road-related mortality of panthers and other wildlife species, and increase connectivity among wildlife populations.

In an effort to help reduce the potential for roadway-related panther and wildlife mortality, Collier County has committed to construct additional wildlife crossings and associated fencing on Oil Well Road (CR 858) in the Camp Keais Strand. The locations of these crossings have been identified as travel corridors for panthers and other wildlife.

Population Viability Analysis

Population Viability Analyses (PVA) are 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). They are also useful in conducting sensitivity analyses to determine where more precise information is needed (Hamilton and Moller 1995; Beissinger and Westphal 1998; Reed et al. 1998; Fieberg and Ellner 2000).

As originally defined by Shaffer (1981); "a minimum viable population for any given species in any given habitat is the smallest isolated population having a 99 percent chance of remaining extant for 1,000 years despite the foreseeable effects of demographic, environmental and genetic stochasticity, and natural catastrophes." However, the goal of 95 percent probability of persistence for 100 years is the standard recommended by population biologists and is used in management strategies and conservation planning, particularly for situations where it is difficult to accurately predict long-term effects (Shaffer 1978, 1981, 1987; Sarkar 2004).

Since 1981 and through June 2010, 182 Florida panthers have been radio-collared and monitored on public and private lands throughout south Florida (FWC 2010a). Recently, a male panther, believed to be associated with calf depredations, was captured and collared in eastern Collier County (FWC 2010c).

These data are used by researchers to estimate survival rates and fecundity and were incorporated into PVA models previously developed for the Florida panther (Seal et al. 1989; Seal and Lacy 1992; Cox et al. 1994; Kautz and Cox 2001; Maehr et al. 2002b). These models incorporated a range of different model parameters such as general sex ratios, kitten survival rates, age distributions, and various levels of habitat losses, density dependence, and intermittent catastrophes or epidemics. The outputs of these models predicted a variety of survival scenarios for the Florida panther and predicted population levels needed to ensure the survival of the species.

Root (2004) developed an updated set of PVA models for the Florida panther based on RAMAS geographic information systems (GIS) software. These models were used to perform a set of spatially explicit PVAs. Three general single-sex (*i.e.,* females only) models were constructed using demographic variables from Maehr et al. (2002b) and other sources. A conservative model was based on Seal and Lacy (1989), a moderate model was based on Seal and Lacy (1992), and an optimistic model was based on the 1999 consensus model of Maehr et al. (2002b). In each model, first-year kitten survival was set at 62 percent based on recent information from routine panther

population monitoring (Shindle et al. 2001). All of the models assumed a 1:1 sex ratio, a stable age distribution, 50 percent of females breeding in any year, and an initial population of 41 females (82 individuals including males), which was the approximate population size in 2001 and 2002 (McBride 2001, 2002).

The use of 41 females in the model was based on the best available data when the model was developed. The total of 41 females represents the number of individual panthers documented in surveys by McBride (2001, 2002). While the total of 41 females includes subadults that do not yet breed, it is reasonable to use this total number in modeling to evaluate population trends for several reasons. First, it is not feasible to differentiate between subadults and adults through field observation. Second, although it is possible that some of the 41 females were not breeding in year one of the model, these females would mature to breeding age by year 2 of the model. Third, the Root (2004) model assumed females to have "a 50 percent chance of breeding in a given year," and therefore only half of the 41 females were modeled as breeding each year. The primary reason the model (Root 2004) assumed a 50 percent chance of breeding in a given year is that kittens stay with their mother from 15 to 24 months prior to dispersal, however, this assumption accounts for the likelihood that some of the 41 females would not breed in a given year, including subadult status of some individuals. Fourth, the Service recognizes that the McBride data is not intended to provide a total population estimate. Although the Service believes that population estimates derived through field surveys are close to the actual population number, it is likely that some individuals in the current panther population have not been documented. In light of these factors, the Service believes that it is reasonable to use the best available count of 41 subadult and adult females as the breeding population for modeling purposes.

Basic PVA Versions: The basic versions of each model incorporated no catastrophes or epidemics, no change in habitat quality or amount, and a ceiling type of density dependence. The basic versions of the models incorporated a carrying capacity of 53 females (106 panthers with a 50:50 sex ratio). Variants of the models were run with differing values for density dependence, various levels of habitat loss, and intermittent catastrophes or epidemics. Each simulation was run with 10,000 replications for a 100-year period. The minimum number of panthers needed to ensure a 95 percent probability of persistence for 100 years was estimated in a series of simulations in which initial abundance was increased until probability of extinction at 100 years was no greater than 5 percent. More detailed information concerning the PVA model parameters appears in Root (2004).

The results of these model runs predicted a probability of extinction for the conservative model of 78.5 percent in 100 years with a mean final total abundance of 3.5 females. Also, the probability of a large decline in abundance (50 percent) was 94.1 percent. The moderate model resulted in a 5 percent probability of extinction and mean final abundance of 42.3 females in 100 years. The probability of panther abundance declining by half the initial amount was 20 percent in 100 years under the moderate model. The optimistic model resulted in a 2 percent probability of extinction and mean final abundance of 51.2 females in 100 years. The probability of panther abundance declining by half the initial amount was only 9 percent in 100 years under the optimistic model. These models also provide a probability of persistence (100 percent minus probability of extinction) over a 100-year period of 95 percent for the moderate model and 98 percent for the optimistic model.

Model results were also provided by Root (2004) for probability of extinctions for 1 percent loss of habitat, within the first 25 years of the model run. The 1 percent loss of habitat equates to essentially all remaining non-urban privately owned lands in the Primary Zone and corresponds to the estimated rate of habitat loss from 1986 to 1996 for the five southwest counties based on land use changes (Root 2004). For the moderate model, the model runs predict a probability of extinction increase of about 1 percent, from a probability of extinction of about 5 percent with no loss of habitat to 6 percent with 1.0 percent habitat loss per year, for the first 25 years. For the optimistic model, probability of extinction increased from about 2 percent with no loss of habitat to 3 percent with 1.0 percent habitat loss per year, for the first 25 years. These models also predicted that the mean final abundance of females would decrease from 41 to 31 females, a 24.3 percent reduction for the moderate model and from 41 to 38 females, a 7.3 percent reduction for the optimistic model.

The model runs predict a probability of persistence (100 percent minus the probability of extinction) over a 100-year period of about 94 percent for the moderate model and 97 percent for the optimistic model. The model runs also predict a mean final abundance of 62 individuals (31 females and 31 males) for the moderate model and 76 individuals (38 females and 38 males) for the optimistic model.

Population Guidelines: Kautz et al. (2006), following review of the output of Root's PVA models and those of other previous PVAs for the Florida panther, suggested a set of population guidelines for use in the management and recovery of the Florida panther. These guidelines are: (1) populations of less than 50 individuals are likely to become extinct in less than 100 years; (2) populations of 60 to 70 are barely viable and expected to decline by 25 percent over 100 years; (3) populations of 80 to 100 are likely stable but would still be subject to genetic problems (*i.e.*, heterozygosity would slowly decline); and (4) populations greater than 240 have a high probability of persistence for 100 years and are demographically stable and large enough to retain 90 percent of original genetic diversity.

Population guidelines for populations of panthers between 50 and 60 individuals and between 70 and 80 individuals were not specifically provided in Kautz et al. (2006). However, the Service views the guidelines in Kautz et al. (2006) as a continuum. Therefore, we consider populations of 50 to 60 individuals to be less than barely viable or not viable with declines in population and heterozygosity. Similarly, we consider populations of 70 to 80 to be more than barely viable or somewhat viable with some declines in population and heterozygosity. Like other population guidelines presented in Kautz et al. (2006), these assume no habitat loss or catastrophes.

PVA Summaries and Population Guidelines: Root's (2004) moderate model runs, which have a carrying capacity 53 females (106 individuals), show final populations of 42.3 females (84 total) and 31.2 females (62 total) with extinction rates of 5 percent and 6 percent, respectively, for the basic and 1 percent habitat loss scenarios. The predicted final populations in Root (2004) are 84 and 62 panthers for no loss of habitat and 1 percent loss of habitat, respectively, over a 100-year period.

Kautz et al.'s (2006) population guidelines, when applied to the populations predicted by Root's (2004) moderate models, describe the "with habitat loss" population (62 panthers) as barely viable and expected to decline by 25 percent over a 100-year period. The "without habitat loss" population (84 panthers) is likely stable but would still be subject to genetic problems.

As discussed in the section on "Population Trends and Distribution," the panther population estimate has shown an increase in the number of panthers reported yearly, beginning in 2000. The Service believes that McBride's verified population of 97 panthers in 2006, 117 panthers in 2007, 104 in 2008, and 113 in 2009 is within Kautz et al.'s (2006) population guidelines 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 Florida panther and that 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 still subject to genetic problems.

Model Violations: The actual likelihood of population declines and extinctions may be different than the guidelines and models suggest, depending upon the number of and severity of assumptions violated. The Service realizes habitat loss is occurring at an estimated 0.8 percent loss of habitat per year (R. Kautz, FWC, personal communication, 2003). The Service has accounted for some habitat loss and changes in habitat quality within its regulatory program, specifically through its habitat assessment methodology (discussed below). For example, we have increased the base ratio used within this methodology to account for unexpected increases in habitat loss. Similarly, we consider changes in habitat quality and encourage habitat restoration wherever possible.

With regard to the assumption of no catastrophes, the Service has considered the recent outbreak of feline leukemia in the panther population at Okaloacoochee Slough as a potential catastrophe. The FWC is carefully monitoring the situation and it appears to be under control at this time due to a successful vaccination program. However, if the outbreak spreads into the population, the Service will consider this as a catastrophe and factor this into our decisions.

We acknowledge uncertainties exist, assumptions can be violated, and catastrophes can occur. The Service and the FWC, along with our partners, will continue to monitor the panther population and the south Florida landscape and incorporate any new information and changes into our decision-making process.

South Florida Panther Population Goal

The Service's goal for Florida panther conservation in south Florida is to locate, preserve, and restore sets of lands containing sufficient area and appropriate land cover types to ensure the long-term survival of a population of 80 to 100 individuals (adults and subadults) south of the Caloosahatchee River. The Service proposes to achieve this goal through land management partnerships with private landowners, through coordination with private landowners during review of development proposals, and through land management and acquisition programs with Federal, State, local, private, and Tribal partners. Based on an average density of 31,923 acres per panther as determined by Kautz et al. (2006), the acreages of lands necessary to achieve this goal are 2,553,840 acres for 80 panthers and 3,192,300 acres for 100 panthers.

The principle regulatory mechanism that allows the Service to work directly with private land owners during review of development and land alteration projects is section 10 of the Act. The Service coordinates with Federal agencies pursuant to section 7 of the Act. In August 2000, the

Service, to assist the Corps in assessing project effects to the Florida panther, developed the Florida panther final interim Standard Local Operating Procedures (SLOPES) for Endangered Species (Service 2000b). The Florida panther SLOPES provide guidance to the Corps for assessing project effects to the Florida panther and recommends actions to minimize these effects. The Florida panther SLOPES also included a consultation area map that identified an action area where the Service believes land alteration projects may affect the Florida panther.

In the original SLOPES, the consultation area map (the Map) was generated by the Service by overlaying existing and historical panther telemetry data on a profile of Florida and providing a connecting boundary surrounding most of these points. Since the development of the Map, we have received more accurate and up-to-date information on Florida panther habitat usage. Specifically, we have received two documents that the Service believes reflect the most likely panther habitat usage profiles, although documentation clearly shows panther use of areas outside these locations. These documents are the publications by Kautz et al. (2006) and Thatcher et al. (2006). Based on the information in these documents, we have clarified the boundaries of the Map to better reflect areas where Florida panthers predominate (Figure 4) and refer to these areas cumulatively as the Florida Panther Focus Area.

The Panther Focus Area was determined from the results of recent panther habitat models south of the Caloosahatchee River (Kautz et al. 2006) and north of the Caloosahatchee River (Thatcher et al. 2006). The Kautz et al. (2006) model of landscape components important to Florida panther habitat conservation was based on an analysis of panther habitat use and forest patch size. This model was used in combination with radio-telemetry records, home range overlaps, land use/land cover data, and satellite imagery to delineate primary and secondary areas that would be most important and comprise a landscape mosaic of cover types important to help support the current panther breeding population south of the Caloosahatchee River.

Thatcher et al. (2006, 2009) developed a habitat model using Florida panther home ranges in south Florida to identify landscape conditions (land-cover types, habitat patch size and configuration, road density and other human development activities, and other similar metrics) north of the Caloosahatchee River that were similar to those associated with the current panther breeding population.

The Panther Focus Area Map south of the Caloosahatchee River is divided into Primary, Secondary, and Dispersal Zones, and north of the Caloosahatchee River into the Primary Dispersal/Expansion Area.

The Primary Zone is currently occupied and supports the only known breeding population of Florida panthers in the world. These lands are important to the long-term viability and persistence of the panther in the wild.

The Secondary Zone lands are contiguous with the Primary Zone and although these lands are used to a lesser extent by panthers, they are important to the long-term viability and persistence of the panther in the wild. Panthers use these lands in a much lower density than in the Primary Zone.

The Dispersal Zone is a known corridor between the Panther Focus Area south of the Caloosahatchee River and the Panther Focus Area north of the Caloosahatchee River. This zone is necessary to facilitate the dispersal of panthers and future panther population expansion to areas north of the Caloosahatchee River. Marked panthers have been known to use this zone.

The Primary Dispersal and Expansion Area is the Fisheating Creek and Babcock-Webb WMA region. These are lands identified by Thatcher et al. (2006) as potential panther habitat with the shortest habitat connection to the Panther Focus Area in south Florida. Several collared and uncollared male panthers have been documented in this area since 1973, and the last female documented north of the Caloosahatchee River was found in this area.

Land Preservation Needs: To further refine the land preservation needs of the Florida panther and to specifically develop a landscape-level program for the conservation of the Florida panther population in south Florida, the Service appointed a Florida Panther Subteam in February 2000. The Florida Panther Subteam was charged with developing a landscape-level strategy for the conservation of the Florida panther population in south Florida. The results of this collaborative effort are partially presented in Kautz et al. (2006). One of the primary goals of this effort was to identify a strategically located set of lands containing sufficient area and appropriate land cover types to ensure the long-term survival of the south population of the Florida panther. Kautz et al. (2006) focused their efforts on the area south of the Caloosahatchee River, where the reproducing panther population currently exists.

Kautz et al. (2006) created an updated Florida panther potential habitat model based on the following criteria: (1) forest patches greater than 4.95 acres; (2) non-urban cover types within 656 ft of forest patches; and (3) exclusion of lands within 984 ft of urban areas. The potential habitat map was reviewed in relation to telemetry data, recent satellite imagery (where available), and panther home range polygons. Boundaries were drawn around lands defined as the Primary Zone (Figures 4 and 7), defined as the most important area needed to support a self-sustaining panther population. Kautz et al. (2006) referred to these lands as essential; however, as observed in the two previous plans (Logan et al. 1993; Cox et al. 1994), lands within the boundaries of the Primary Zone included some urban areas and other lands not considered to be truly panther habitat (*i.e.*, active rock and sand mines). The landscape context of areas surrounding the Primary Zone was modeled and results were used to draw boundaries of the Secondary Zone (Figure 4 and 7), defined as the area capable of supporting the panther population in the Primary Zone, but where habitat restoration may be needed (Kautz et al. 2006).

Kautz et al. (2006) also identified, through a least cost path model, the route most likely to be used by panthers dispersing out of south Florida, crossing the Caloosahatchee River, and dispersing into south-central Florida. Kautz et al. (2006) used ArcView GIS© version 3.3 and ArcView Spatial Analyst© version 2 (Environmental Systems Research, Incorporated, Redlands, California) to construct the least-cost path models and identify optimum panther dispersal corridor(s). The least-cost path models operated on a cost surface that ranked suitability of the landscape for use by dispersing panthers with lower scores indicating higher likelihood of use by dispersing panthers. The lands within the boundaries of the least cost model prediction were defined as the Dispersal Zone (Figure 4 and 7). The preservation of lands within this zone is important for the survival and

recovery of the Florida panther, as these lands are the dispersal pathways for expansion of the south Florida panther population. The Primary Zone covers 2,270,590 acres, the Secondary Zone covers 812,104 acres, and the Dispersal Zone covers 27,883 acres, providing a total of 3,110,578 acres (Kautz et al. 2006).

Compensation Recommendations: To achieve our goal to locate, preserve, and restore sets of lands containing sufficient area and appropriate land cover types to ensure the long-term survival of a population of Florida panthers south of the Caloosahatchee River, the Service chose the mid point (90 panthers) in Kautz et al.'s (2006) population guidelines that a population of 80 to 100 panthers is likely to be stable, although subject to genetic problems, through 100 years. In addition, a population of 90 individuals is 8 individuals greater than a population of 82 individuals, which according to the best available PVA (Root 2004) is 95 percent likely to persist over 100 years (assuming a 50:50 male to female ratio). These eight individuals provide a buffer for some of the assumptions in Root's (2004) PVA. Our process to determine compensation recommendations for project impacts that cannot be avoided in both our section 7 and section 10 consultations is based on the amount and quality of habitat that we believe is necessary to support a population of 90 panthers in south Florida.

The Service, based on Kautz et al.'s (2006) average panther population density of 31,923 acres per panther, determined 2,873,070 acres of Primary Zone "equivalent" lands need to be protected and managed. Since lands in the Secondary Zone are of less value to panthers than those in the Primary Zone, this equivalency factor is needed to assure that additional acreage is acquired in the Secondary Zone to compensate for its lower quality panther habitat. In other words, more than 31,923 acres per panther would be needed, hypothetically, if this acreage were all in the Secondary Zone (see discussion of Primary Zone equivalent lands in the following section). The combined acreage of lands within the Primary, Dispersal, and Secondary Zones is 3,110,577 acres (Kautz et al. 2006). Currently, 2,073,865 acres of Primary Zone equivalent lands are preserved (Table 5) and 1,202,699 acres of Primary Zone equivalent lands are at-risk (private ownership) (Table 6), so 799,205 additional acres need to be preserved to support a population of 90 panthers in south Florida (2,873,070 minus 2,073,865 equals 799,205).

Panther Habitat Assessment

The Service originally developed a Panther Habitat Assessment methodology and refugia design in 2003 to help guide the agency in evaluating permit applications for projects that could affect panther habitat. This methodology was a way to assess the level of impacts to panthers expected from a given project, and to evaluate the effect of any proposed compensation offered by the project's applicant.

Following our refugia design assessment approach, since 2003 through May 2011, reviewed projects have affected 13,059 acres in the Primary Zone, 7,475 acres in the Secondary Zone, and 4,558 acres in the Other Zone. Compensation provided by these same projects included 25,261 acres in the Primary Zone, 652 acres in the Dispersal Zone, 272 acres in the Secondary Zone, and 1,646 acres in the Other Zone. The project affected lands were primarily agricultural fields consisting of row crops and citrus groves and natural lands with varying degrees of exotic vegetation. Habitat value of these lands to the Florida panther, following our Panther Habitat

Assessment methodology, provided a PHU loss from development of 86,122 primary equivalent PHUs, with a corresponding PHU preservation and enhancement complement of 215,428 primary equivalent PHUs. The preservation lands were generally native habitat lands or disturbed lands that included restoration. Restoration included exotic species removal, fire management, wetland hydrology improvement, improved forest management practices, and full restoration from agriculture uses to native habitats.

Analysis of the Species Likely to be Affected

The Florida panther is an endangered animal restricted to 2 to 3 million acres of land (6 to 9 percent of the total land area of Florida) in south Florida. The panther is a wide-ranging species that requires a biotically diverse landscape to survive. Dispersing subadult males wander widely through unforested and disturbed habitat. Human population in south Florida has dramatically increased, from one million in 1950 to six million in 1990. In southwest Florida (Charlotte, Collier, and Lee Counties), where the reproducing panther population is primarily located, human population has increased from 833,892 in 2000 to an estimate of 1,231,100 in 2010, representing an increase of 47.6 percent over the 10-year period (University of Florida 2009). This population increase results in secondary disturbances such as increased human presence and noise, light, air, and water pollution. Increasing human population has resulted in increasing impacts on native habitat and flora and fauna. Resulting threats to panthers include road mortality, habitat loss, habitat fragmentation, and human disturbance.

Wood Stork

Species Description

The wood stork was listed under the Act as endangered on February 28, 1984 (49 FR 7332). No critical habitat is designated for the wood stork; therefore, none will be affected. The wood stork is a large, long-legged wading bird, with a head to tail length of 85 to 115 cm (33 to 45 inches [in]) and a wingspan of 150 to 165 cm (59 to 65 in) (Coulter et al. 1999). The plumage is white, except for iridescent black primary and secondary wing feathers and a short black tail. Wood storks fly with their neck and legs extended. On adults, the rough scaly skin of the head and neck is unfeathered and blackish in color, the legs are dark, and the feet are dull pink. The bill color is also blackish. During courtship and the early nesting season, adults have pale salmon coloring under the wings, fluffy undertail coverts that are longer than the tail, and their toes are bright pink. 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).

Life History

Wood stork nesting habitat consists of mangroves as low as 1 m (3 ft), cypress as tall as 30.5 m (100 ft), and various other live or 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 nest colonially, often in conjunction with other wading bird species, and generally occupy the large-diameter trees at a colony site (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 that 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 may roost in trees over dry ground, on levees, or on 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 rookeries, a handful of new stork nesting colonies are discovered each year and each year a number of colonies also become inactive depending on local environmental conditions and sometimes remain inactive (Meyer and Frederick 2004). 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, where prey are available to storks and the water is shallow and open enough to hunt successfully (Ogden et al. 1978; Browder 1984; Coulter 1987). Calm water, about 2 to 16 in (5 to 40 cm) in depth, 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, shallow, seasonally flooded roadside or agricultural ditches, and managed impoundments (Coulter and Bryan 1993; Coulter et al. 1999).

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. During nesting, these areas must also be sufficiently close to the colony to allow storks to efficiently deliver prey to nestlings. Hydrologic and environmental characteristics have strong effects on fish density, and these factors may be some of the most significant in determining foraging habitat suitability, particularly in southern Florida.

Within the wetland systems of southern Florida, the annual hydrologic pattern is very consistent, with water levels rising over 3 feet during the wet season (June-November), and then receding gradually during the dry season (December-May). Storks nest during the dry season and rely on the drying wetlands to concentrate prey items in the ever-narrowing wetlands (Kahl 1964). Because of the continual change in water levels during the stork nesting period, any one site may only be suitable for stork foraging for a narrow window of time when wetlands have sufficiently dried to begin concentrating prey and making water depths suitable for storks to access the wetlands. Once the wetland has dried to where water levels are near the ground surface, the area is no longer suitable for stork foraging and will not be suitable until water levels rise and the area is again repopulated with fish. Consequently, there is a general progression in the suitability of wetlands for foraging based on their hydroperiods, with the short hydroperiod wetlands being used early in the season, the mid-range hydroperiod sites being used during the middle of the nesting season, and the longest hydroperiod areas being used later in the season (Kahl 1964, Gawlik 2002).

In addition to the concentration of fish due to normal drying, several other factors affect fish abundance in potential foraging habitats. Longer hydroperiod areas generally support more fish and larger fish (Loftus and Ecklund 1994, Jordan et al. 1997 and 1998, Turner et al. 1999, Trexler et al. 2002). 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 in southern Florida.

Across the highly modified landscape of southern Florida, fish availability varies with respect to hydrologic gradients and 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 wide variety of hydroperiod classes, nutrient conditions, and spatial variability. Dense submerged and emergent vegetation may reduce foraging suitability by preventing storks from moving through the habitat and interfering with prey detection (Coulter and Bryan 1993). Some submerged and emergent vegetation does not detrimentally affect stork foraging and may be important to maintaining fish populations. Average submergent and emergent vegetation cover at foraging sites was 26 and 29 percent, respectively, at foraging sites at a Georgia colony but ranged from 0 to100 percent (Coulter and Bryan 1993). These cover values did not differ significantly from random wetland sites. Similarly, densely forested wetlands may preclude storks from accessing prey within the areas (Coulter and Bryan 1993). Storks tend to select foraging areas that have an open canopy, but occasionally use sites with 50 to 100 percent canopy closure (Coulter and Bryan 1993, O'Hare and Dalrymple 1997, Coulter et al. 1999).

Carlson and Duever (1979) also noted in their study that long distance movement of fish into deeper habitats is not a regular occurrence in the Big Cypress watershed communities. They also noted in their study that the preponderance of obstacles and plant debris all contribute to hindering mobility and limiting movement across the site. In addition, in Chapman and Warburton's (2006) studies on *Gambusia*, they noted that movement between drying pools was limited. Carlson and Duever (1979) concluded in their study that "*density and biomass of both wet and dry season fish populations are dependant primarily on the production of the particular site and not of adjacent habitats from which fish may have migrated*."

Wood storks feed almost entirely on fish between 2.5 to 25.4 cm (1 to 10 in) length (Kahl 1964, Ogden et al. 1976, Coulter 1987), but may consume crustaceans, amphibians, reptiles, mammals, birds, and arthropods. Lauritsen (Corkscrew Sanctuary, personal communication 2007, 2009) observed wood stork foraging on crayfish. Studies by Depklin et al. (1992) of wood stork foraging at colonies in east-central Georgia also noted the presence of crayfish in the diets of wood storks. In their analysis, crayfish represented 1 percent of the biomass and 1.9 percent of the prey items. Fish represented 92 percent of all individual prey items and 93 percent of the biomass. A similar study conducted by Bryan and Gariboldi (1998) also noted the presence of crayfish in wood stork diets and noted a similar frequency of occurrence. In the foraging studies conducted by Ogden et al. (1976), Coulter et al. (1999), Carlson and Duever (1979), Turner et al. (1999) and Trexler et al. (2002), little information is provided on consumption of invertebrates. Ogden et al. (1976) summarized information from Kahl's publications (1962, 1964) on stomach contents of wood storks sampled in south Florida and southwest Florida and noted all individuals examined contained only fish. Ogden et al.'s (1976) study also noted the prey consumed were fish, although the average density of prawns was 2.5 times the density of the most abundant fish.

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 the beak immersed and open about 6.4 to 8.9 cm (2.5 to 3.5 in). When the wood stork encounters prey within its bill; the mandibles snap shut, the head is raised, and the food is 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.

In Georgia, wood storks generally forage in wetlands within 50 km (31 miles) of the colony site (Bryan and Coulter 1987), but forage most frequently within 20 km (12 miles) of the colony (Coulter and Bryan 1993). Herring (2007) noted similar foraging patterns for wood storks in south Florida with most frequent foraging within 10.29 km (6.4 miles). 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 wood storks. Storks forage the greatest distances from the colony at the beginning of the nesting season, before eggs are laid, and near the end of the season when the young are large. They feed nearest the colony during incubation (Browder 1984, Mitchell 1999). In south Florida, wood storks generally use wet prairie ponds early in the dry season, then shift to slough ponds later in the dry season, thus, following water levels as it recedes into the ground (Browder 1984).

Gawlik (2002) characterized wood storks foraging in the Everglades 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, although prey was still sufficiently available that other wading bird species were still foraging in large numbers. Wood stork choice of foraging sites in the Everglades 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).

Breeding wood storks are believed to form new pair bonds every season. First age of breeding has been documented in 3- to 4-year old birds, but the average first age of breeding is unknown. Eggs are laid as early as October in south Florida and as late as June in north Florida (Rodgers 1990). A single clutch of two to five (average three) eggs is 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 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). The younger birds are first to die during times of scarce food.

The young fledge in about 8 weeks, but will stay at the nest for 3 to 4 more 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). Feedings are less frequent when wood storks are forced to 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 stork colonies experience considerable variation in production among colonies and years in response to local habitat conditions and food availability (Holt 1929; Kahl 1964; Ogden et al. 1978; Clark 1978; Ehrhart 1979; Hopkins and Humphries 1983; Rodgers and Schwikert 1997). Recent studies (Rodgers et al. 2008; Bryan and Robinett 2008; Winn et al. 2008; Murphy and Coker 2008) documented production rates to be similar to rates published between the 1970s and 1990s. Rodgers et al. (2008) reported a combined production rate for 21 north and central Florida colonies from 2003 to 2005 of 1.19$\pm$ 0.09 fledglings per nest attempt (n=4,855 nests). Bryan and Robinette (2008) reported rates of 2.3 and 1.6 fledged young per nesting attempt for South Carolina and Georgia in 2004 and 2005. Murphy and Coker (2008) report that since listing, South Carolina colonies averaged 2.08 young per successful nest with a range of 1.72 to 2.73. The Palm Beach County Solid Waste Authority colony (M. Morrison, PBC, personal communication 2008) was documented with 0.86 fledgling per nesting attempt (2003 to 2008) with annual rates ranging from 0.25 to 1.49.

Rodgers and Schwikert (1997) reported on the breeding chronology of 21 north and central Florida wood stork colonies for the years 1981 to 1985. They found wood storks produced an average of 1.29 fledglings per nest and 0.42 fledgling per egg, which is a probability of survivorship from egg laying to fledgling of 42 percent (Rodgers and Schwikert 1997). The probability of survivorship from egg laying to day 14 is 80 percent, to day 28 (hatching) 70 percent, to day 42 (nestling 2 weeks of age) 62 percent, to day 56 (nestling 4 weeks of age) 56 percent, to day 70 (nestling 6 weeks) 50 percent and to day 84 (fledgling) 42 percent. The greatest losses occur from egg laying to hatching with a 30 percent loss of the nest production. From hatching to nestlings of 2 weeks of age, nest production loss is an additional 8 percent. Corresponding losses for the remainder of the nesting cycles are on the average of a 6 percent loss per 2 week increase in age of the nestling (Rodgers and Schwikert 1997).

During the period when a nesting colony is active, storks are dependent on consistent foraging opportunities in wetlands within about 20 to 30 km of the nest site (Kahl 1964 and Coulter and Bryan 1993) 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 201 kg (443 pounds) of fish during the breeding season, with 50 percent of the nestling stork's food requirement occurring during the middle third of the nestling period (Kahl 1964). Receding water levels are necessary in south Florida to concentrate suitable densities of forage fish (Kahl 1964; Kushlan et al. 1975).

Fleming et al. (1994) as well as Ceilley and Bortone (2000) believe the short hydroperiod wetlands in south Florida provide a more important pre-nesting foraging food source and a greater effect on early nestling survival for wood storks than the foraging base (grams of fish per square meter (m^2))

that is suggested in short hydroperiod wetlands. For instance, Loftus and Eklund (1994) for foraging sites in the Everglades, provided an estimate of 50 fish per m^2 for long hydroperiod wetlands and 10 fish per m^2 for short hydroperiod wetlands. Because of the consistent pattern of drying that normally occurs during the stork nesting season, the short hydroperiod wetlands would also be the ones used for foraging early in the season, when long hydroperiod wetlands remain too deep for storks to forage effectively or sufficient prey concentration has not yet occurred as a result of drying.

Although the short hydroperiod wetlands support fewer fish and lower fish biomass per unit area than long hydroperiod wetlands, these short hydroperiod wetlands were historically more extensive and provided foraging areas for storks during colony establishment, courtship, and nest-building, egg-laying, incubation, and the early stages of nestling provisioning. This period corresponds to the greatest periods of nest failure (*i.e.*, 30 percent and 8 percent, respectively, from egg laying to hatching and from hatching to nestling survival in 2 weeks) (Rodgers and Schwikert 1997).

Based on Kahl's (1964) estimate that 201 kg are needed for the success of a nest and that 50 percent of the foraging base is needed in the middle third of the nesting cycle when chicks are about 23 to 45 days old (Kahl 1962), it is estimated about 50 kg are needed to meet the foraging needs of the adults and nestling in the first third of the nesting cycle. Considering the relatively low habitat foraging values these short hydroperiod wetlands provide in relationship to corresponding long hydroperiod wetlands, much larger acreages of these wetlands are needed to ensure survival and to sustain development of nestlings. The disproportionate reduction (85 percent) of this specific habitat loss known to have occurred from development and over drainage has been proposed as a major cause of late colony formation and survivorship reduction in early nestling survival rates (Fleming et al. 1994).

Storks that are not breeding do not require the same degree of fish concentration that is required to sustain successful nesting. Kahl (1964) estimated the food requirements for an individual free-flying stork to be about 502 g (live weight) per day. Storks that are not nesting are able to find sufficient prey to sustain themselves in many wetlands that would not be suitable to sustain adults and chicks during nesting.

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 because of 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 (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 far beyond Florida into Georgia, Alabama, Mississippi, and South Carolina (Coulter et al. 1999; Borkhataria et al. 2004; Borkhataria et al. 2006b). 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. (2006b) reported that nearly all storks that had been tagged in the southeastern U.S. moved into Florida near the beginning of the dry season, including all subadult 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). Range wide occurrence of wood storks in December, recorded during the 1995 to 2008 Audubon Society Christmas Bird Counts for the Southeast U.S. (Audubon 2008) suggests that 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). As a result 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 significant portion of the southeastern United States wood stork population, including storks that breed in Georgia and the Carolinas, and subadult storks from throughout the stork's range. In addition, these same wetlands support a wide variety of other wading bird species (Gawlik 2002).

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 and a low of 2,500 pairs during a severe drought conditions in 1978 (49 FR 7332). The total number of nesting pairs in 1995 was 7,853 with 11 percent in South Carolina, 19 percent in Georgia, and 70 percent in Florida (Service 1997). However, nesting data from 1981 to 2009 suggest that the wood stork population in the southeastern United States appears to be increasing (Table 7, Figure 10). Population totals indicate that the stork population has reached its highest level since it was listed as endangered in 1984. More than 12,700 wood stork pairs nested within their breeding range in the southeastern United States in 2009 (Service 2010). The nesting and colony data (Table 8, Figure 11) show increases in both the number of nests and the number of colonies, with the greatest increases in both nests and colonies in Georgia, South Carolina, and North Carolina. Recent data also show a decrease in the average size of colonies (Frederick and Meyer 2008). The Florida nesting population appears to fluctuate yearly and vary around a 3-year running average of 54 colonies and 4,273 nests (data through 2009). All south Florida colonies have been continuously monitored since listing and, south Florida nesting data show nesting pairs of 2,648 in 2006, 696 in 2007, 344 in 2008, and 5,816 in 2009 (Cook and Herring 2007, Cook and Kobza 2008, 2009) (Table 8). Researchers attribute the drop in nest production in 2006 and 2007 to the severe drought conditions present in south Florida during the nesting periods.

However, 2009 nesting data for Corkscrew Sanctuary rookeries noted 1,120 nests producing 2,570 nestlings (Audubon 2009). Similar rebounds in nest production were recorded for other south Florida rookeries as well with probably the largest number of nest starts since 2004 (South Florida Wading Bird Report [Cook and Kobza 2009]}. Nests starts were estimated to be about 3,000 nests throughout the WCAs and the Tamiami West colony (District 2009). Data reported by Cook and Kobza (2009) noted about 6,452 nests in south Florida during the 2009 breeding season. The final nest count was 5,816 nests in 2009 for south Florida (Service 2010). Data reports from rookeries in north Florida and Georgia also noted record numbers of wood stork nests (GDNR 2009, W.B. Brooks, Service, personal communication 2009).

A review of the historic data show that, since the 1960s, the wood stork population 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). The number of nesting pairs in northern and central Florida doubled between 1976 and 1986 (Ogden 1991). Although Ogden (1991) attributed this to an increase in the availability of altered wetland and artificial wetland nesting sites, the regional increase coincided with the northward shift of the wood stork breeding population center and the overall population decline in the southeastern United States.

Between 1958 and 1985, the wood stork breeding population center shifted north from Lake Okeechobee to Polk County, a distance of about 132 km (82 miles) (Ogden et al. 1987). The 1976 breeding season was the last year when more pairs nested in south Florida than in central and north Florida. Production is generally higher in central-north Florida than south Florida. Whereas the number of colonies in south Florida has remained relatively stable, the number of colonies in central and north Florida region continues to increase (Ogden et al. 1987). The increase in central-north Florida is associated with an increase in colony numbers and not colony size. Colonies in the north are smaller than colonies in the south. Historically, colonies in the south were associated with extensive wetlands and food was abundant. The implication is that food resources may be limiting colony sizes in central-north Florida (Ogden et al. 1987). Ogden et al. (1987) suggested the population shift is the result of deteriorating feeding conditions in south Florida and better nesting success rates in central and north Florida that compound population growth in that area.

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.
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). Traditional colony nesting sites may be abandoned completely by storks 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 forage fish (Kahl 1964; Service 1997; Coulter et al. 1999).

The annual climatological pattern that appeared to stimulate the heaviest nesting efforts by storks was a combination of the average or above-average rainfall during the summer rainy season prior to colony formation and an absence of unusually rainy or cold weather during the following winter-spring nesting season. This pattern produced widespread and prolonged flooding of summer marshes that maximized production of freshwater fishes, followed by steady drying that concentrated fish during the dry season when storks nest (Kahl 1964).

Status and Distribution

The wood stork is found from northern Argentina, eastern Peru and western Ecuador north to Central America, Mexico, Cuba, Hispaniola, and the southeastern United States (AOU 1983). Only the population segment that breeds in the southeastern United States is listed as endangered. 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). Dahl (1990) estimates these states lost about 38 million acres, or 45.6 percent, of their historic wetlands 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 Flats. These wetlands were strongly preferred by wood storks as nesting habitat. Currently, wood stork nesting is known to occur in Florida, Georgia, South Carolina, and North Carolina. Breeding colonies of wood storks are currently documented in all southern Florida counties, except for Okeechobee County. Additional expansion of the breeding range of wood storks in the southeastern United States may continue in coming years, both to the north and possibly to the west along the Gulf Coast (Service 2007).

The decline that led to listing in the United States population of the wood storks is thought to be related to one or more of the following factors: (1) reduction in the number of available nesting sites; (2) lack of protection at nesting sites; and (3) loss of an adequate food base during the nesting season (Ogden and Nesbitt 1979). 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. Ogden and Nesbitt (1979) also suggest that changes in remaining wetland systems in Florida, including drainage and impoundment, may be a larger concern for wood storks than loss of foraging habitat.

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. 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 occurring south of Lake Okeechobee, Florida, for the period 1900 through 1973. We combined their data for habitat types known to be important foraging habitat for wood storks (cypress domes and strands, wet prairies, scrub cypress, freshwater marshes and sloughs, and sawgrass marshes) and found these south Florida wetland habitat types have been reduced by about 35 percent since 1900.

The alteration of wetlands and the manipulation of wetland hydroperiods to suit human needs have also reduced the amount of 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 may decrease food production 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 utilize, while still supporting smaller prey fish. Water level manipulation can also facilitate 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.

During the 1970s and 1980s, wood storks have also been observed to shift 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 increased from about 10 percent of all nesting pairs from 1959 to 1960 to 60 to 82 percent during 1976 to 1986 (Ogden 1991). Nest trees in these artificially impounded sites often include exotic species such as Brazilian pepper or Australian pine. 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.

Human disturbance is a factor known to have a detrimental effect on wood stork nesting (Service 1997). Wood storks have been known to desert nests when disturbed by humans, thus exposing eggs and young birds to the elements and to predation by gulls and fish crows.

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 production 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. The authors 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 adults from Costa Rica. Young birds from Florida also exhibited higher levels of cadmium and lead than young birds from Costa Rica. The authors recommended the lead levels in Florida be monitored. Burger et al. (1993) drew no conclusions about the potential health effects to wood storks.

Population Trends

The wood stork population in the southeastern United States appears to be increasing. Preliminary population estimates indicate the stork population has recently reached its highest level since it was listed as endangered in 1984. In all, over 11,000 wood stork pairs nested within their breeding range in the southeastern United States in 2006. The first wood stork nesting was recorded in North Carolina in 2005 and this colony has been active each year since. This suggests that the northward expansion of wood stork nesting may be continuing. Several new colonies were located in 2006, including several in Florida. Of the estimated 11,232 nesting pairs, 7,261 occurred within Florida (Service 2007). There were 1,919 nests recorded in Georgia, 1,963 in South Carolina, and 125 in North Carolina. Total nest numbers have also been over 9,000 in 2002 and 2003 (Service 2004). The number of colonies also continues to rise, and over 80 nesting colonies were reported

in 2006 throughout the southeastern United States (Service 2007), which is the highest to date in any 1 year. The 2006 stork-nesting season also appeared to be very productive for storks throughout their range. While final production estimates are still not available, preliminary estimates are over 2.5 chicks per nest (Borkhataria et al. 2006).

Total population and nest data are not available for 2007 and 2008 as all Florida colonies are not monitored every year, but estimates with most colonies reporting were 4,300 in 2007 and 5,900 in 2008 (W.B. Brooks, Service, personal communication 2009). However, all colonies were monitored in south Florida (Cook and Herring 2007, Cook and Kobza 2008) and nesting data show a significant drop in nesting pairs from 2,710 in 2006 to 770 in 2007 and 704 in 2008. Researchers attribute this drop to the drought conditions present in south Florida during the nesting periods. South Florida data records (Service 2010) noted 5,816 nesting pairs in 2009.

The 2009 wood stork nesting data for Corkscrew Sanctuary rookeries noted 1,120 nests producing 2,570 nestlings (Audubon 2009). Similar rebounds in nest production were recorded for other south Florida rookeries as well with probably the largest number of nest starts since 2004 Cook and Kobza 2009). About 3,000 nest starts were estimated throughout the WCAs and the Tamiami West colony (District 2009). More recent data reported by Cook and Kobza (2009) noted about 6,452 nests in south Florida. Data reports from rookeries in north Florida and Georgia also noted record numbers of wood stork nests (GDNR 2009, W.B. Brooks, Service, personal communication 2009).

Recovery Goals

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 through 2006. Three-year averages calculated from nesting data from 2001 through 2006 indicate that the total nesting population has been consistently above the 6,000 threshold, and the averages have ranged from about 7,400 to over 8,700 during this time period.

Wood Stork Nesting

Southeastern United States

Population totals for the southeast U.S. indicate that the wood stork has reached its highest level since it was listed as endangered in 1984 (Service 2007) (Table 7, Figure 10). In 2006, an estimated 11,232 wood stork pairs nested within their breeding range in the southeastern United States. Wood stork nesting was again recorded in North Carolina in 2006, 2007, and 2008 after it was first documented there in 2005. This suggests the northward expansion of wood stork nesting may be continuing. New colonies have been documented in recent years (2007 and 2008)

including several in Florida and some colonies have become inactive. New colonies were also recorded in 2008 in Georgia and South Carolina (W.B. Brooks, Service, personal communication 2009). The total number of colonies has peaked at over 80 in 2006 (Service 2007), which is the highest to date in any year. From 2001 through 2006, the number of colonies and nesting wood storks in Florida appears to fluctuate yearly and varies around a 3-year running average of 49 colonies and 5,040 nests annually (Service 2007).

Current nesting data for the wood stork population in the southeastern United States, although incomplete for 2007 (4,300 nesting pairs), 2008 (5,900), and 2009 (no range wide totals) show a reduction in population numbers in years 2007 and 2008 and increases in 2009 for most nests monitored. Significant reductions in nest production in 2007 and 2008 in the south Florida rookeries were reported and were likely due to the severe drought conditions (Cook and Herring 2007, Cook and Kobza 2008). However, 2009 data provided by Cook and Kobza (2009) noted large numbers of nests at most south Florida rookeries. Similar reports for rookeries in north Florida and Georgia also reported record numbers of wood storks nesting at rookeries in Georgia (GDNR 2009), north Florida including the St. Augustine and Jacksonville Zoo rookeries (W.B. Brooks, Service, personal communication 2009), and rookeries in the Everglades and Big Cypress Systems (District 2009, W.B. Brooks, Service, personal communication 2009).

Everglades and Big Cypress Systems

The *South Florida Multi-Species Recovery Plan* (MSRP) (Service 1999) defines the Everglades and Big Cypress systems as the region 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 been variable, but have shown a general pattern of decline (Crozier and Gawlik 2003, Service 2003, Crozier and Cook 2004, Cook and Call 2005). However, in a review of the 10-year nesting data (Table 8, Figure 11), wood stork nesting success increased from the mid-1990s (an average of 400 to 500 pairs) to a high of 6,452 pairs in 2009. A 3-year running average over the reported years period ranges from 507 to 3,742 pairs with considerable variability over the 10-year period. These observed fluctuations in the nesting between years and nesting sites has been attributed primarily to variable hydrologic conditions during the nesting season (Crozier and Gawlik 2003, Crozier and Cook 2004). Frequent heavy rains during nesting can cause water levels to increase rapidly. The abrupt increases in water levels during nesting, termed reversals (Crozier and Gawlik 2003), may cause nest abandonment, re-nesting, late nest initiation, and poor fledging success. Abandonment and poor fledging success was reported to have affected most wading bird colonies in southern Florida during 2004 and 2005 (Crozier and Cook 2004, Cook and Call 2005). 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 the Corkscrew Sanctuary rookeriesy (Cook and Herring 2007, Cook and Kobza 2008). However, 2009 nesting data for Corkscrew Sanctuary rookeries noted 1,120 nests producing 2,570 nestlings (Audubon 2009. Similar rebounds in nesting activity were recorded for other south Florida rookeries as well with possibly the largest number of nest starts since 2004, with estimates of about 3,000 nests throughout the WCAs and the Tamiami West colony (District 2009). Data reported by Cook and Kobza (2009) noted about 6,452 nests in south Florida, with a final count of 5,816 (Service 2010).

Analysis of the Species Likely to be Affected

The primary cause of wood stork population decline in the United States is loss of wetland habitats or loss of wetland function resulting in reduced prey availability. The alteration of wetlands and the manipulation of wetland hydroperiods to suit human needs have also reduced the amount of habitat available to wood storks and affected the prey base availability. The altered hydrology of the central and south Florida wetland systems has also fostered the invasion of these systems by the exotic plant species, melaleuca. This plant produces a dense understory and closed canopy, limiting the suitability of these wetland systems to foraging by wood storks, although sufficient prey base may be present in the wetlands. Increasing human population has resulted in increasing impacts on native habitat and flora and fauna. Continuing threats to wood storks include habitat loss, habitat fragmentation, and human disturbance. Critical habitat has not been designated for the wood stork; therefore, none would be affected.

ENVIRONMENTAL BASELINE

Climate Change

Climate change is evident from observations of increases in average global air and ocean temperatures, widespread melting of snow and ice, and rising sea level, according to the Intergovernmental Panel on Climate Change (IPCC) Report (2007). The IPCC Report describes natural ecosystem changes with potential wide-spread effects on organisms from marine mammals to migratory birds. The potential for rapid climate change poses a significant challenge for fish and wildlife conservation. Species' abundance and distribution are dynamic, relative to a variety of factors, including climate. As climate changes, the abundance and distribution of fish and wildlife will also change. Highly specialized or endemic species are likely to be most susceptible to the stresses of changing climate.

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

Prior to the 2007 IPCC Report, Titus and Narayanan (1995) modeled the probability of sea level rise based on global warming. They estimated that the increase in global temperatures could likely raise sea level 6 inches by 2050 and 13 inches by 2100. While these estimates are lower than the estimates described in the IPCC Report (2007), Titus and Narayanan's (1995) modeling efforts developed probability-based projections that can be added to local tide-gauge trends to estimate future sea level at specific locations.

The Southwest Florida Regional Planning Council projected sea level rise in southwest Florida by 2200 based on Titus and Narayanan's (1995) worst-case scenario of a 4-meter (13-foot) rise in 200 years.

General Environmental Baseline

The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions, which occur simultaneously with the consultation in progress.

Florida Panther

As stated previously, the Service has determined, for the purposes of this biological opinion, the action area is considered to include the project site and a 25-mile radius surrounding the site with the western most boundary of the action area the I-75 corridor.

Status of the Species within the Action Area

Panther use of the Mirasol action area: The Service used current and historical radio-telemetry data, information on habitat quality, prey base, and evidence of uncollared panthers to evaluate panther use in the action area. Panther telemetry data are collected 3 days per-week from fixed-wing aircraft, usually in early to midmorning. However, researchers have shown panthers are most active between dusk and dawn (Maehr et al. 1990a, Beier 1995) and are typically at rest in dense ground cover during daytime monitoring flights (Land 1994). Therefore, telemetry locations may present an incomplete picture of panther activity patterns and habitat use (Comiskey et al. 2002). In addition, telemetry data alone may be misleading since less than half of the panther population is currently collared. Although telemetry data may not provide a complete picture of panther activity patterns, telemetry locations are a good indicator, due to the extensive data set, of the approximate boundaries of home ranges, panther travel corridors, and the range of Florida panthers south of the Caloosahatchee River. The FWC also uses observational data collected during telemetry flights to assess the yearly breeding activity of radio-collared panthers. Female panthers accompanied by kittens or male panthers within close proximity of an adult female were assumed to have engaged in breeding activity during that year.

Within the 25-mile radius action area: Based on telemetry data as of March 2011, at least 19 living radio-collared panthers have been recorded on 4,069 occasions within the action area. These panthers are FP 65 (male), FP 113 (female), FP 119 (male), FP 133 (male), FP 137 (male), FP 143 (male), FP 145 (female), FP 146 (male), FP 147 (male), FP 148 (female) FP 149 (female), FP 154 (male), FP 158 (female), FP 159 (male), FP 160 (female), FP 171 (male), FP 177 (male), FP 178 (female), and FP 180 (female). In addition, Service review of telemetry and mortality data (FWC 2010a) notes previous use of the action area by 126 other panthers prior to their mortality, 54 females and 73 male. The nearest telemetry point to the site of a panther still alive as of this document was FP 159 (male), documented onsite on February 18, 2008, in the northwestern corner of the onsite preserve lands.

Within a 5-mile radius of the project site: Historically, there have been a total of seven radio-collared male and female panthers (FP 28 (male), FP 92 (male), FP 99 (male), FP 159 (male), FP 168 (male), FP 173 (male), and TX 101 (female) recorded on 60 occasions based on telemetry data from February 1981 through March 30, 2011 (Figure 12). Panther 28 (male) was documented 4 times in 1989 and died in 1992 from intraspecific aggression. Panther 92 (male) was documented 11 times in 2001 and died in 2001 from unknown causes. Panther 99 (male) was documented 14 times from 2001 to 2002 and died in 2002 from a vehicle collision. Panther 159 (male) was documented 8 times in 2008 and documented onsite on February 18, 2008, in the northwestern corner of the onsite preserve lands. Panther 168 (male) was documented 15 times in 2009 and 2010 and died in 2010 from intraspecific aggression. Panther 173 (male) was documented 3 times in 2010 and died in 2010 from unknown causes. Texas puma 101 (female) was documented 5 times in 1995 and died of unknown causes in 2000. The status and activities of uncollared Florida panthers within the action area are unknown. The Service believes the project site may occasionally be used by other non-collared panthers because it contains habitat types used by panthers and their prey, and the project vicinity has been used historically by panthers as indicated by telemetry locations.

Road Mortality: There have been 82 documented panther-vehicle collisions within the 25-mile action area (see Table 9 and Figure 9). The panther-vehicle collision closest to the project site (UCFP 156 [male]) occurred in 2011, on I-75, about 4.1 miles northwest of the site. Another panther, UCFP 103 (male), was killed in 2008, about 5.4 mile south on Pine Ridge Road. Four panther-vehicle collisions have occurred in the action area in 2006. Five panther-vehicle collisions have also occurred in the action area in 2007, 7 in 2008, 10 in 2009, 10 in 2010 and 5 in 2011. The most recent vehicle mortality in the action area was panther UCFP 156 (male) on I-75 near mile-marker 114 (February 26, 2011).

Wildlife Value*:* A protected species survey was initially conducted by Turrell and Associates from June 1999 to March 2000 utilizing belt transects and drift fence and bucket trap arrays. RCW surveys were updated in 2010 and Turrell also provided more recent observations based on on-going wildlife surveys. A survey for white-tailed deer and feral hog tracks was conducted and eight sets of white-tail deer tracks were observed, but no feral hog tracks were observed. Based on the track surveys, the applicant calculated a deer density of one deer per 591 acres. Evidence of armadillo, bobcat, and raccoon was observed during the surveys. Other small mammals also constituting panther prey may utilize the site. Bears, which also prey on small mammals, have been documented by their tracks in the northeastern portion of Section 15 and along Broken-Back Road to the east of the project site.

Based on the track surveys (Tyson 1952), deer densities on exotic-infested private lands in Lee County have averaged one deer per 591 acres (Turrell 2001) to one deer per 534 acres (Passarella Associates, Incorporated 2004). In comparison, deer densities on wildlife management areas average one deer per 165 acres to one deer per 250 acres (Steelman et al. 1999). Density estimates from deer tracks, however, should be viewed with caution. Track estimates are most appropriately used as long-term indicators (McCown 1991) and several factors can influence counts including weather, food abundance, population density, season, and availability of water (O'Connell et al. 1999).

Habitat Quality: Historical vegetation on the property included a mosaic of upland and wetland habitats that provided a seasonal pattern of plant growth. However, past agricultural practices and the invasion of the habitats by the exotics, primarily melaleuca and Brazilian pepper, have resulted in the growth of dense stands of monotypic plant species that provide reduced quality foraging needs for resident deer populations. Florida Land Use, Cover, and Forms Classification System (FLUCCS) mapping of the habitats on the property document that exotic vegetation, primarily melaleuca, has infested just under 69 percent (1,174.45 acres) of the project site with exotic densities averaging greater than 50 percent of existing vegetative cover. The area proposed for development is infested with melaleuca, averaging just under 70 percent (571.34 acres), with exotic densities greater than 50 percent. The adjacent onsite compensation site, with its growth of invasive exotic plant species and altered hydrology, also displays similar foraging challenges. Melaueuca coverage at greater than 50 percent occurs on 70 percent (615.01 acres) of the site. However, the proposed enhancements will result in a more diverse mosaic of plant species, which will provide an increased foraging value to resident deer populations.

Factors Affecting the Species Environment within the Action Area

Factors that affect the species environment (positively and negatively) within the action area include, but are not limited to Federal, State, or private actions and other human activities in the action area that influence the construction of highways and urban development, agriculture operations, resource extraction, public lands management (prescribed fire, public use, exotic eradication, etc.), hydrological restoration projects, and public and private land protection efforts.

Federal Action - Formal Consultations: Federal actions implemented since the listing of the panther under the Act are included in the baseline for Florida panthers in south Florida. All formal consultations were initiated because of likely adverse effects to panthers. However, not all formal consultations concluded an anticipated incidental take of panthers or loss of panther habitat. Each formal consultation concluded the proposed action under review was not likely to jeopardize the continued existence of the panther.

Within the 25-mile action area: The Service, since January 14, 1992, has formally consulted on 44 Federal actions, informally consulted on 23 Federal actions (excluding Comprehensive Everglades Restoration Plan (CERP) consultations), and 6 technical assistances with habitat compensation regarding the panther that were a result of Federal actions (database entries for formal consultations prior to 1992 are incomplete for projects in the action area) (Appendix 2C). These projects have impacted or are expected to impact about 29,724 acres of panther habitat. These projects have also incorporated a total of 28,808 acres of preservation and restoration of panther habitat.

Within a 5-mile radius of the project site: The Service, within the last 5 years, has formally consulted on three projects within the same watershed (CREW) as the Mirasol project (Table 10 and Figure 2). The Service issued a biological opinion for the Bonita Beach Road project on October 6, 2003, a revised biological opinion for the Parklands project on March 28, 2008, and a revised biological opinion for the Terafina project on August 28, 2007. As shown on Figure 2 and tabulated in Table 10, the combined habitat loss from these projects is

1,967 acres. The impacted lands border existing developments and prior to construction supported a mosaic of habitats for panther prey species and hunting and dispersal habitat to panthers. Existing habitat value to panther prey species (deer and hog), as discussed in the biological opinions for these projects, was degraded by varying levels of exotic species infestations that also reduced the quantity and quality of foraging food base for these prey species.

The 1,921 acres of companion preserves prior to restoration also were degraded by exotic species infestations. Following restoration, primarily the removal of the exotic species, the quality and quantity of forage for panther prey species is expected to improve with a corresponding increase in use by panther prey and the Florida panther. In addition, the proposed 1,921 acres of companion preserve lands are interconnected to each other and to the adjacent CREW. These interconnected preserves provide greater access and facilitate panther and panther prey movement in and out of adjacent publicly owned lands and provide refugia for dispersing panthers. The Service concluded in all of the aforementioned biological opinions that these projects, as proposed, do not jeopardize the survival and recovery of the Florida panther, that the proposed compensation plans provide habitat preservation and restoration within and near the project area, and that the compensation plans benefit the survival and recovery of the Florida panther as referenced in the Panther Recovery Plan (Service 2008) goal 1.1.1.2.3. This goal recommends habitat preservation and restoration within the Primary Zone be provided in situations where land use intensification can not be avoided. The applicants have proposed sufficient habitat protection and restoration, to compensate for both the quantity and functional value of the lost habitat.

CERP Actions: The Service has completed formal consultation on one CERP project in the action area. The project is the Picayune Strand Restoration Project (PSRP). The PSRP would restore more than 55,000 acres of land to near pre-development conditions. Formerly known as the Southern Golden Gate Estates, the project area was planned as a residential subdivision in the 1950s and roads and drainage canals were constructed in the 1960s and early 1970s. The project would remove the infrastructure of the subdivision and restore its pre-drainage hydrology by construction of weirs, pumping stations, 10 miles of tie-back levees, 2.5 miles of spreader swales, 260 miles of road removal and degradation, and backfill of four major north-south canals. The Service's March 12, 2009, BO determined that the proposed action was not likely to jeopardize the continued existence of the panther.

The Service completed section 7 consultation with the Corps on the Prairie Canal Early Start portion of the PSRP in October 2003. The Service concurred with the Corps' determination that the backfill of Prairie Canal on the eastern extent of the project "may affect, but is not likely to adversely affect" the Florida panther, wood stork, Everglade snail kite *(Rostrhamus sociabilis plumbeus)*, West Indian manatee *(Trichechus manatus)* and its critical habitat, American crocodile *(Crocodylus acutus)*, red-cockaded woodpecker (*Picoides borealis)*, eastern indigo snake (*Drymarchon corais couperi)*, and bald eagle (*Haliaeetus leucocephalis*). This concurrence was based on a project proposal developed by the applicant, the District, which included pre-project wildlife surveys, construction protection plans for affected listed species, and post-restoration project monitoring and reporting.

The Service as a restoration partner is also coordinating with the Corps, the District, and Lee County on the Southern CREW project. The project is a 4,000-acre wetland restoration project that will provide wetland restoration, remove exotic species, fill agricultural ditches and provide water storage and aquifer recharge capacity to CREW. Portions of the restoration completed to date include clearing exotics from 2,560 acres, removing roads and plugged agricultural ditches on 640 acres, and constructing the Kehl Canal Wier. As of January 2009, the District has invested $27.4 million to conserve the lands, with the U.S. Department of the Interior contributing another $7 million to the restoration effort.

Federal Action - Informal Consultations: From July 2000 through September 2006 (6 year period), the Service also engaged in informal consultation for projects under 5 acres with the Corps on 757 projects affecting about 764.1 acres in Collier County (primarily Northern Golden Gate Estates) and about 202.8 acres in Lee County (primarily Lehigh Acres) (database entries for informal consultations prior to 2000 are incomplete for projects in the consultation area). These informal consultations, over the 6-year period, concerned about of 126 actions per year with an average acre impact of 1.3 acres per action. Cumulative impact per year is about 161.2 acres. Almost all of these projects involved the construction of single-family residences in partially developed areas, each in most cases involving less than an acre of direct impact. Although panthers have been known to cross these areas to other parts of their range, prey base and denning utilization of these areas have been affected by the level of development and the additions of these residences is not expected to significantly further impact these habitat functions. For these actions, the Service concurred with the Corps' determination of "may affect, but is not likely to adversely affect" for these individual projects. These projects have been incorporated into the Service's environmental baseline for the Florida panther.

Based in part on historical consultation data referenced above, the Service, in 2007, provided the Corps with a Florida Panther Effect Determination Key (February 19, 2007). The Key provides guidance to the Corps for effect determinations for the Florida panther and "may affect, but is not likely to adversely affect" determinations for projects less than 1 acre. The Key provides an assessment that on an individual basis, single-family residential developments on lots no larger than 1 acre will not have a measurable effect on panthers. Panthers are a wide ranging species and individually, a 1-acre habitat change is not likely to adversely affect panthers. However, collectively they may have an effect and regular monitoring and reporting of these effects are important.

Non-Federal Actions - Isolated Wetlands: We have received information that within the Panther Focus Area that lies within 25 miles of the project site, the Corps has, between March 2004 and September 2006, issued non-jurisdictional wetland determinations for 10 projects totaling about 1,812.9 acres, with about 134 acres of isolated wetlands. We also received data that during the 2008 calendar year, the Corps provided 15 non-jurisdictional wetland determinations for project in Lee, Collier, and Charlotte counties affecting 266 acres. These determinations were issued per jurisdictional guidance provided recently in the Supreme Court decision, *Solid Waste Agency of Northern Cook County vs. U.S. Army Corps of Engineers*, 531 U.S. 159 (2001) and, therefore, they will not require a Federal Clean Water Act 404 wetland permit. However, since loss of panther habitat may occur from construction of these projects and no Corps wetland permit is required, the Service is recommending that the applicants pursue incidental take permits in accordance with section 10 of the Act.

Non- Federal Action - State of Florida Environmental Resource Permit (ERP): Although the Corps of Engineers and the State of Florida, since 1982, have had a joint wetland permit application process, where all permit applications submitted to the State are copied to the Corps and vice versa, the State also reviews projects that have no wetland impacts or where the wetlands are not considered jurisdictional by the Corps. To determine which of these projects would likely include no wetland impacts and not require a secton 404 Clean Water Act wetland permit from the Corps, we identified the percentage of the project site that was classified as wetland habitat, based on the FLUCCS mapping units. The mapping units relied on by the Service included the 600 series (wetland classifications) and the 411 and 419 pine flatwood classifications (hydric pine systems). Although subject to Federal review, for our purposes, we considered properties with less than 5 percent wetlands unlikely to require a section 404 wetland permit from the Corps as these wetlands would be avoided through project design in compliance with section 404(b)(1) guidelines that require impacts to wetlands be avoided and minimized to the maximum extent practable.

Within the action area, the District has issued ERP permits (2005 to 2010) for 115 projects (17 in 2005, 30 in 2006, 22 in 2007, 21 in 2008, 19 in 2009, 10 in 2010) affecting 14,958 acres and impacting 1,355 acres of wetlands and preserving 2,781 acres of wetlands and 679.23 acres of uplands. Based on FLUCCS mapping, about 14 projects (2 in 2005, 2 in 2006, 2 in 2007, 2 in 2008, 4 in 2009, 2 in 2010) affecting 2,712 acres and 8.87 acres of wetlands, with 35.34 acres of wetland preservation and 10.84 acres of upland preservation, could be expected to be subject to development without Federal permit involvement through the Clean Water Act section 404 (Appendix 2E). This loss represents 9.3 percent of a female panther's average home range (29,059 acres) and 4.3 percent of a male panther's average home range (62,542 acres). However, since loss of panther habitat may occur from construction of these projects and no Corps wetland permit is required, the Service is recommending that the applicants pursue incidental take permits in accordance with section 10 of the Act.

Summary: From January 1992 through March 2011, the Service has consulted on 830 projects negatively affecting 29,724 acres of panther habitat in south Florida. The Service has also identified that in the action area, an additional 14 actions, affecting 2,712 acres, may have been developed without the need for a section 404 wetland permit from the Corps. These habitat losses may contribute to increases in intraspecific aggression and decreases in spatial extent of lands available to the panther for hunting, breeding, and dispersing. We anticipate any resident panthers with home ranges overlapping or in the vicinity of the project areas will adjust the size and location of their ranges to account for this loss and that adjustment is anticipated to occur in concert with project construction. These projects have been incorporated in the Service's environmental baseline for the Florida panther in this biological opinion and the Service has determined, based on the location of these projects (generally in the western fringe of the panther's geographic range), the quality of the habitat present on these project sites, and the overall status of the Florida panther, these projects individually and cumulatively do not jeopardize the survival and recovery of the Florida panther.

Activities within the action area have also benefited panthers. The issuance of Corps permits has preserved 28,808 acres of panther habitat (1992 to 2011). Within the same watershed as the proposed project, the issuance of Corps permits has preserved 1,921 acres of companion preserve lands that are interconnected to each other and to the adjacent CREW. These interconnected

preserves provide greater access and facilitate panther and panther prey movement in an out of adjacent publicly owned lands and provide refugia for dispersing panthers. In addition, installation of wildlife crossings under SR 29 and I-75 within the action area has also benefited the panther by protecting habitat connectivity and reducing panther-vehicle collision mortalities. The PSRP restoration project will restore more than 55,000 acres of land to near pre-development conditions. The CREW restoration project will restore about 4,000 acres of wetlands to near pre-development conditions. The District through their ERP program is preserving 2,781 acres of wetlands and 679.23 acres of uplands. Additional benefits have resulted from the protection of high quality habitat through acquisition programs by the other Federal, State, and County resource agencies. For example, Lee County's Conservation Lands Program, since it's inception in 1995 has purchased a total of 23,820 acres, with the most recent acquisition, the 1,213 acres adjacent to the Bob Janes Preserve in eastern Lee County. A similar program in Collier County, the Conserve Collier Program, recently purchased 368 acres adjacent to Corkscrew Sanctuary and purchased the 2,500-acre Pepper Ranch.

Moreover, the management of public lands, including prescribed fire and eradication of exotic vegetation in the Picayune Strand State Forest, Fakahatchee Strand State Preserve, Florida Panther NWR, ENP, and other conservation areas, is intended to improve habitat for panther prey species, which benefits panthers within these areas.

EFFECTS OF THE ACTION

Factors to be Considered

This section analyzes the direct, indirect, interrelated, and independent actions on the Florida panther. Direct effects are primarily habitat based and occur at the time of construction. Indirect effects occur later in time and can also be habitat based. In our assessment we are combining both direct and indirect effects as joint factors. The combined direct and indirect effects include: (1) temporary loss and fragmentation of panther habitat, habitat that supports panther prey, and habitat for hunting, breeding and dispersing panthers; (2) permanent loss and fragmentation of panther habitat, habitat that supports panther prey, and habitat for hunting, breeding and dispersing panthers; (3) changes in the geographic distribution of habitat for the species (4) risk of roadway injury or mortality (5) disturbance from construction activities, (6) panther/human interactions; and (7) intraspecific aggression.

Direct and Indirect Effects: To assess habitat, the Service based in part on an evaluation of habitat use data for the Florida panther provided by Swainson et al. (2005) and Kautz et al. (2006), developed an assessment approach that provides a comparison of pre- and post-development habitat as a matrix of primary zone equivalent lands. The primary zone equivalent lands were then equated to the habitat preferences of the Florida panther and incorporated as component of our goal to conserve sufficient lands to support a population of at least 90 panthers in south Florida.

Primary Zone Equivalent Lands: Kautz et al. (2006), through their habitat evaluation of lands important to the Florida panther, identified three sets of lands, *i.e.*, Primary Zone, Secondary Zone, and Dispersal Zone, and documented the relative importance of these lands to the Florida panther. These lands, generally referred to as Kautz et al.'s panther core lands (Figure 7), include the majority of the home ranges of the current population of the Florida panther. The Service, in our

evaluation of habitat needs for the Florida panther, expanded the boundaries of the Kautz et al. (2006) lands to include those lands south of the Caloosahatchee River where additional telemetry points were recorded. These additional lands (about 819,995 acres), referred to as the "Other" Zone, are added to the lands in Kautz et al.'s (2006) panther core lands. The core lands and the other zone lands together are referred to by the Service as the Service's Panther Focus Area (Figure 4). The Other Zone lands are labeled on Figure 5 as "Original Panther Consultation Area South of the Caloosahatchee River". The Other Zone lands, as well as the lands within the Secondary Zone, provide less landscape benefit to the Florida panther than the Primary and Dispersal Zones, but are important as a component of our goal to conserve sufficient lands to support a population of at least 90 panthers in south Florida.

Kautz et al. (2006) identifies the need for restoration in the Secondary Zone to achieve maximum panther benefits. To estimate the Primary Zone equivalent of Secondary Zone lands, we derived a relative habitat value (average PHU value) for each by comparing the habitat ranks estimated in Kautz et al. (2006) for each habitat type per zone. The average PHU value for the Primary Zone is 6.94, and for the Secondary Zone, 4.79. Based on this analysis, the habitat value of the Secondary Zone is roughly 69 percent of the Primary Zone, and restoration is needed to achieve full landscape function (4.79/6.94 = 0.69). Using this assessment, the 503,481 acres of Secondary Zone lands equate to 347,402 acres of Primary Zone equivalent lands.

At-risk lands in the Other Zone total 819,995 acres. Although some actions on some of the Other Zone lands may have little effect on panthers or their habitat, future proposed actions will be reviewed on a case-by-case basis. We estimate actions on 80 percent of these lands will have an effect on panther conservation (819,995) times 0.8 equals 655,996 acres). We then multiplied this acreage (655,996 acres) by 0.33 to determine the acres of Primary Zone equivalent lands the Other Zone can provide (655,996 times); 0.33 equals 216,479 acres of Primary Zone equivalent lands.

These equivalent values, 0.33 and 0.69, for Other and Secondary Zones, respectively, and a 1:1 ratio for the Dispersal Zone, are important components in our recommendations for compensation for a project in the panther consultation area and are components of our habitat assessment methodology as discussed below.

Habitat Assessment Method***:*** As of January 2005, the Service has been using a panther habitat suitability ranking system based in part on methods in publications by Swainson et al. (2005) and Kautz et al. (2006) and adjusted by the Service to consolidate similar types of habitats and to include CERP water treatment and retention areas located in the panther's range (Table 11). Since the implementation of this ranking system, the Service has received two additional, published habitat assessment studies (Cox et al. [2006] and Land et al. [2008]) that further assess habitat usage by the Florida panther. As it is the Service's policy to incorporate the most current peer-reviewed science into our assessment and review of project effects on the Florida panther, we have revised the current habitat suitability ranking system.

To revise these values, the Service, in coordination with the FWC, examined the habitat ranking values in the two new papers referenced above and Kautz et al.s' (2006) publication and developed a spreadsheet. The spreadsheet was developed to: (1) compare the results of each of these published analyses; and (2) provide a habitat ranking system for each of the assessments. On the

first page of the spreadsheet, labeled "Panther Habitat Selection Analysis - Habitat Papers Comparison," we summarized the types of analyses performed as to whether it was second order (selection of a home range with a large study area) or third order (selection of habitats within a home range). For each of these analyses we then listed the habitat types reported in each paper and their order of selection by panthers (Table 12). We used the Cost Surface Scores and the Rank Differences from the Kautz et al. (2006) analyses as the selection order and for a measure of statistical differences among the habitat types. Selected habitat types are represented as bold black numbers and avoided habitats are bold red numbers. Habitats that were neither selected nor avoided are shown as normal font black numbers. Ranks with the same letter are not different from each other. Results from the Cox et al. (2006) and Land et al. (2008) papers using Euclidean analyses are shown in a similar fashion.

On the second page of the spreadsheet, labeled "Summary of Ranking Values," we ranked the habitat types on a scale from 0 to 10 according the results from each study and professional judgment (Table 13). We used our original ranking from the Kautz et al. (2006) analyses (with the ranking scale reversed such that the best habitat received a "10" and the lowest quality habitat was "0").

We developed similar rankings for the habitat analyses reported in Cox et al. (2006) and Land et al. (2008). Selected habitats fell in the range of 7 to 10; habitats that were used in proportion to availability were ranked from 4 to 6; and habitats that were avoided by panthers were ranked from 0 to 3. Ranks for habitats within each of the 3 outcomes began at the top of each of the ranges (selected = 10, used in proportion to availability = 6, avoided = 3). Some shifting of the ranks occurred based on the letter-coded statistical ranking. For instance, under "Land GPS Euclidean third order" both upland and wetland forests were selected by panthers and were not statistically different from each other (note the ranking of A and AB for upland and wetland forest, respectively). However, wetland forest and dry prairie also were not significantly different from each other. To show these relationships, we ranked upland forest as a 10, wetland forest as a 9, and we increased dry prairie from a 6 (top of the neither selected nor avoided ranking) to a 7 to reflect the interplay between dry prairie and wetland forest based on professional judgment.

To generate a new ranking of panther habitats for use as a habitat assessment measure, we simply averaged the ranks of the six different analyses presented in the spreadsheet to the first decimal place. Half of these results were second order habitat analyses (Kautz et al. compositional, Kautz et al. Euclidean, and Cox et al. Euclidean) and the other half were third order analyses (Cox et al. Euclidean, Land et al. VHF Euclidean, Land et al. GPS Euclidean).

In our assessment, we noted several outlier habitat rankings that, based on our understanding of habitat needs of the Florida panther and our concern for human/panther interactions, appear to provide conflicting values. These habitats and their associated rankings are: (1) Barren/ Disturbed – 5.2; (2) Urban – 5.0; (3) Open water – 3.3; and (4) Coastal wetlands – 1.0. We believe adjustments are warranted for these four categories and our adjusted values are based on the following:

1. *Barren/Disturbed***:** Barren/Disturbed lands may include many temporary changes to land use, such as crop rotation and prescribed fires that likely have little impact on the value to panthers. Areas disturbed by human impact on a longer-term basis (*e.g*., parking of equipment and material storage

areas) have chronic effects on panthers that we judge decrease the value of these lands for panthers. Barren/Disturbed lands include disturbed lands (FLUCCS 740) and spoil areas (FLUCCS 733). Based on the above reasons, we assigned barren/disturbed land a value of 3.

2. *Urban***:** Panther habitat models typically include urban in the "other" category that was neither avoided nor selected by panthers. Highly urbanized areas are not found in the panther core area that was used in assessing habitat use as panthers have already selected against these land use types by reducing their range. However, urbanizing areas in more rural settings may appear in the assessment of habitat use. Nevertheless, we believe that potential human/panther interactions are important conflict factors to consider as well. Therefore, we assigned both developed rural and highly urbanized areas a value of 0.

3. *Open water***:** Open water has been found to be either avoided by panthers or included in the "other" category that was neither avoided nor selected by panthers. We believe open water in any setting provides little to no value to panthers. However, open water edges and berms can be a valuable foraging area or dispersal pathway in more rural settings, although these edges in an urbanized setting could promote human/panther conflicts. Therefore, we assigned open water in an urban setting, with or without emergent vegetation, and surrounding berms a value of 0. However, in rural settings, the littoral edges and berms may provide species benefit and are further addressed under the reservoir discussion below.

4. *Coastal wetlands***:** There are few strictly coastal wetlands, such as salt marshes and mangrove swamps, within the panther focus area. Where these occur, they are closely interspersed with other upland habitats. In this context, we believe that these areas are of greater value to the panther than the models indicate. These areas may, for the most part, be avoided by panthers; but, they can be of value in the proper landscape context to higher value habitats. Therefore we assigned these areas a value of 3.

We also note that three additional land uses and or habitat types referenced in our original habitat rankings were not components addressed directly in the model. These include: (1) Exotic/Nuisance plants; (2) Storm Water Treatment Areas (STAs), and (3) Reservoirs. We believe these categories are important in our assessment of panther habitat values and warrant consideration in our habitat ranking system.

5. *Exotic/Nuisance plants***:** Although exotic plants can be suitable for providing denning cover and habitat connectivity between other land types for panthers and panther prey, they generally do not provide the preferred foraging base of plants consumed by deer and other herbivores (Fleming et. al. 1994). We believe that prey foraging value, or lack of, is an important constraint in our habitat assessments. Therefore, we assigned these habitats a value of 3. Likewise, some native plant species can become so dominant and dense, especially under altered hydrologic and fire suppression regimes, that they no longer provide high habitat value for the panther even though occasional use may occur. The most common example is dense, nearly monotypic cattail stands, which are of reduced value relative to less altered marsh communities. Another example of this type of nuisance species dominance is dense stands of cabbage palm dominated communities. For systems represented by this habitat profile, we also assigned a value of 3.

6. *Storm Water Treatment Areas (STAs) (Everglades Restoration*)**:** STAs are generally designed to provide a water quality treatment function for nutrient removal from received upstream discharges and may include multiple berms and adjacent littoral shelves. Depending on the design and mode of operation, they can become vegetated by dense monotypic stands of cattails or can incorporate a diverse mosaic of wetland communities and hydroperiods that support sawgrass and shrub/scrub species. Therefore, they can provide various levels of resource benefit to panthers and panther prey species as discussed below. For this reason, the final value of an STA is determined in a case-by-case basis during project review.

   The Service participates in planning efforts that encourage location of STAs at sites with minimal areas of natural habitat, with a preference for sites that are currently in agriculture. Because these facilities by design are located in areas that currently provide a reduced value to panthers and panther prey species, the Service values these systems pre and post project development as a neutral effect on panthers. In these situations, the development of an STA from existing agriculture land uses would be evaluated as if the agriculture land use was present following project development, with no increase or decrease in habitat value to the panther.

   However, this neutral effect assessment is only applicable to land conversions from nonnative habitats to STAs. For those projects that remove natural habitats, the Service considers STA functional values to mimic the value of the natural system the STA is designed to achieve. As an example, a STA design that results in a dense monotypic stand of cattails would be appropriately evaluated following the exotic/nuisance species profile. Similarly, a system designed to provide a diverse mosaic of wetland communities and hydroperiods would be evaluated following the wet prairie/marsh profile. Another system design that incorporates internal and external berms could include an edge benefit evaluation identifying the berms and adjacent littoral shelves and their benefit to the Florida panther and panther prey species, and follow the values provided for improved pasture for the berms and or wet prairie/marsh values for the littoral shelves. An individual project assessment of pre and post habitat impacts will identify whether the project as designed results in loss of functional value or provides benefit to the Florida panther and panther prey species.

7. *Reservoirs (Everglades Restoration, large water storage area, mines)***:** Reservoirs were classified as their own category in our 2003 assessment method. They differ from open water systems primarily with their location in the landscape. In urban areas, reservoirs have always been considered open water and given a value of 0. In rural areas, the open water portion of the reservoir provides no habitat value, although the edges and the berms can provide valuable foraging area or dispersal pathways for the panther and panther prey species. Therefore, the 2003 methodology assigned a value of 1.5 to reservoirs to attempt to account for these benefits.

   After further consideration, we believe that a more appropriate way to evaluate the value of reservoirs is to evaluate the open water component separately from the reservoir edges and berms. Therefore, we are no longer assigning a value to reservoirs as their own habitat classification. When large-scale reservoir projects are proposed in the rural landscape, all open water areas should be classified as such (value = 0). Berms and edges should be classified as the habitat they will most resemble in the post-project condition. For example: a 1,000-acre reservoir with 50 acres of grassed berms and 50 acres of berms with roads along the top would be evaluated as 900 acres of open water, 50 acres of pasture, and 50 acres of urban.

We also recognized the habitat matrix (Table 13) lists four native habitats similar in habitat value to panthers as non-native habitats: marsh/wet prairie – 4.7; xeric scrub – 4.5; shrub and brush – 5.5; and dry prairie – 6.3. These habitat ratings, which are between 4 and 6, are classified as being neither selected nor avoided by panthers. The Service's Florida panther recovery plan's (Service 2008) action 1.1.1.2.3, recommends habitat preservation and restoration within the Primary Zone be provided in situations where land use intensification cannot be avoided. We view this recommendation as a key parameter in our conservation goal to locate, preserve, and restore sets of lands containing sufficient area and appropriate land cover types to ensure the long-term survival of a population of Florida panthers south of the Caloosahatchee River.

Therefore, for assessment purposes, if a project is proposing restoration of non-native habitats (*e.g.*, pasture, row crops, groves, etc) to native habitats, we believe that a restoration lift to a value of 7 is appropriate. The functional value of 7 corresponds to that value found in the literature where panthers begin to select for that habitat attribute (Table 13). We also believe that a full functional lift credit for these restorations is appropriate as the time lag from restoration to full functional value is estimated to be relatively short (less than 5 years) for non-forested systems. However, the calculation of forested restoration values remains the same as in the previous methodology, which is one-half the difference between pre- and post-restoration.

In conclusion, we believe that appropriate adjustments to our original PHU values are warranted based on the most current peer-reviewed science and our category specific discussions above. Therefore, we have incorporated the above referenced values into our revised habitat assessment matrix and these values are the current basis for habitat evaluations and the recommended compensation values to minimize project effects to the Florida panther (Table 14).

Base Ratio: To develop a base ratio that will provide for the protection of sufficient acreage of Primary Zone equivalent lands for a population of 90 panthers from the acreage of Primary Zone equivalent non-urban lands at risk, we developed the following approach.

The available Primary Zone equivalent lands are estimated at 3,276,563 acres (actual acreage is 4,376,444 acres [the "actual acreage" value includes acres of lands in each category in the Secondary and Other Zones as well as the lands in the Primary Zone]) (data summed from Tables 5 and 6). Currently 2,073,865 acres of Primary Zone equivalent lands (actual acreage is 2,578,152 acres) of non-urban lands are preserved (Table 5). The remaining non-urban, at-risk, private lands are estimated at 1,202,699 acres of Primary Zone equivalent lands (actual acreage is 1,798,295 acres) (Table 6). To meet the protected and managed lands goal for a population of 90 panthers, an additional 799,205 acres of Primary Zone equivalent lands are needed. The base ratio is determined by dividing the primary equivalents of at-risk habitat to be secured (799,205 acres) by the result of the acres of at-risk habitat in the Primary Zone (610,935 acres) times the value of the Primary Zone (1); plus the at-risk acres in the Dispersal Zone (27,883 acres) times the value of the Dispersal Zone (1); plus the at-risk acres in the Secondary Zone (503,481 acres) times the value of the Secondary Zone (0.69); plus the at-risk acres in the Other Zone (655,996 acres) times the value of the Other Zone (0.33); minus the at-risk acres of habitat to be protected (799,205 acres). The results of this formula provide a base value of 1.98.

$$799{,}205 / ((610{,}935 \times 1.0) + (27{,}883 \times 1) + (503{,}481 \times 0.69) + (655{,}996 \times 0.33)) - 799{,}205 = 1.98$$

In evaluating habitat losses in the south Florida consultation area, we used an estimate of 0.8 percent loss of habitat per year (R. Kautz , FWC, personal communication, 2004) to predict the amount of habitat loss anticipated in south Florida during the next 5 years (*i.e.*, 6,000 ha/year; 14,820 acres/year). We conservatively assumed that the Service would be aware of half of these projects. We also assumed that half of the projects would occur in the Primary Zone and half would occur in the Secondary Zone. Based on these assumptions, we estimated that about 37,000 acres would be developed without Federal review over a 5-year period. As a result, we adjusted the base value from 1.98 to 2.23.

Habitat losses from individual single-family residential developments may cumulatively compromise the Service's goal to secure sufficient lands for a population of at least 90 panthers. On an individual basis, single-family residential developments by individual lot owners on lots no larger than 2.0 ha (5.0 acres) are not likely to result in take of panthers on a lot-by-lot basis; however, collectively these losses may impact the panther. Panthers are a wide-ranging species, and individually a 2.0 ha (5.0 acres) habitat change is not likely to have a measurable effect provided the area affected is not a den site. To account for these losses, we estimated another 12,950 acres over a 5-year period (2,590 acres per year) would be developed through this avenue. We further adjusted the base value from 2.23 to 2.48.

There is a need for road crossings in strategic locations to prevent panther/vehicle collisions because there are projects that may not have habitat loss factors but will generate increases in traffic or changes in traffic patterns. The Service considers increases in traffic or changes in traffic pattern as an indirect effect from a project which can contribute to panther mortality. Therefore, we have added another 0.02 to the base ratio to address traffic impacts, which could provide an incentive to implement crossings in key locations. Following the same approach shown above, we adjusted the base ratio from 2.48 to 2.5. The Service intends to re-evaluate this base ratio periodically and adjust as needed to make sure all adverse effects are adequately ameliorated and offset to achieve the Service's conservation goal for the Florida panther.

Landscape Multiplier: As stated in the above section on Primary Zone Equivalent Lands, the location of a project in the landscape of the core area of the Florida panther is important. As we have previously discussed, lands in the Primary and Dispersal Zones are of the most importance in a landscape context to the Florida panther, with lands in the Secondary Zone of less importance, and lands in the Other Zone of lower importance. These zones affect the level of compensation the Service believes is necessary to minimize a project's effects to Florida panther habitat. Table 15 provides the landscape compensation multipliers for various compensation scenarios. As an example, if a project is in the Other Zone and compensation is proposed in the Primary Zone, a Primary Zone equivalent multiplier of 0.33 is applied to the PHUs (see discussion above on Primary Zone Equivalent Lands) developed for the project. If the project is in the Secondary Zone and compensation is in the Primary Zone, then a Primary Zone equivalent multiplier of 0.69 is applied to the PHUs developed for the project.

Panther Habitat Units – Habitat Value: Prior to applying the base ratio and landscape multipliers discussed above, we evaluate the project site and assign values to the habitats present. This is done by assigning each habitat type onsite a habitat suitability value from the habitats shown in Table 14.

The habitat suitability value for each habitat type is then multiplied by the acreage of that habitat type resulting in a number representing PHUs. These PHUs are summed for a site total, which is used as a measurement of the value the habitat provides to the Florida panther. This process is also followed for the compensation sites.

Invasive and Exotic Species Assessment: Many habitat types in south Florida are invaded with invasive or exotic plant species. Exotic species are non-native and invasive or nuisance species are native or naturalized species which get out of control. For example, a site with 100 acres of pine flatwoods with 10 percent exotics would be treated in our habitat assessment methodology as 90 acres of pine flatwoods and 10 acres of exotics. Adding another 100 acres of cypress swamp with 10 percent exotics would change our hypothetical site from 90 acres of pine flatwoods and 10 acres of exotics to 90 acres of pine flatwoods, 90 acres of cypress swamp, and 20 acres of exotics.

Habitat Assessment Methodology Application – Example: To illustrate the use of our habitat assessment methodology, we provide the following example. A 100-acre project site is proposed for a residential development. Plans call for the entire site to be cleared. The project site contains 90 acres of pine flatwoods and 10 acres of exotic vegetation, and is located in the Secondary Zone. The project sponsors have offered habitat compensation in the Primary Zone to minimize the impacts of the project to the Florida panther. To calculate the PHUs provided by the site, we multiply the habitat acreage by the "habitat suitability value" for each habitat type and add those values to obtain a value of 885 PHUs ((90 acres of pine flatwoods x 9.5 [the habitat suitability value for pine flatwoods] = 855 PHUs) + (10 acres of exotic vegetationx 3 [the habitat suitability value for exotics] = 30 PHUs) = 885 PHUs). The value of 885 PHUs is then multiplied by 0.69 (the landscape multiplier) to provide a primary equivalent PHU site value of 611 PHUs. This value is multiplied by 2.5 (the base ratio) to provide the recommended compensation needs. The value is 1,528 PHUs for the project site. In this example, the acquisition of lands in the Primary Zone containing at least 1,528 PHUs is recommended to compensate for the loss of habitat to the Florida panther resulting from this project.

Habitat Assessment - Mirasol: The application of the habitat assessment methodology including the PHU determinations, landscape multiplier, base ratio and compensation recommendations, are presented below for the Mirasol project and compensation areas. Table 16 illustrates the PHU calculations for the Mirasol project with impacts to 809.83 acres of land in the Primary Zone (772.97 acres development footprint and 36.86 acres internal preserve not accessible to panthers) and compensation provided by the preservation and enhancement of about 1,276.97 acres of panther habitat (903.66 acres onsite, 291.10 acres offsite, and 82.21 acres at PIMB) in the Primary Zone. Table 16 shows the 809.83-acre impact area represents a loss of 3,884.12 PHUs. This value is multiplied by 2.5 to provide the base ratio compensation need, which is 9,710.30 PHUs. Since the project is located in the Primary Zone and compensation is in the Primary Zone, the base ratio PHUs are unaffected by the landscape compensation multiplier of 1.0.

The 1,276.97 acres provided by onsite and offsite preserves and credits at PIMB provides for 9,710.30 PHUs (6,671.75+708.88+2,329.67=9,710.30). Therefore, the Service believes the impacts associated with the habitat lost by the proposed project will be minimized by the compensation actions proposed by the applicant. The lands proposed for development are on the

western limits of the panther's range, are in the Primary Zone, and panther prey foraging habitat value has been diminished by exotic infestation. Lands proposed for preservation and restoration are in the Primary Zone, adjacent to other natural lands, and following restoration will provide an increased foraging value to panther prey species and an expected corresponding increase in use by panther prey and panthers. The proposed preserve and compensation plan also benefits the survival and recovery of the Florida panther as referenced in the Panther Recovery Plan (Service 2008) goal 1.1.1.2.3. This goal recommends habitat preservation and restoration within the Primary Zone be provided in situations where land use intensification can not be avoided. The applicant has proposed sufficient habitat protection and restoration, to compensate for both the quantity and functional value of the lost habitat. The proposed preserve is also consistent with the Service's panther goal to strategically locate, preserve, and restore sets of lands containing sufficient area and appropriate land cover types to ensure the long-term survival of the Florida panther population south of the Caloosahatchee River.

Analysis for Effects of the Action

Habitat Fragmentation: 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 key component of the definition. For panther conservation, this definition underscores the need to maintain contiguous habitat and protected habitat corridors in key locations in south Florida. Habitat fragmentation can result from road construction, urban development, and agricultural land conversions within the habitat of panther prey species and affect the ability of panthers to move freely throughout their home ranges. Construction of highways in wildlife habitat typically results in loss of habitat, traffic-related injury or mortality, and panther avoidance of associated human development. Female panthers appear to be less likely to cross roads than males, which may increase the effects of habitat fragmentation (Maehr 1990).

Temporary Impacts and Fragmentation of Panther Habitat, Habitat that Supports Panther Prey, and Habitat for Hunting, Breeding, and Dispersing Panthers: The temporary impacts are associated with activities to remove the exotic species present in the preserve areas and will result in impacts to 903.66 acres (19.95+883.71=903.66) onsite. Exotic and nuisance plants will be manually removed from the preservation areas in order to facilitate re-vegetation by native plants. Following initial exotic treatment, quarterly maintenance treatments will be necessary to eliminate exotics that reappear. The preserve area will be left to regenerate naturally for at least a year before proposing replanting. Replanting will be considered appropriate if less than 75 percent coverage by appropriate native vegetation is documented. Exotic plant species will be controlled within the preservet footprint as part of the project action and managed in accordance with the Mirasol Mitigation and Monitoring Plan.

Once the exotic vegetation has been removed and the native vegetation restored, the lands are proposed to be donated to CREW or another appropriate public entity for perpetual preservation. In addition to the donation of the property to an appropriate public entity, the applicant will also

establish an escrow fund for the long-term maintenance of the preserve. The amount of the escrow fund will be determined at the time the preserve is turned over and based on the expected long-term maintenance requirements. However, until such time as that may happen, the entirety of the preserve shall be placed into conservation easements, and enforcement right shall be granted to the District, Corps, and Collier County. The conservation easement for this area will be filed and recorded within a year after the initial clearing activities associated with the project are started. It is also the responsibility of the applicant to reach the success criteria outlined in the Mirasol Mitigation and Monitoring Plan before donation.

Although there will be a temporary impact and fragmentation of habitat in the preserve areas during site restoration, these actions will restore these lands to habitats that may be used more frequently by panthers or their prey. The restored lands may provide a beneficial effect to the Florida panther through an increase in quality of habitat and may reduce the local and landscape-scale effects of the initial habitat loss and fragmentation. No temporary impacts are expected to lands at the PIMB, as restoration has been completed. Temporary impacts may also occur on the 291.10 acres of additional lands proposed for panther compensation; if the additional compensation occurs in an area where exotic species restoration has not been completed.

Permanent Loss and Fragmentation of Panther Habitat, Habitat that Supports Panther Prey, and Habitat for Hunting, Breeding and Dispersing Panthers: The project will result in the permanent loss of 809.83 acres of panther habitat (772.97 acres development and 36.86 acres of internal preserve not accessible to panthers. Though the habitat value of the existing project site to the panther and panther prey species has been reduced by exotic infestation, the permanent loss and fragmentation of habitat may adversely affect the panther by decreasing the spatial extent of lands available to the panther. In addition panthers may be periodically disturbed at these locations by human presence, road traffic, lights, and noise during project operations.

Although there will be a permanent loss of panther habitat from construction of the project, the proposed restoration of lands in the onsite and offsite preserves will restore these lands to habitats that may be used more frequently by panthers or their prey, thereby increasing, over time, distribution and quality of habitat which would reduce the local and landscape-scale effects of the initial habitat loss and fragmentation.

Changes in the Geographic Distribution of Habitat for the Species: The project will result in the temporary impacts to about 903.66 acres (19.95+883.71=903.66) onsite and 291.10 acres offsite and the permanent loss of 809.83 acres of panther habitat in the Primary Zone of the panther focus area. The permanent loss represents 0.069 percent of the 1,202,699 acres of available non-urban private lands at risk in the Service's panther core area (Table 6).

The Service's South Florida Panther Population Goal or refugia design is to preserve 2,873,070 acres of primary zone equivalent lands for a population of 90 panthers. Currently, 2,073,865 acres of primary zone equivalent lands are preserved (Table 5) and 1,202,699 acres of primary zone equivalent lands are at-risk (private ownership) (Table 6), so 799,205 additional acres need to be preserved in south Florida (2,873,070 minus 2,073,865 equals 799,205). The proposed preserves, 903.66 acres onsite, 291.10 acres offsite, and 82.21 acres in PIMB (total of 1,276.97 acres) represent 0.14 percent of the lands needed for the Service's refugia design.

The proposed preserve and compensation plan also benefits the survival and recovery of the Florida panther as referenced in the Panther Recovery Plan (Service 2008) goal 1.1.1.2.3. This goal recommends habitat preservation and restoration within the Primary Zone be provided in situations where land use intensification can not be avoided. The applicant has proposed sufficient habitat protection and restoration, to compensate for both the quantity and functional value of the lost habitat. The lands proposed for conservation and restoration are consistent with the Service's efforts to locate, conserve, and restore sets of lands containing sufficient area, access, and appropriate cover types to ensure the long-term survival of the Florida panther south of the Caloosahatchee River.

Risk of Roadway Injury or Mortality: In evaluating a project's potential to increase roadway mortality to the Florida panther, we consider the location of the project in relation to surrounding native habitats, preserved lands, and wildlife corridors that are frequently used by the Florida panther. We also consider the current configuration and traffic patterns of surrounding roadways and the projected increase and traffic patterns expected to result from the proposed action. We evaluate the habitats present onsite, their importance in providing prey for the Florida panther and foraging needs of panther prey species, and if the site development would further restrict access to surrounding lands important to the Florida panther and panther prey species.

No expansion of surrounding roads will occur as part of the Mirasol project. However, some improvements may be necessary to enhance the existing lanes and drainage swales to meet public health and safety standards for ingress and egrass of vehicles to the project development. The project will result in minor increased vehicular traffic in the project vicinity during construction and operation. Vehicular mortality and injury data (see Table 9 and Figure 9) provided by the FWC indicate collisions with motor vehicles have been increasing since 2001 in the 25-mile radius project action area. In 2002 there were 3 documented panther-vehicle collisions, 7 in 2003, 6 in 2004, 4 in 2005 and 2006, 5 in 2007, 7 in 2008, 10 in 2009, 10 in 2010, and 4 in 2011. Panther-vehicle collisions in 2009 and 2010 represent the most panthers killed by vehicles in single years in the action area. Of the 82 documented collisions, 73 (89 percent) have occurred more than 10 miles away from the project site and 9 (11 percent) occurred less than 10 miles from the project site. The closest panther-vehicle collision, UCFP 156 (male), occurred on February 26, 2011, on I-75 at Mile Marker 114 in Collier County at a distance of 4.1 miles from the site.

According to traffic studies by Vanasse and Daylor, Incorporated and updated by Omega Consulting Group (2010), construction traffic will be coming from CR 846 (Immokalee Road) and CR 951 (Collier Boulevard), which are south of the project. The access is along major roadways already heavily traveled. It is projected that about 80 percent of the project traffic post construction will be to and from the west of the project on Immokalee Road (CR 846), 19 percent will be to/from the south of the project on Collier Boulevard (CR 951), and 1 percent will be to/from the south on Wilson Boulevard. The projected project traffic estimated as a percentage of existing traffic represents an increase by about 13 percent of the existing traffic of Immokalee Road to the west of the project, by about 3 percent of the existing traffic on Immokalee Road east to Collier Boulevard, and by about 1 percent of the existing traffic of Immokalee Road to the east to Wilson Boulevard. From a percentage basis, the project traffic is projected to be 7 percent of the capacity of Immokalee Road to the west of the project, 3.1 percent of the capacity on CR 951 south of Immokalee Road, and 1 percent of the capacity of Immokalee Road to the east of CR 951.

The risks to the panther from collisions with vehicles as a result of the Mirasol project are difficult to quantify. However, the Service believes the increase in traffic generated by the project may potentially contribute to mortality of panthers in the action area. Panthers are known to use the lands within the project vicinity and 9 panthers were killed within 10 miles of the project action area; 3 in 2011, 3 in 2010, 1 in 2008, 1 in 2006, and 1 in 2002. The closest panther-vehicle collision, UCFP 156 (male), occurred on February 26, 2011, on I-75 near Mile Marker 114 in Collier County at a distance of about 4.1 miles from the site. The most recent collision occurred on March 25, 2011, on US 41, west of Port of the Islands, Collier County.

Disturbance from Construction Activities: The timing of construction for this project, relative to sensitive periods of the panther's lifecycle, is unknown. However, land clearing; additional vehicle access, additional human presence, heavy equipment operation, road traffic, noise and lighting associated with the project will occur in phases, primarily during daylight hours, lasting over several years. The land clearing for the proposed development will be immediate and these lands will no longer be available as habitat for the Florida panther. The exotic species removal in the preserve lands will occur over several years. These activities and disturbances may cause panthers and or their prey to temporarily avoid the areas in which they occur. We anticipate any resident panthers with home ranges overlapping or in the vicinity of the project areas will adjust the size and location of their ranges to account for this loss and disturbance and the adjustment is anticipated to occur in concert with project construction.

Panther/Human Interactions: Potential increases in disturbance to the Florida panther and panther prey were evaluated. As construction proceeds across areas of the Mirasol site, an increase in panther/human interactions and prey disturbance may occur as construction activities often include dawn to dusk heavy equipment operations to remove site vegetation, site grading and infrastructure necessary for the development. Associated melaleuca removal and burning in the preserve lands also increases the potential for human and panther interactions. Panthers were occasionally documented (telemetry), and panther prey has been sighted on internal site trails during wildlife survey, monitoring well logging, and fish surveys. Panthers and their prey may avoid locations of construction disturbance during site development and exotic species removal in the preserves, but are expected to resume normal behaviors in the preserve lands after the disturbance ceases.

The onsite preserves that are proposed on lands adjacent to planned residential lots increases the potential for direct panther/human interaction associated with panther use of the preserve lands. To minimize this affect, the applicant has proposed the placement of stormwater retention lakes and/or golf course fairways between residential developments and the preserve lands. The applicant has also proposed the placement of border fencing (minimum of 8-foot height) in locations where golf course fairways and stormwater retention lakes are not present. Although panthers may cross these border buffers, the increased activities and disturbances associated with residential development may cause panthers and/or their prey to avoid the areas.

Intraspecific Aggression: Potential increases and decreases in Florida panther intraspecific aggression were evaluated as a result of temporary or permanent losses of habitat, which may cause panthers to compete for limited space within existing or overlapping territories. Potential increases in intraspecific aggression could occur as a result of permanent losses of habitat from installation of project infrastructure (roads, stormwater retention ponds, golf course fairways, etc.). The project will result in

the loss of 809.83 acres of panther habitat. According to the most current home range estimates of the Florida panther (Lotz et al. 2005), this loss represents 2.9 percent of a female panther's average home range (29,059 acres) and 1.3 percent of a male panther's average home range (62,542 acres).

We also provided an evaluation of documented intraspecific aggression between Florida panthers in the action area. Based on mortality data (FWC 2011), 120 panther deaths have occurred in the action area since 1979 with 19 deaths (13 male and 6 female) from intraspecific aggression. Over the reporting period, the average is one death per year, with two mortalities from intraspecific aggression in 2001 and 2002 and 3 in 2010. The most recent mortality, FP170 (female) occurred on March 2, 2011, in Picayune Strand State Forest, 22 miles east of the project site. The closest intraspecific aggression mortality occurred on April 9, 2008, 6.3 miles northeast of the project site.

The risks to the panther from increases in intraspecific aggression as a result of the Mirasol project is difficult to quantify. However, given the relative small scale of historical use of project lands by panthers and no document panther presence in the development footprint, the risk of increasing intraspecific competition is considered unlikely. In addition, intra-specific aggression is a common behavioral attribute of this species. Therefore, the relative change or increase in intra-specific aggression among young male panthers as a result of this project is also likely immeasurable.

Interrelated and Interdependent Actions

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. No interrelated or interdependent actions are expected to result from the project.

Species Response to the Proposed Action

The proposed action will result in increased human activity and noise in the project area during construction of the project. However, since panthers are not commonly known to use lands within and adjacent to the project site, activities associated with construction of the Mirasol project are not anticipated to significantly increase risk of disturbance to panthers, though some temporary disturbance may occur.

The project will result in the loss of 809.83 acres of panther habitat. According to the most current home range estimates of the Florida panther (Lotz et al. 2005), this loss represents 2.9 percent of a female panther's average home range (29,059 acres) and 1.3 percent of a male panther's average home range (62,542 acres). Since the project area provides panther habitat and panthers have been occasionally documented onsite, the loss of habitat may contribute to an increase in intraspecific aggression and a decrease in the spatial extent of lands available to the panther for hunting, breeding, and dispersing. We anticipate any resident panthers with home ranges overlapping or in the vicinity of the project area will adjust the size and location of their ranges to account for this loss and the adjustment is anticipated to occur in concert with project construction.
Panthers are sensitive to habitat fragmentation. However, the project site is located on the western fringe of occupied habitat, is adjacent to urban development, and is not located within known dispersal corridors (FWC 2006b) between larger publicly owned managed lands. Therefore, fragmentation of panther habitat is not expected to result from project implementation.

ENVIRONMENTAL BASELINE

Wood Stork

As stated previously, the Service has determined, for the purposes of this biological opinion, the action area is considered to include the project site and the CFAs of the three wood stork nesting colonies (Figure 6). Two of these colonies are located within Corkscrew Sanctuary, about 5.5 miles and 6.6 miles northeast of the project site. The third wood stork nesting colony is located about 16.5 miles east of the project site, just north of the Fakahatchee Strand State Preserve. The action area encompasses about 1,621.1 square-miles of Collier, Lee, and Hendry Counties, Florida.

Status of the Species within the Action Area

Habitat: Suitable wood stork foraging habitat consists of shallow wetlands with water depths of 2 to 15 inches. Data obtained from the National Wetland Inventory (NWI) indicate about 473,462 acres of wetlands containing potentially suitable habitat for wood stork foraging occur within the action area. However, the inventory was last updated in 1984 and increasing development in Lee, Collier, and Hendry Counties has impacted some of these potential foraging areas. In order to provide a more accurate accounting of the wetlands within the core foraging areas of the three wood stork colonies, the Service used both the NWI and the FLUCCS maps. The specific step-by-step analysis used is referenced below.

Land use maps developed by the District are based on FLUCCS codes, which is a different land use classification system than that used in the NWIs. Corresponding NWI and wetland FLUCCS codes that provide overlapping wetland categories are the 500 and 600 series FLUCCS codes. However, there are several FLUCCS codes in the 200 and 400 categories that could be either upland or wetland. For instance, the majority of the subject property on the District maps is depicted as 4119 (pine flatwood [an upland FLUCCS code designation]). U.S. Army Corps of Engineers (Corps) approved jurisdictional information on these types of habitats in the action area shows the majority of these properties as being hydric pine flatwoods and are considered wetlands although not classified as such by the FLUCCS codes. The District maps also do not allow for wetland determinations on agricultural activities, such as pastures (200 series). For this reason, our analysis used both sets of maps. Specifically, we used the 1984 NWI map as the base map and overlaid the District maps. We eliminated the NWI wetlands areas that the District maps depicted as developed. Those areas indicated on the District map as passive agricultural (such as pasture and fallow lands) that were also shown to be wetlands on the 1984 NWI maps were left in and counted as wetlands for purposes of this analysis. We also included those lands with a FLUCCS code of 4119 (hydric pine flatwoods) as wetlands in our analysis. Based on the above assessment we estimate the action area contains about 481,666 acres of wetlands suitable for wood stork foraging (Table 17).

Hydrology: Alteration of hydrology and historical flow-ways can result in restrictions in flows and drainages and can negatively influence wetlands and other surface water systems important to wood storks. These influences can include changes in seasonal flooding patterns that affect drawdown cycles and produce extended periods of unusually high or low water. The extended periods of unusually high or low water may alter the vegetative community facilitating a change from a mixed open forest canopy with a herbaceous component to a closed canopy, dense forest without a herbaceous component.

The NWI, the District Land Use Maps, and personal knowledge have been used to estimate wetland coverage and hydroperiod classes within the CFA of the three colony sites. As previously discussed, we consider short hydroperiods to be wetlands inundated for 180 days or fewer, which includes Classes 1, 2, and 3. Following this approach, the wetland hydroperiods for three CFAs were estimated and are shown in Table 17. The acreages in Table 17 are estimated from the NWI and District maps. We estimate about 227,845 acres of short hydroperiod wetlands are within the core foraging areas of the three rookeries, with an additional 253,821 acres of long hydroperiod wetlands.

Project Area Habitat: The analysis of existing habitats expected to be impacted by the proposed project is based on vegetation mapping conducted by Turrell in their FLUCCS mapping provided in the Corps' August 24, 2006, Public Notice (Appendix 2A and 2B). Information on the project site was also based on recent Service (2010) field verification surveys. The prevalent community type, although historically classified as pine and pine/cypress flatwoods is primarily a community dominated by the exotic species, melaleuca. In most vegetated communities recently surveyed by the Service during field visits, this community was classified as primarily a closed canopy forest, with an understory, when one was present, of remnant herbaceous graminoid species. Melaleuca expansion into native habitat and density increases in previously invaded habitat have increased from 1972 through 2010 as seen in aerial photographs over this time frame.

Project Area Hydrology: Project Wetlands: As discussed for wetlands in the action area, a similar assessment of the wetland hydroperiods for the proposed development footprint (Table 18) and boarding preserve area (Table 19) was conducted. The hydroperiods of the wetlands within the development footprint are estimated at 575.66 acres of short hydroperiod wetlands and 69.69 acres of long hydroperiod wetlands (total 645.35 within the developed area) and an additional 44.41 acres of short and 10.11 acres of long hydroperiod wetlands in the internal preserves in the development footprint. The total for the developed area and the internal preserves is 699.87 acres. The hydroperiods (Table 19) of wetlands within the boarding preserve are estimated at 507.56 acres of short hydroperiod wetlands and 323.79 acres of long hydroperiod wetlands (total 831.35).

Historic and current patterns of wood storks in the action area: Wood stork nest surveys have been conducted annually at the three nesting colonies in the action area through aerial surveys (Meyer and Frederick 2004) and ground-based monitoring of stork numbers and reproductive success (Audubon 2010). Data for the two colonies located in Corkscrew Sanctuary noted 900 nests in 1999, 1,722 nests in 2000, no nest in 2001, 1,240 nests in 2002, 1,100 nests in 2003, and 520 nests in 2004. In 2005, birds attempted to nest, but most nests were ultimately abandoned. In 2006, 800 pairs nested and 1,550 birds fledged with an average of 1.9 fledglings per nest (Lauritsen 2006). No nests were reported in 2007 and 2008, with 1,120 nests in 2009 (Cook and Kobza 2009). No nests have been reported at the northern most Corkscrew Sanctuary colony since 2004, with a report of 30 nests (Service 2010). Additional data collected by the National Audubon Society indicate 2,538 wood storks fledged during 2000 and 3,160 fledged during 2002. In 2003 and 2004, 780 and 450 young were fledged, respectively (Audubon 2004). On average over the last 44 years, 1,654 nests are initiated yearly, producing an average of 2,161 fledged young, or 1.3 young fledged per nest. However, the 44-year average is somewhat misleading. Prior to 1968, as many as 5,000 wood stork nests were initiated annually. Nesting activity peaked in 1961 when 6,000 nests produced a record of 17,000 fledglings, or 2.8 fledged young per nest. Surveys for nests at the third wood stork nesting colony located just north of the Fakahatchee

Strand State Preserve have noted no nests recorded for the past 10 years. No data on nest productivity is available for the colony north of Fakahatchee Strand State Preserve; however, based on the overlapping CFAs, it is likely these birds face many of the same foraging conditions as the storks nesting within Corkscrew Sanctuary.

Historical data on colony locations identifies the Everglades basin colonies and the Corkscrew Sanctuary colonies as the primary nesting locations for wood storks in south Florida (Ogden and Nesbitt 1979). In the late 1950s and early 1960s, the Corkscrew Sanctuary colonies accounted for 51 percent of the Florida population, and supported about 6,000 nesting pairs (Audubon 2002). Survey data collected between 1991 and 1995 indicate the Corkscrew Sanctuary colonies represent about 12 percent of the Florida population of nesting storks and is consistently one of the largest nesting colonies in Florida. The original listing recognized the relationship between the declining wood stork population, the loss of suitable foraging habitat, and colony nesting failures, particularly in the breeding colonies in south Florida where human actions had reduced wetland areas by about 35 percent (Ogden and Nesbitt 1979). Although the Corkscrew Sanctuary colonies currently account for 12 percent of the Florida nesting population, these colonies continue to occasionally produce large numbers of young in south Florida (Service 1999). The acquisition and preservation of these colonies' habitat, and recovery of more natural hydropatterns within the foraging grounds surrounding these colonies, are recognized as important to the recovery of wood storks in south Florida (Service 1997, 1999).

Historic and current patterns of wood storks in the project footprint: No data are available to indicate wood storks have historically nested in the Mirasol project area and none are known to have nested there since systematic statewide wading bird surveys were initiated in the 1970s. Ongoing wildlife surveys have been conducted and documented by Turrell (2006, 2010). During the survey periods, wood storks have been observed perching on cypress and slash pine trees along the Cocohatchee Canal. Wood storks have also been documented foraging along the canal where water flows over an armored shoreline about 0.5 mile to the west of the property. Foraging has also been documented within an open pasture area immediately to the west of the property. Wood storks were observed onsite in 2007, at one of the cattle water holes on the Mirasol property (Turrell 2007). Wood storks were also observed onsite in 2006 (December) in a cattle watering hole during an aerial flight (Jason Lauritsen, Corkscrew Sanctuary, Court Transcript, January 5, 2007). Although fish density investigations were conducted in 2003 through 2006, none were conducted in 2007 (drought conditions). In 2008 and 2009, no wood storks were observed.

Factors Affecting the Species Environment within the Action Area

Development pressures due to ongoing population growth in Collier and Lee Counties continue to threaten wetlands in the action area. Data from the U.S. Census Bureau from 1968 to 2000, show the populations of Collier, Hendry, and Lee Counties have increased by 94, 78, and 88 percent, respectively. The population of this three-countywide area was estimated at 731,675 during the 2000 census, and is expected to continue to grow. In southwest Florida (Charlotte, Collier, and Lee Counties), the human population has increased from 833,892 in 2000 to about 1,231,100 in 2010, representing an increase of 47.6 percent over the 10-year period (University of Florida 2009). Factors that affect the species environment (positively and negatively) within the action area include, but are not limited to Federal, State, or private actions and other human activities in the action area that influence the construction of

highways and urban development, agriculture operations, resource extraction, public lands management (prescribed fire, public use, exotic eradication, etc.), hydrological restoration projects, and public and private land protection efforts.

Federal Action - Formal Consultations: Past and ongoing Federal and State actions affecting wood stork habitat in the action area include the issuance of Corps 404 and State of Florida ERP permits authorizing the filling of wetlands for development projects and other purposes. Since 1982, the Corps and the State have had a joint wetland permit application process, where all permit applications submitted to the State are copied to the Corps and vice versa. From January 1992 through March 2011, in association with consultations on other species within the action area, the Service has formally consulted on 5 projects and informally consulted on 63 projects regarding the wood stork. The projects resulted in the loss of 3,906 acres of wetlands and the restoration and preservation of 20,104 acres of wetlands (Appendix 2D).

Within the same watershed as the Mirasol project, formal consultations have exempted incidental take of productivity of 66 nests per year (Table 20). This productivity loss was associated with the direct loss of 769 acres of wetlands and indirect effects (hydrological change) on 1,500 acres of wetlands. These same projects also provided for preservation and restoration of 2,019 acres of wetlands.

The Corkscrew Sanctuary rookery complex (FWC 619018 and 619310), is the largest wood stork rookery complex in the United States and is in the same watershed as the referenced projects and the proposed Mirasol project. Over the last 44 years, wood stork productivity at the combined rookeries averaged 1,654 nests per year with some years with no productivity. Based on this variability in nest productivity, researchers (Ogden 1996) consider the Corkscrew Sanctuary rookeries to be limited by food resources.

As discussed previously, wood stork foraging biomass is affected by wetland loss, changes in hydroperiod, and availability of foraging biomass. Within the core foraging area of the Corkscrew Sanctuary rookeries, short hydroperiod wetlands represent 137,269 acres and long hydroperiod wetlands represent 122,444 acres (Table 17). The combined loss of wetlands from the referenced projects (769+1500=2,269 acres) represents a loss of 1.7 percent of the available short or long hydroperiod wetlands (data not specific to individual hydroperiods for all projects). The loss of 66 nests represents a loss of 4 percent of the average nest productivity of the affected rookeries (66/1,654=0.0399)

Although the hydroperiods of the wetlands in several of the earlier 2003 consultations were not specificially defined, most projects review by the Service in the consultation area affected short hydroperiod wetlands. In the Service's review of the affected wetlands, the biological opinions noted that the wetlands were degraded by varying levels (stem density) of exotic species, which limit the wood stork's ability to forage. The Service also noted in the biological opinions for the referenced projects that concurrent with the wetland losses, 2,019 acres of wetlands that were also degraded by exotic species were restored (primarily by removal of exotic species) resulting in greater availability and access to the foraging base present in these wetlands, post restoration.

Although the Service has noted a reduction in wood stork productivity of 66 nests from a loss of 2,269 acres of wetlands, the estimated loss is based on a reduction of foraging biomass in wetlands readily available for wood stork foraging (access not restricted by exotic species stem density).

However, as previously discussed, the listed project wetlands were degraded by exotic species and because of this, the estimated productivity loss is considered a conservative estimate. Considering this assessment and based on the the benefits from exotic species removal from the preserved wetlands, the estimated nest productivity loss may be less. In addition, the biological opinions for the referenced projects also noted the restoration of 2,019 acres of wetlands and the benefits to wood stork nest productivity were not quantified in the documents. However, based on our biomass assessment methodology, restoration of impacted wetlands with 50 to 75 percent exotics results in an increase in forage prey base to the wood stork from 37 percent to 100 percent (Table 24), a greater than two fold increase (100/37=2.7).

In summary, the proposed projects will result in the loss of 2,269 acres of wetlands with a corresponding loss of 13,266 kg of biomass (66 nests * 201 kg per nest = 13,266 kg) or 5.85 kg per acre (13,266 / 2,269 = 5.85). Following restoration the 2,019 acres of preserved wetlands, which are in the same watershed as the impacted wetlands, have an existing wood stork available biomass of 11,812 kg (2,019 * 5.85 = 11,812). Following restoration, these wetlands will provide a wood stork available biomass of 31,892 kg (11,812 * 2.7 fold increase = 31,812) or 15.76 kg per acre (2,019 / 31,812 = 15.76). The Service determined in the biological opinions issued for these 5 projects that individually and cumulatively these projects do not jeopardize the survival and recovery of the wood stork and based on the above assessment, these projects represent a net loss of 1.7 percent of the available short hydroperiod wetlands of the affected rookeries. Following habitat restoration of the proposed preserves, the existing foraging base available to wood storks is expected to increase above base by an estimated increase of 6,814 kg (31,892 – 11,812 – 13,266 = 6,814). Since the timing of construction preceeds full restoration (3 to 5 years for full restoration), we expect nest productivity losses per hydroperiod to be difficult to determine on an intermediate basis and incorporating projected productivity benefits from restoration, an increase in nest productivity of 34 nests per year is projected after full restoration (6,814 / 201 = 33.9). Although the projects combined will result in the loss of 2,269 acres of wetlands, the lost productivity associated with the lost wetlands will be offset when restoration is complete.

CERP Actions: The Service has completed informal consultations on three CERP projects in the action area, the PSRP, the Prairie Canal Early Start portion of the PSRP, and the Southern CREW project. The PSRP would restore more than 55,000 acres of land to near pre-development conditions. Formerly known as the SGGE, the project area was planned as a residential subdivision in the 1950s and roads and drainage canals were constructed in the 1960s and early 1970s. The project would remove the infrastructure of the subdivision and restore its pre-drainage hydrology by construction of weirs, pumping stations, 10 miles of tie-back levees, 2.5 miles of spreader swales, 260 miles of road removal and degradation, and backfill of four major north-south canals. The Service's March 12, 2009, BO (for panthers) determined that the proposed action was not likely to adversely affect the wood stork.

The Service completed section 7 consultation with the Corps on the Prairie Canal Early Start portion of the PSRP in October 2003. The Service concurred with the Corps' determination that the backfill of Prairie Canal on the eastern extent of the project "may affect, but is not likely to adversely affect" the Florida panther, wood stork, Everglade snail kite, West Indian manatee (and its critical habitat), American crocodile, RCW, eastern indigo snake, and bald eagle. This

concurrence was based on a project proposal developed by the applicant and the District, which included pre-project wildlife surveys, construction protection plans for affected listed species, and post-restoration project monitoring and reporting.

The Service as a restoration partner is also coordinating with the Corps, the District, and Lee County on the Southern CREW project. The project is a 4,000-acre wetland restoration project that will provide wetland restoration through removal of exotic species, filling of agricultural ditches and providing water storage and aquifer recharge capacity to CREW. Portions of the restoration completed to date include clearing exotics from 2,560 acres, removing roads and plugging agricultural ditches on 640 acres, and constructing the Kehl Canal Weir. As of January 2009, the District has invested $27.4 million to conserve the lands, with the U.S. Department of the Interior contributing another $7 million to the restoration effort.

Federal Action - Informal Consultations: From July 2000 through September 2006, the Service conducted in informal consultation for projects under 5 acres with the Corps on 757 projects affecting about 764.1 acres in Collier County (primarily Northern Golden Gate Estates) and about 202.8 acres in Lee County (primarily Lehigh Acres) (database entries for informal consultations prior to 2000 are incomplete for projects in the consultation area), with varying amounts of wetland impacts ranging from less that 0.1 acre to 5 acres. Almost all of these projects involved the construction of single-family residences in partially developed areas. As discussed above, existing habitat value to wood storks was diminished by varying levels of exotic species infestations. Generally for project wetland impacts greater than 0.1 acre, habitat compensation is required by the Corps that functionally replaces the wetland habitat value lost from the project impact. The Service concurred with the Corps' determinations of "may affect, but is not likely to adversely affect" for these individual projects. These projects have been incorporated into the Service's environmental baseline for the wood stork.

Based in part on historical consultation data referenced above, the Service, in 2007, provided the Corps with a Wood Stork Effect Determination Key (November 9, 2007), which was updated in 2010 (May 18, 2010). The Key provides guidance to the Corps for effect determinations for the wood stork and "may affect, but is not likely to adversely affect" determinations for projects less than one-half acre of wetland impact. The Key identifies that on an individual basis, impacts to wetlands less than one-half acre generally will not have a measurable effect on wood storks, although we request that the Corps require mitigation for these losses. Wood storks are a wide ranging species, and individually, habitat change from impacts to suitable foraging habitat of less than one-half acre are not likely to adversely affect wood storks. However, collectively they may have an effect and therefore regular monitoring and reporting of these effects are important.

Non-Federal Actions - Isolated Wetlands: We have received information that within the wood stork action area, the Corps has, between March 2004 and September 2006, issued non-jurisdictional wetland determinations for 28 projects totaling about 2,439 acres, with about 190 acres of isolated wetlands. We also received data that during the 2008 calendar year, the Corps provided 15 non-jurisdictional wetland determinations for project in Lee, Collier, and Charlotte counties affecting 266 acres. These determinations were issued per jurisdictional guidance provided recently in the Supreme Court decision, *Solid Waste Agency of Northern Cook County vs. U.S. Army Corps of Engineers,*

531 U.S. 159 (2001) and, therefore, they will not require a Federal Clean Water Act 404 wetland permit. However, since loss of wood stork foraging habitat may occur from construction of these projects and no Corps wetland permit is required, the Service is recommending the applicants pursue incidental take permits in accordance with section 10 of the Act.

Non-Federal Action - State of Florida Environmental Resource Permit (ERP): Although the Corps of Engineers and the State of Florida, since 1982, have had a joint wetland permit application process, where all permit applications submitted to the State are copied to the Corps and vice versa, the State also reviews projects that have no wetland impacts or where the wetlands are not considered jurisdictional by the Corps. To determine which of these projects were unlikely to have wetland impacts and not require a section 404 Clean Water Act wetland permit, we identified the percentage of the project site that was classified as wetland habitat, based on the FLUCCS mapping units. The mapping units relied on by the Service included the 600 series (wetland classifications) and the 411 and 419 pine flatwood classifications (hydric pine systems). For our purposes, although subject to Federal review, properties with less than 5 percent wetlands were considered unlikely to require a section 404 wetland permit from the Corps because these wetlands could be avoided through project design in compliance with section 404(b)(1) guidelines that require impacts to wetlands be minimized to the maximum extent practable.

Within the action area, the District has issued ERP permits (2005 to 2010) for 323 projects (33 in 2005, 61 in 2006, 83 in 2007, 63 in 2008, 54 in 2009, 29 in 2010) impacting 25.6 acres of wetlands (Appendix 2F). These projects also provided wetland preservation of 328 acres. Based on FLUCCS mapping, about 265 projects (24 in 2005, 60 in 2006, 58 in 2007, 55 in 2008, 44 in 2009, 23 in 2010) affecting 11.8 acres of wetlands, with 27.8 acres of wetland preservation, could be expected to be subject to development without Federal permit involvement through the Clean Water Act section 404. Although the proposed State actions allowed a loss of wetlands, the applicants have provided mitigation of these losses at an average ratio of 2.35 acres (27.8 / 11.8 = 2.35) (protected and restored) for every acre impacted. This wetland loss represents less than 0.0024 percent (11.8 / 481,666 = 0.000024) of the estimated wetland acreage in the action area. Therefore, the Service believes these losses are discountable and insignificant and the proposed preservation and restoration of wetlands is beneficial to the wood stork.

Summary: From January 1992 through March 2011, the Service has consulted on 825 projects negatively affecting 4,872 acres of wetlands in south Florida. The Service has identified that in the action area, an additional 293 actions, affecting 468 acres, may have been developed without the need for a Federal wetland permit. Over the review period evaluated in the Environmental Baseline, the Service has identified a combined loss of 5,340 acres of wetlands. The wetland losses represent 1.12 percent of the estimated wetlands in the action area.

Activities within the action area have also benefited wood storks. The issuance of Corps permits has preserved 20,104 acres of wetlands (January 1992 through March 2011). The wetland restoration associated with these projects represents about 4.17 percent of the wetlands in the action area. The PSRP restoration project will restore more than 55,000 acres of wetlands and uplands to near pre-development conditions. The CREW restoration project will restore about 4,000 acres of wetlands to near pre-development conditions. The District through their ERP

program is preserving 2,781 acres of wetlands and 679.23 acres of uplands. Additional benefits have resulted from the acquisition of high quality habitat through acquisition programs by the other Federal, State, and County resource agencies. For example, Lee County's Conservation Lands Program, since it's inception in 1995, has purchased a total of 23,820 acres, with the most recent acquisition the 1,213 acres adjacent to the Bob Janes Preserve in eastern Lee County. A similar program in Collier County, the Conserve Collier Program, recently purchased 368 acres adjacent to Corkscrew Sanctuary and also purchased the 2,500-acre Pepper Ranch.

The Service believes the identified permitted and non-permitted wetland losses are discountable and insignificant and the proposed preservation and restoration of wetlands is beneficial to the wood stork. These projects have been incorporated in the Service's environmental baseline for the wood stork in this biological opinion and the Service has determined, based on the location of these projects, the quality of the habitat present on these project sites, and the overall status of the wood stork, that these projects individually and cumulatively do not jeopardize the survival and recovery of the wood stork.

EFFECTS OF THE ACTION

Factors to be Considered

This section analyzes the direct, indirect, interrelated, and independent actions on the wood stork. Direct effects are primarily habitat based and occur at the time of construction. Indirect effects occur later in time and can also be habitat based. In our assessment we are combining both direct and indirect effects as joint factors. The combined direct and indirect effects include: (1) habitat fragmentation; (2) permanent loss of habitat; (3) changes in mosaic of hydroperiods; (4) changes in wood stork prey base (5) construction harassment; (6) a reduction in the geographic distribution of habitat; and (7) habitat compensation.

Direct and Indirect Effects: To evaluate habitat, the Service developed an assessment approach that provides a comparison of pre- and post-development habitat as a matrix of changes in biomass production and availability to foraging by wood storks. Factors that can affect biomass production and biomass availability for wood stork foraging include hydroperiod duration and prey accessibility. Prey accessibility can be affected by vegetation density and/or canopy cover.

Foraging Habitat: Researchers have shown that wood storks forage most efficiently and effectively in habitats where prey densities are high and the water shallow and canopy open enough to hunt successfully (Ogden et al. 1978, Browder 1984, Coulter 1987). Prey availability to wood storks is dependent on a composite of variables consisting of density (number or biomass/m^2) and the vulnerability of the prey items to capture (Gawlik 2002). For wood storks, prey vulnerability appears to be largely controlled by physical access to the foraging site, water depth, the density of submerged vegetation, and the species-specific characteristics of the prey. For example, fish populations may be very dense, but not available (vulnerable) because the water depth is too deep (greater than 30 cm) for storks to forage or the tree canopy at the site is too dense for storks to land. Calm water, about 5 to 40 cm (2 to 16 in) in depth, and free of dense aquatic vegetation is ideal (Coulter and Bryan 1993).

We have identified four variables in assessing wood stork foraging:

- the density of vegetation within habitats suitable for wood stork foraging;
- the hydroperiod of the wetland, which includes two subcomponents (1) the prey (fish and crayfish) density per hydroperiod, and (2) the prey (fish and crayfish) biomass per hydroperiod;
- the suitability of fish size for the wood stork, which provides an adjustment to the biomass per hydroperiod and is referenced hereafter as the wood stork suitable prey base; and
- the likelihood that the wood stork is the wetland species that actually consumes the concentrated prey and is referenced as the competition factor.

All four of these parameters when combined provide us with an estimate of the wetland foraging losses and gains in kg of biomass in our assessment of the effects of the action on wood storks.

Variable 1 - Density of vegetation within habitats suitable for wood stork foraging:

Vegetation density: As discussed previously, wetland suitability for wood stork foraging is partially dependent on vegetation density. Coulter and Bryan's (1993) study suggested that wood storks preferred ponds and marshes, and visited areas with little or no canopy more frequently. Even in foraging sites in swamps, the canopy tended to be sparse. They suggested open canopies may have contributed to detection of the sites and more importantly may have allowed the storks to negotiate landing more easily than at closed-canopy sites. In their study, the median amount of canopy cover where wood stork foraging was observed was 32 percent. Other researchers (P.C. Frederick, University of Florida, personal communication 2006; J.A. Rodgers, FWC, personal communication 2006) also confirm that wood storks will forage in woodlands, though the woodlands have to be fairly open and vegetation not very dense. Furthermore, the canopies must be open enough for wood storks to quickly take flight to avoid predators.

Melaleuca-infested wetlands: In south Florida, melaleuca is a dense-stand growth plant species, effectively producing a closed canopy and a dense understory growth pattern that generally limits a site's accessibility to foraging by wetland dependant species. The primary mechanisms for control of exotic plant species infestations is the mechanical removal and/or chemical treatment of these plants and in some instances hydrological changes in wetland hydroperiods that benefit the recruitment of desirable native species. However more recent methods have included the use of biological controls. The most promising proposal is the use of the curculionid weevil, *Oxyops vitiosa*, as a natural control of melaleuca. This weevil and its larvae feed aggressively on leaf foliage. Studies have shown that this feeding produces a corresponding increase in growth tissue production and a substantial decrease in seed reproduction (Pratt et al. 2005). The authors state in their evaluation "Although herbivory by *O. vitiosa* can clearly reduce fruit and seed production of its host, it remains unclear how these impacts alter melaleuca abundance and invasion potential. The lack of a long-lived soil seed bank (about 2 years), however, makes melaleuca particularly vulnerable to herbivore-mediated reduction in fitness and delays in reproductive maturation. As canopy held seed banks continue to diminish over time, reproductive suppression is predicted to have direct, long-term effects on recruitment, invasion potential, and abundance." Additional studies are being proposed to evaluate this demographic transition and quantify the effects of herbivory in the context of the entire plant life cycle and its ability to expand or diminish over time.

Since the original release of the curculionid weevil (Pratt et al. 2005), the U.S. Department of Agriculture's, Invasive Plant Research Laboratory has also released psyllids (an insect) (*Boreioglycaspis melaleucae*) throughout melaleuca monocultures, primarily in Miami-Dade County. In locations where both weevil and psyllid populations have become well established, monitoring indicates that melaleuca seed production has declined by 80 percent (Rayamajhi et al. 2008). In addition, tree density decline has accelerated primarily due to mortality of the smaller trees (Rayamajhi et al. 2007). As a result, a significant increase (2 to 4 fold during 2001 through 2005) in plant species diversity has been noted at these sites (Rayamajhi et al. 2008).

The researchers note that the weevil does not establish well at permanently wet sites; because the weevil pupates in the soil and needs drier conditions for this stage of its life cycle. However, the psyllid has established at non-flooded, seasonally-flooded, and permanently-flooded sites. Additional herbivorous insects that induce galls on the developing vegetative and reproductive buds (the tip-gall midge, *Lophodiplosis trifida*; the bud-gall fly, *Ferfusionina* spp.) are currently in test locations and may be available for future release as a complement to the previously released biological control agents.

The results of these studies indicate the incorporation of multiple agents may effectively control melaleuca regrowth and provide an important adjunct to mechanical and chemical controls since stumps of felled trees produce copious regrowths and would otherwise require treatment with herbicides (Rayamajhi et al. 2008). The importance of these factors in long-term management of exotics in south Florida is an evolutionary process that may provide resource value benefits to wetland dependent species over time by increasing foraging efficiencies and prey access for these species. However, the potential availability of bio-control for the long-term management of exotics does not alter our conclusions about the relative habitat value of melaleuca-infested wetlands or the ecological lift anticipated from the proposed mitigation during the projected time span of the proposed action.

Wood stork foraging potential: Wood storks will forage in melaleuca-dominated wetlands when the trees are non-continuous, in broken stands (blow-downs), in small islands, or sparsely distributed. However, they generally will not forage in melaleuca where the stem density is high and the canopy closed (P.C. Frederick, University of Florida, personal communication 2006). O'Hare and Dalrymple (1997) suggest moderate infestations of melaleuca may have little effect on some species' production (*i.e.*, amphibians and reptiles) as long as critical abiotic factors, such as hydrology, remain. However, they also note as the levels of infestation increase, usage by wetland dependent species decreases. Their studies also indicate the number of fish species present in a wetland system remains stable at certain levels of melaleuca infestation. However, the availability of the prey base for wood storks and other wetland dependant species is reduced by the restriction of access caused from dense and thick exotic vegetation. Wood storks and other wetland-dependant bird species can forage in these systems in open area pockets (*e.g.*, wind blow-downs), provided multiple conditions are optimal (*e.g.*, water depth, prey density).

Ceilley et al. (2005) provided an assessment of effects to aquatic fauna and wetland dependent species from various densities of melaleuca infestation. In their study, the comparisons were between sites classified as free of exotic species (less than 1 percent), moderately infested with melaleuca (40 to 60 percent), and areas completely dominated (greater than 90 percent).

Conclusions from their study noted that (1) the number of fish families collected in wet prairie habitats decreased at sites moderately infested and dominated by melaleuca, (2) fish abundance decreased with increasing melaleuca infestation, (3) the abundance in insect orders decreased with increasing melaleuca, and (4) macroinvertebrate family and species richness decreased with increasing melaleuca infestation. Their avian species data also noted that wetland dependent, wading, and mixed habitat use species showed a decrease in the number of species and individuals with increased density of melaleuca, which corresponds with the habitat uses shown by O'Hare and Dalrymple (1997).

Foraging suitability: To develop an estimate of the importance a particular wetland type may have to wetland dependent species (based on density and aerial coverage from exotic species), we developed a foraging suitability value using observational data from O'Hare and Dalrymple (1997). In their study, O'Hare and Dalrymple (1997) identified five cover types and provide information on the number of wetland dependant species and the number of individual birds observed within each of these vegetation classes (Table 21).

The number of wetland dependent species and individuals observed per cover type is shown in columns 1, 2, and 3 of Table 22. The foraging suitability value, as shown in column 5, is calculated by multiplying the number of species by the number of individuals and dividing this value by the maximum number of species and individuals combined. The results are shown below for each of the cover types in O'Hare and Dalrymple (1997). As an example, for the P50 cover type, the foraging suitability is calculated by multiplying 11 species by 92 individuals for a total of 1,012 (11 x 92 = 1,012). Divide this value by 1,584, which is the maximum number of species times the maximum number of individuals (12 x 132 = 1,584) and the result is 0.6389 or 64 percent (11 x 92 = 1,012 / 1,584 x 100 = 63.89).

This approach was developed to provide us with a method of assessing wetland acreages and their relationship to prey densities and prey availability. For assessment purposes, we consider use by wetland dependant species to be a general index of food availability. Based on this assessment, we developed a general index of food availability (Table 23).

Both the O'Hare and Dalrymple (1997) and Ceilley et al. (2005) studies looked at various species and are the only studies conducted that we are aware of that attempt to quantify the number of birds as well as the number of bird species that are found in varying categories of melaleuca density. Although the study designs are slightly different, the general conclusions from the studies are similar and the studies note that as the extent (density) of exotics increases, the corresponding use by wading birds and wetland dependent species decreases. Therefore, the Service continues to choose the data in the O'Hare and Dalrymple (1997) study as the basis to create an index as a surrogate for the degree to which wetlands may provide value to wetland dependant birds. It should be noted that, while this index has been newly developed by the Service, the scientific literature is rich with examples of habitat suitability indices used to measure the value of habitat and the use of habitat by various species. For example, Brower et al. (1990) discuss a variety of indices for use in analyzing species richness and diversity. In fact, both O'Hare and Dalrymple (1997) and Ceilley et al. (2005) use the number of species and individuals to measure species richness and diversity.

In the above assessment, exotic species density values range from 0 percent to 100 percent, depending on the density of exotic vegetation, with 100 percent suitability representing densities between 0 and 25 percent exotics and 0 percent suitability representing 90 to 100 percent density of exotics. As previously discussed, wood storks will forage in melaleuca-dominated wetlands when the trees are non-continuous, in broken stands (blow-downs), in small islands, or sparsely distributed. We also have observed that field delineations between 75 percent and 90 percent exotics and 90 to 100 percent exotics are problematic. Therefore, in our application method we are applying a minimum of 3 percent suitability to the 90 to 100 percent exotics, not 0 percent. Table 24 represents this change and is the exotic densities applicable to our methodology.

Variable 2 – Hydroperiod duration – Hydroperiod duration includes two components (1) prey (fish and crayfish) density per hydroperiod, and (2) prey (fish and crayfish) biomass per hydroperiod

Hydroperiod: The hydroperiod of a wetland can affect the prey densities in a wetland. For instance, research on Everglades fish populations using a variety of quantitative sampling techniques (pull traps, throw traps, block nets) have shown that the density of small forage fish increases with hydroperiod. Marshes inundated for less than 120 days of the year average ± 4 fish/m^2; whereas, those flooded for more than 340 days of the year average ± 25 fish/m^2 (Loftus and Eklund 1994, Trexler et al. 2002).

Kushlan (1990) as referenced by the Service (1999) described short hydroperiod wetlands as wetlands flooded between 0 and 180 day (flooded less than 6 months); intermediate hydroperiod wetlands as wetlands flooded between 180 and 270 days (flooded 6 to 9 months); and long hydroperiod wetlands as wetlands flooded between 270 and 360 days (flooded more than 9 months). However, Trexler et al. (2002) defined short hydroperiod wetlands as systems with less than 300 days per year inundation. For our discussion of hydroperiods in this BO, we are maintaining the same definitions as referenced by Kushlan (1990) and Service (1999), which define short hydroperiod wetlands to be those flooded between 0 and 180 days.

The most current information on hydroperiods in south Florida was developed by the District's 2x2 groundwater model for evaluation of various restoration projects throughout the Everglades Protection Area. In their modeling efforts, they identified seven hydroperiods (Table 25).

Fish density per hydroperiod: In the Service's assessment of project related impacts to wood storks, the importance of fish data specific to individual hydroperiods is the principle basis of our assessment. In order to determine the number of fish per individual hydroperiod and the biomass of fish per individual hydroperiod, the Service relied on the number of fish per m^2 per hydroperiod developed from throw-trap data in Trexler et al.'s (2002) study and did not use the number of fish caught per unit of effort from electrofishing data also presented in Trexler et al.'s (2002) study, which is not hydroperiod specific. Although the throw-trap sampling generally samples fish 8 cm or less, the Service believes the data can be used as a surrogate representation to determine the total biomass of fish per m^2 per hydroperiod consumed by wood storks.

As referenced above, Trexler et al.'s (2002) study included electrofishing data targeting fish greater than 8 cm, the data is recorded in catch per unit effort and, in general, is not hydroperiod specific. However, Trexler et al. (2002) note in their assessment of the electrofishing data that, in general, there is a correlation with the number of fish per unit effort per changes in water depth. In literature reviews of electrofishing data by Chick et al. (1999 and 2004), they note electrofishing data provides a useful index of the abundance of larger fish in shallow, vegetated habitat, but length, frequency, and species compositional data should be interpreted with caution. Chick et al. (2004) also noted that electrofishing data for large fish (greater than 8cm) provided a positive correlation of the number of fish per unit effort (abundance) per changes in hydroperiod. Studies by Turner et al. (1999), Turner and Trexler (1997), and Carlson and Duever (1979) also noted this abundance trend for fish species sampled. Therefore, the data in general from all the studies referenced, suggests that as the hydroperiod decreases, the abundance of larger fishes also decreases accordingly.

We noted in our analysis of prey consumption by wood storks in the Ogden et al. (1976) study (Figure 1 in Ogden's report) (discussed below), the wood storks most likely consumed prey size fish measuring 1.5 cm to 9 cm. We also acknowledged wood storks consume fish larger than the limits discussed in the Ogden et al. (1976) study. A similar assessment is referenced by Trexler and Goss (2009), noting a diversity of size ranges of prey available for wading birds to consume, with fish ranging from 6 to 8 cm being the preferred prey for larger species of wading birds, particularly wood storks (Kushlan et. al. 1975).

Because data were not available to quantify fish densities (number of fish per m^2) of fish larger than 8 cm to a specific hydroperiod and Ogden et al.'s (1976) study notes the wood stork's general size of fish prey consumed is fish measuring 1.5 cm to 9 cm and that empirical data on fish densities per unit effort correlated positively with changes in water depth, we believe the Trexler et al. (2002) throw-trap data represents a reasonable surrogate to predict the changes in total fish density (fish per m^2 for fish smaller and larger than 8 cm combined) and the corresponding biomass (kg per m^2 for fish smaller and larger than 8 cm combined) per hydroperiod for our wood stork assessment.

The Service used the data presented in the Trexler et al. (2002) study on the number of fish per m^2 per hydroperiod for fish 8 cm or less for estimating the total biomass (kg) per m^2 per hydroperiod for all fish likely consumed by wood storks. In determining the biomass (kg) of fish per m^2 per hydroperiod, the Service relied on the summary data provided by Turner et al. (1999), which provides an estimated fish biomass of 6.5 g/m^2 for a Class 7 hydroperiod for all fish, including fish 8 cm or less and those larger. The summary included throw trap data biomass estimates for fish 8 cm or less and a 0.6 g/m^2 correction estimate added for fishes greater than 8 cm. The biomass correction is based on block-net rotenone samples (Turner et al. (1999). Using the number of fish per m^2 per hydroperiod from Trexler et al.'s data, we extrapolated biomass (kg) values per individual hydroperiods based on the total biomass of a Class 7 hydroperiod (Turner et al.'s data), which is 6.5 g/m^2.

In summary, we believe the number of fish per m^2 per hydroperiod in the Trexler et al. (2002) study can be used as a surrogate to determine the fish biomass (kg) per m^2 of prey consumed for both fish larger and smaller than the 1.5 to 9 cm size. We believe the Trexler et al. (2002) study

provides the best available scientific data concerning prey density in relation to hydroperiod, and the use of this data as a surrogate to determine fish biomass (kg) per m^2 for all fish sizes is a reasonable, scientifically justified application of the Trexler et al. (2002) study.

Number of fish per m^2 per hydroperiod: Trexler et al.'s (2002) studies in the Everglades provided densities, calculated as the square-root of the number of fish per m^2, for only six hydroperiods; although these cover the same range of hydroperiods developed by the District. Based on the throw-trap data and Trexler et al.'s (2002) hydroperiods, the square-root fish densities are (Table 26):

For our assessment, we squared these numbers to provide fish per m^2, a simpler calculation when other prey density factors are included in our evaluation of adverse effects to listed species from the proposed action. We also extrapolated the densities over seven hydroperiods, which is the same number of hydroperiods characterized by the District. For example, Trexler et al.'s (2002) square-root density of a Class 2 wetland with three fish would equate to a District Model Class 3 wetland with nine fish. Based on the above discussion, the following mean fish densities were extrapolated to the seven District Model hydroperiods (Table 27):

Fish biomass (kg) per hydroperiod: A more important parameter than fish per m^2 in defining fish densities is the biomass these fish provide. In the ENP and WCA-3 based on studies by Turner et al. (1999), Turner and Trexler (1997), and Carlson and Duever (1979), the standing stock (biomass) of large and small fishes combined in unenriched Class 5 and 6 hydroperiod wetlands averaged between 5.5 to 6.5 grams-wet-mass/m^2. In these studies, the data were provided in g/m^2 dry-weight and converted to g/m^2 wet-weight following the procedures referenced in Kushlan et al. (1986) and also referenced in Turner et al. (1999). The fish density data provided in Turner et al. (1999) included both data from samples representing fish 8 cm or smaller and fish larger than 8 cm and included summaries of Turner and Trexler (1997) data, Carlson and Duever (1979) data, and Loftus and Eklund (1994) data. These data sets also reflected a 0.6 g/m^2 dry-weight correction estimate for fish greater than 8 cm based on Turner et al.'s (1999) block-net rotenone samples.

Relating this information to the hydroperiod classes developed by the District, we estimated the mean annual biomass densities (kg) per hydroperiod. For our assessment, we considered Class 7 hydroperiod wetlands based on Turner et al. (1999) and Trexler et al. (2002) studies to have a mean annual biomass of 6.5 grams-wet-mass/m^2 (referenced in our discussion on fish densities) and to be composed of 25 fish/m^2 (referenced in our discussion on number of fish per m^2). The remaining biomass weights per hydroperiod were determined as a direct proportion of the number of fish per total weight of fish for a Class 7 hydroperiod (6.5 grams divided by 25 fish equals 0.26 grams per fish).

For example, given that a Class 3 hydroperiod has a mean annual fish density of 9 fish/m^2, with an average weight of 0.26 grams per fish, the biomass of a Class 3 hydroperiod would be 2.3 grams / m^2 (9 * 0.26 = 2.3). Based on the above discussion, the biomass per hydroperiod class is presented in Table 28.

Variable 3 - Wood stork suitable prey size and wood stork suitable prey base (biomass per hydroperiod)

Wood stork suitable prey size: Wood storks are highly selective in their feeding habits and in studies on fish consumed by wood storks, five species of fish comprised over 85 percent of the number and 84 percent of the biomass of over 3,000 prey items collected from adult and nestling wood storks (Ogden et al. 1976). Table 29 lists the fish species consumed by wood storks in Ogden et al. (1976).

These species were also observed to be consumed in much greater proportions than they occur at feeding sites, and abundant smaller species [*e.g.*, mosquito fish (*Gambusia affinis*), least killifish (*Heterandria formosa*), bluefin killifish (*Lucania goodei*)] are under-represented, which the researchers believed was probably because their small size did not elicit a bill-snapping reflex in these tactile feeders (Coulter et al. 1999). Their studies also showed that, in addition to selecting larger species of fish, wood storks consumed individuals that are significantly larger (greater than 3.5 cm) than the mean size available (2.5 cm), and many were greater than 1-year old (Ogden et al. 1976, Coulter et al. 1999). However, Ogden et al. (1976) also found that wood storks most likely consumed fish that were between 1.5 and 9.0 cm in length (Figure 4 in Ogden et al. 1976).

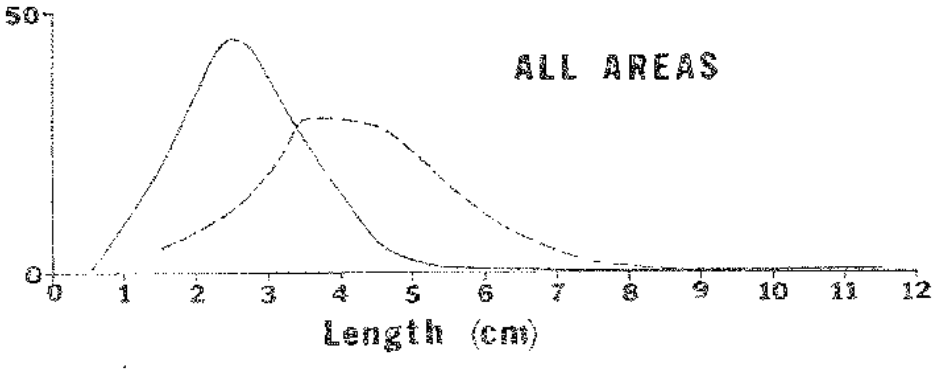

Figure 12. Length frequency distribution of fish available to and consumed by wood storks in different habitats.

In Figure 12 (Ogden et al. 1976), the dotted line is the distribution of fish consumed and the solid line is the available fish. Straight interpretation of the area under the dotted line curve represents the size classes of fish most likely consumed by wood storks and is the basis of our determination of the amount of biomass that is within the size range of fish most likely consumed by wood storks, which in this example is a range size of 1.5 and 9.0 cm in length.

Wood stork suitable prey base (biomass per hydroperiod): The wood stork suitable prey base (biomass per hydroperiod) has two separate components. The first component is (1) what is the amount of biomass that is within the range of fish sizes likely to be consumed by wood storks and the second component is (2) what is the likelihood that this prey base is actually consumed by the wood stork.

Amount of biomass that is within the range of fish sizes likely to be consumed by wood storks: To estimate the fraction of the available fish biomass within the size range of fish that might be consumed by wood storks, the following analysis was conducted. Trexler et al.'s (2002) 2-year throw trap data of absolute and relative fish abundance per hydroperiod distributed across

20 study sites in the ENP and the WCAs was considered to be representative of the Everglades fish assemblage available to wood storks (n = 37,718 specimens of 33 species). Although Trexler et al.'s (2002) data was based on throw-trap data and representative of fish 8 cm or smaller, the Service believes the data set can be used to predict the biomass/m^2 for total fish (those both smaller and larger than 8cm). This approach is also supported, based on our assessment of prey consumption by wood storks in the Ogden et al. (1976) study (Figure 4 in Ogden's report), that the wood storks general prey consumption is fish measuring 1.5 cm to 9 cm and is generally inclusive of Trexler et al.'s (2002) throw-trap data of fish 8 cm or smaller.

To estimate the fraction of the available fish biomass within the size range of fish that might be consumed by wood storks, the Service, using Trexler et al.'s (2002) throw-trap data set, determined the mean biomass of each fish species that fell within the wood stork prey size limits of 1.5 to 9.0 cm. The mean biomass of each fish species was estimated from the length and wet mass relationships for Everglades icthyofauna developed by Kushlan et al. (1986). The proportion of each species that was outside of this prey length and biomass range was estimated using the species mean and variance provided in Table 1 in Kushlan et al. (1986). These biomass estimates assumed the length and mass distributions of each species was normally distributed and the fish biomass could be estimated by eliminating that portion of each species outside of this size range. These biomass estimates of available fish prey were then standardized to a sum of 6.5 g/m^2 for Class 7 hydroperiod wetlands (Appendix 1).

For example, Kushlan et al. (1986) lists the warmouth (*Lepomis gulosus*) with a mean average biomass of 36.76 g. In fish samples collected by Trexler et al. (2002), this species accounted for 0.048 percent (18 / 37,715 = 0.000477 * 100 = 0.048) of the Everglades freshwater ichthyofauna. Based on an average biomass of 36.76 g (Kushlan et al. 1986), the 0.048 percent of total fish collected from Trexler et al. (2002) represents 1.75 g (36.76 * 0.048 = 1.754) of the mean mass biomass collected or 5.07 percent (1.75 / 34.579 = 0.0507 * 100 = 5.07) of the total estimated biomass collected (34.579 g) of Trexler et al.'s (2002) samples (Appendix 1).

Standardizing this data to a sample size of 6.5 g/m^2, the warmouth biomass for long hydroperiod wetlands would be about 0.330 g (Appendix 1). However, the size frequency distribution (assumed normal) for warmouth (Kushlan et al. 1986) indicate 48 percent are too large for wood storks and 0.6 percent are too small (outside the 1.5 cm to 9 cm size range most likely consumed), so the warmouth biomass within the wood stork's most likely consumed size range is only 0.168 g (0.330 - (0.330 * (0.484 + 0.006)) = 0.168) in a 6.5 g/m^2 sample. Using this approach summed over all species in long hydroperiod wetlands, only 3.685 g/m^2 of the 6.5 g/m^2 sample consists of fish within the size range likely consumed by wood storks or about 57 percent (3.685 / 6.5 * 100 = 56.7) of the total biomass available.

An alternative approach to estimate the available biomass is based on Ogden et al. (1976). In their study (Table 29), the sunfishes and four other species accounted for 84 percent of the biomass eaten by wood storks and totaled 2.54 g of the 6.5 g/m^2 sample (Appendix 1). Adding the remaining 16 percent from other species in the sample, the total biomass would suggest 3.01 g of a 6.5 g/m^2 sample are most likely to be consumed by wood storks or about 46.4 percent (3.01 /6.5 = 0.464).

The mean of these two estimates is 3.34 g/m^2 for long hydroperiod wetlands (3.685 + 3.01 = 6.695 / 2 = 3.348). This proportion of available fish prey of a suitable size (3.348 g/m^2 / 6.5 g/m^2 = 0.515 or 52 percent) was then multiplied by the total fish biomass in each hydroperiod class to provide an estimate of the total biomass of a hydroperiod that is the appropriate size and species composition most likely consumed by wood storks.

As an example, a Class 3 District model hydroperiod wetland with a biomass of 2.3 grams/m^2, adjusted by 52 percent for appropriate size and species composition, provides an available biomass of 1.196 grams/m^2. Following this approach, the biomass per hydroperiod potentially available to predation by wood storks, based on size and species composition is referenced in Table 30.

Crayfish Biomass: Lauritsen (Corkscrew Sanctuary, personal communication 2007; 2009) noted that wood storks forage in mixed forested wetlands, coastal plains willow, and cypress. Lauritsen also noted the value of crayfish as part of the foraging base available to and consumed by wood storks. An injured wood stork transported to the Sanctuary regurgitated only crayfish from its stomach. However, efforts undertaken by Lauritsen in 2008 to gather more data on prey selection as part of an ongoing research project "Wood Stork Foraging Habitat Assessment for Southwest Florida in Corkscrew Swamp" (Audubon 2009) were hampered by the drought that year. Current year surveys are ongoing, although data are not yet available.

In our review of the literature on wood stork food habits, there is evidence of consumption of crayfish by wood storks (Kahl 1964; Coulter et al. 1999; Carlson and Duever 1979). Studies by Depklin et al. (1992) of wood stork foraging at colonies in east-central Georgia also noted the presence of crayfish in the diets of wood storks. In their analysis, crayfish represented one percent of the biomass and 1.9 percent of the prey items. Fish represented 92 percent of all individual prey items and 93 percent of the biomass. A similar study conducted by Bryan and Gariboldi (1998) also noted the presence of crayfish in wood stork diets and noted a similar frequency of occurrence. In the foraging studies conducted by Ogden et al. (1976), Coulter et al. (1999), Carlson and Duever (1979), Turner et al. (1999) and Trexler et al. (2002), little information is provided on consumption of invertebrates. Ogden et al. (1976) summarized information from Kahl's publications (1962, 1964) on stomach contents of wood storks sampled in south Florida and southwest Florida and noted that all individuals examined contained only fish. Ogden et al.'s (1976) study also noted that the prey consumed were fish, although the average density of prawns was 2.5 times the density of the most abundant fish.

O'Hare and Dalrymple (1997) found that crayfish were most abundant in three of the five cover types of melaleuca-infested wetlands in their study of species richness and relative abundance. They also noted that crayfish showed random distributions among cover types indicating that melaleuca coverage was not as important in the dispersion of the species as were other variables, such as standing water.

Lauritsen (Corkscrew Sanctuary, personal communication 2007; 2009) noted that crayfish are present in dense melaleuca communities and, following seasonal drying of these communities, migrate to surrounding wetlands that are more open and available to foraging by wood storks. However, studies have noted that *P. alleni* typically burrow during the dry season, a behavior

which provides persistence during droughts, while another species of crayfish (*P. fallax)* was typically found in habitat characterized by prolonged flooding (Hendrix and Loftus 2000). Studies by Depklin et al. (1992) and Bryan and Gariboldi (1998) documented crayfish as a foraging prey base for wood stork colonies on Georgia representing less than 2 percent of the wood stork's diet.

The Service's review of the literature identified no definitive studies that would suggest that crayfish are important components of the foraging biomass for wood storks (Depklin et al. 1992; Bryan and Gariboldi 1998; and Kahl 1964). However, we do have evidence that wood storks consume crayfish (Lauritsen, Corkscrew Sanctuary, personal communication 2007 and 2009; Depklin et al. 1992; Bryan and Gariboldi 1998; and Kahl 1964). Therefore, in our assessment of biomass production per hydroperiod, we discuss data availability on crayfish populations and applicability to wetland production for wood stork foraging biomass. If we are to evaluate crayfish as an important food source for wood storks as suggested by Lauritsen (Corkscrew Sanctuary, personal communication 2007; 2009), then we need to consider the crayfish data from Acosta and Perry (2002), who studied crayfish as a model organism to compare spatial and temporal patterns of density, biomass, and production in the seasonal wetlands of the Florida Everglades.

Because Acosta and Perry (2002) hydroperiods are defined in terms of months of inundation, we converted these periods to days to match the hydroperiod classes used in this document. Consequently, Acosta and Perry's (2002) research provides crayfish densities and biomass information for hydroperiod Classes 2, 4, and 5. Although data were not provided in Acosta and Perry's (2002) study for hydroperiods 1, 3, 6, and 7, they did note that crayfish densities were not linked to fluctuations in water temperature or dissolved oxygen and were only artificially associated with water depth. They also noted that long hydroperiod wetlands typically had densities two times greater than medium-range hydroperiods and five times greater than short-range hydroperiods.

Table 31 lists the crayfish biomass for those hydroperiods referenced by Acosta and Perry (2002) and we estimated the crayfish biomass for the remaining hydroperiods. We estimated the crayfish biomass for hydroperiod Class 3 as half the difference between hydroperiod Class 2 and Class 4. The Service is considering a Class 1 hydroperiod to be representative of a density of 0.05 (0.229 / 5 = 0.045), which is based on Acosta and Perry's (2002) comment that long hydroperiod wetlands (Class 5) typically had densities five times greater than short hydroperiod wetlands. For the Class 5 hydroperiod, we used Acosta and Perry's (2002) average long hydroperiod value (0.229 grams/m^2). We based the hydroperiod 7 value on the maximum density recorded in the study (0.248 gram/m^2) and hydroperiod 6 on one-half the difference between hydroperiod 5 and hydroperiod 7. Table 31 also shows the combined values of the fish and crayfish biomass for each hydroperiod class.

Variable 4 - Is the wood stork the wetland species that actually consumes the concentrated prey?

<u>Amount of suitable prey base (biomass) by size actually consumed by the wood stork (Competition Factor):</u> In 2006, the Service developed an assessment that suggested that 55 percent of the adjusted available biomass was actually consumed by wood storks (Service

2006a). Since the implementation of this assessment approach, the Service has received comments from various sources concerning the Service's understanding of Fleming et al.'s (1994) assessment of the adjusted prey base consumed by wood storks versus the adjusted prey base assumed available to wood storks and the factors included in the 90 percent prey reduction value.

In our original assessment, we stated that, "*Fleming et al. (1994) provided an estimate of 10 percent of the total biomass in their studies of wood stork foraging as the amount that is actually consumed by the storks. However, the Fleming et al. (1994) estimate also includes a second factor, the suitability of the foraging site for wood storks, a factor that we have calculated separately. In their assessment, these two factors accounted for a 90 percent reduction in the biomass actually consumed by the storks. We consider these two factors as equally important and are treated as equal components in the 90 percent reduction; therefore, we consider each factor to represent 45 percent of the reduction. In consideration of this approach, Fleming et al.'s (1994) estimate that 10 percent of the biomass would actually be consumed by the storks would be added to the 45 percent value for an estimate that 55 percent (10 percent plus the remaining 45 percent) of the available biomass would actually be consumed by the storks and is the factor we believe represents the amount of the prey base that is actually consumed by the stork.*"

In re-evaluating Fleming et al.'s (1994) report, we noted that the 10 percent reference is to prey available to wood storks, not prey consumed by wood storks. We also noted that the 90 percent reduction also includes an assessment of prey size, an assessment of prey biomass by water level (hydroperiod), an assessment of suitability of habitat for foraging (openness), and an assessment for competition with other species; not just the two factors considered originally by the Service (openness and competition). Therefore, in re-evaluating our approach, we identified four factors in the 90 percent biomass reduction and not two as we previously considered.

Since data are not available to determine the proportionality of the four factors in the 90 percent biomass reduction, we are considering these factors to be represented in equal proportions, which correspond to an equal split of 22.5 percent for each factor. Since we have accounted previously for three of these factors (prey size, habitat suitability or openess, and hydroperiod) and they are treated separately in our assessment, we consider the remaining factor, the competition factor to be represented by the sum of Fleming et al.'s (1994) 10 percent value plus the remaining 22.5 percent from the 90 percent reduction discussed above. Following this revised assessment, our competition factor would be 32.5 percent (22.5 + 10 = 32.5), not the initial estimate of 55 percent. We believe this approach is a reasonable application of the best available scientific information.

Other comments reference the methodology's lack of sensitivity to limiting factors, *i.e.*, "is there sufficient habitat available across all hydroperiods during critical life stages of wood stork nesting and does this approach over emphasize the foraging biomass of long hydroperiod wetlands with a corresponding under valuation of short hydroperiod wetlands?" The Service's focus on individual hydroperiod class and the relative change in each is a key component of the analyses that recognizes the importance of different classes, including short hydroperiod wetlands. New science generated in the future may provide further information on these subjects.

Summary: Through the above discussions, we have identified that there are essentially four variables in assessing wood stork foraging habitat.

- the density of vegetation within habitats suitable for wood stork foraging;
- the hydroperiod of the wetland, including two subcomponents: (1) the fish density per hydroperiod (number of fish/m^2), and (2) the fish biomass per hydroperiod (g/m^2);
- the wood stork suitable prey size, which provides an adjustment to the fish biomass per hydroperiod and is referenced as the wood stork suitable prey base; and
- the likelihood that the wood stork is the wetland species that actually consumes the concentrated prey.

All four of these variables, when combined, provide us with an estimate of the effect of wetland foraging losses and gains in grams of fish per m^2 in our assessment of the effects of the action on wood storks.

Example – Fish Only: If a project impacts a 50-acre wetland with 10 percent melaleuca coverage and supports a hydrology of 25 acres of Class 3 and 25 acres of Class 4, the biomass values are shown below.

In the above example, 50 acres converts to 202,344 m^2. A Class 3 hydroperiod provides 1.20 g/m^2 of appropriate size fish biomass and a Class 4 hydroperiod provides 2.18 g/m^2 of appropriate size fish biomass (Table 30). Therefore, wood stork suitable prey base (biomass per hydroperiod) for a Class 3 hydroperiod is 121 kg and for a Class 4 hydroperiod is 221 kg for a total biomass value of 342 kg.

- In this scenario, the 10 percent melaleuca coverage is 100 percent suitable for wood stork foraging. In this assessment, the wood stork competition factor is 32.5 percent across all hydroperiods and the foraging suitability is 100 percent.

  The assessment for the loss of 25 acres of short hydroperiod wetlands is 121 kg of short hydroperiod biomass times 100 percent foraging suitability times 32.5 percent competition factor which equals 39.3 kg of short hydroperiod biomass loss from the proposed project. The corresponding assessment for the loss of 25 acres of long hydroperiod wetlands is 221 kg of long hydroperiod biomass times 100 percent foraging suitability times 32.5 percent competition factor which equals 71.83 kg of long hydroperiod biomass loss from the proposed project.

Example – Crayfish Contributions: If we adjust the fish baseline biomass value to include the crayfish contribution of 0.13 gram/m^2 for a Class 3 hydroperiod and 0.15 gram/m^2 for a Class 4 hydroperiod (Table 31), the biomass baseline values per hydroperiod change from 1.2 to 1.3225 and 2.18 to 2.34, respectively for Class 3 and 4 hydroperiods. In the above estimates, the available biomass values change from 342 kg to 370 kg, an 8 percent increase in biomass value. The impact to wood stork nest production also changes accordingly and increases about 8 percent. However, as shown in Table 31, short hydroperiod biomass changes including crayfish contributions show a change of 19.2 percent increase for hydroperiods 1 and 2 and represent an important contribution to biomass productivity for these hydroperiods. Therefore for our assessment approach,

we are adding the crayfish biomass estimates to the fish biomass estimates for all hydroperiods as a composite value and this composite value is the wood stork suitable prey base value applied to our assessment methodology, as referenced in Table 31.

Example – Nest Productivity: In the above example we provided an assessment of prey base (fish and crayfish) losses associated with impacts to 50 acres of wetlands for two hydroperiods, Class 3, and Class 4. In our assessment, hydroperiod 3 is considered a short hydroperiod and hydroperiod 4 isconsidered a long hydroperiod. Many researchers including Flemming et al. (1994) and Ceilley and Bortone (2000) believe the short hydroperiod wetlands provide a more important pre-nesting foraging food source and a greater early nestling survivor value for wood storks than the foraging base (grams of fish per m^2) suggests. Kahl's (1964) estimated that 201 kg are needed for the success of a nest; that 50 percent of the foraging base is needed in the middle third of the nesting cycle when chicks are about 23 to 45 days old (Kahl 1962); that 25 percent (50 kg) of the biomass is needed to meet the foraging needs of the adults and nestling in the first third of the nesting cycle; and that 25 percent (50 kg) of the foraging biomass is needed from fledging to dispersing juveniles.

Because of the consistent pattern of drying that normally occurs during the stork nesting season, the short hydroperiod wetlands would also be the ones used for foraging early in the season, when long hydroperiod wetlands remain too deep for storks to forage effectively or sufficient prey concentration has not yet occurred as a result of drying. Following this assessment, short hydroperiod wetlands would provide the foraging needs from egg laying to hatching to two weeks of age (50 kg) and long hydroperiod wetlands would provide the foraging needs from 2 weeks of age through fledging and dispersing juveniles (151 kg).

Considering the above assessment, the biomass loss associated with hydroperiod 3, a short hydroperiod, is 43.5 kg (1,001,172 * 1.32 * 0.325 / 1,000 = 43.5 kg). The corresponding nest productivity loss is 0.87 nest (43.5 / 50 = 0.8697). The biomass loss associated with hydroperiod 4, a long hydroperiod, is 76.8 kg (1,001,172 * 2.34 * 0.325 / 1,000 = 76.8 kg). The corresponding nest productivity loss is 0.51 nest (76.8 / 151 = 0.51).

Method Application – Project Development Footprint Foraging Prey Base Assessment (fish and crayfish combined): Following this approach, a foraging prey base evaluation of the proposed project footprint, based on the above information, provides a biomass loss to wood storks of 190 kg (Table 32, Appendix 2G). The biomass loss is based on 645.35 acres of wood stork foraging habitat. The exotic species foraging suitability values range from 3 percent to 100 percent. The hydroperiods vary from Class 2 (60 to 120 days) to Class 5 (240 to 300 days) with 78 percent of the project footprint represented by Class 3.

Method Application – Project Preserve Foraging Prey Base Assessment (fish and crayfish combined): A foraging prey base evaluation of the proposed preserve (831.35 acres) provides a biomass foraging pre-enhancement of 660.18 kg and a post-enhancement of 2,842.05 to wood storks, a net change of 1,991.81 kg (2,842.05 - 660.18 = 1,991.81) (Table 32, Appendix 2H–pre, Appendix 2I–post). The exotic species foraging suitability values range from 3 percent to 100 percent. The hydroperiods vary from Class 2 (60 to 120 days) to Class 6 (300 to 330 days) with 59 percent of the project footprint represented by Class 3.

Analysis for Effects of the Action

Habitat Fragmentation: Mac et al. (1998) define 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." In the case of the proposed project, about 645.35 acres of wetlands will be lost by the development of the property. The applicant has proposed about 54.52 acres of wetlands internal to the development that may provide foraging benefit to wood storks. These wetlands although available for foraging are only indirectly connected to other larger acreages of wetlands and would be considered fragmented habitat. The applicant's remaining proposed onsite wetland preserve (776.83 acres – Table 1b) is adjacent to existing and proposed preserve areas to the west and east. For these reasons, fragmentation of wood stork habitat is not significant.

Permanent Loss of Habitat: The project will result in the loss of about 645.35 acres of wetlands on the site. The land will be converted to support a residential golf course community. Habitat foraging suitability has been affected by exotic density coverage averaging 65 percent. This loss represents about 0.13 percent (645.36 / 481,666 = 0.0013) of the available foraging area within the CFA of the three colonies in the action area. No wood storks are known to have nested within the project area and all of the wading bird censuses conducted to date have demonstrated that the area is periodically used by wood storks.

Although there will be a permanent loss of wood stork foraging habitat from construction of the project, the proposed restoration of lands in the onsite preserves will restore these lands to habitats that may be used more frequently by wood storks, thereby increasing, over time, distribution and quality of foraging habitat, which would reduce the local and landscape-scale effects of the initial habitat loss.

Changes in the Mosaic of Hydroperiods: Stork nesting success generally relies on a mosaic of hydroperiods within the core foraging area of the colony. Storks nest during the dry season, and rely on the drying wetlands to concentrate prey items in the ever-narrowing wetlands (Kahl 1964). Because of the continual change in water levels during the stork nesting period, any one site may only be suitable for stork foraging for a narrow window of time when wetlands have sufficiently dried to begin concentrating prey, making water depths suitable for storks to access the prey. Once the wetland has dried to where the water levels are near the ground surface, the area is no longer suitable for stork foraging, and will not be suitable until water levels rise and the area is again repopulated with fish. Consequently, there is a general progression in the suitability of wetlands for foraging based on their hydroperiods, with the short hydroperiod wetlands used early in the season, the mid-range hydroperiod sites being used during the middle of the nesting season, and the longest hydroperiod areas being used later in the season (Kahl 1964; Gawlik 2002). In our evaluation of hydroperiods within the wood stork action area (overlap of all three rookeries), we determined that within the action area (481,666 acres), there were about 227,845 acres of short hydroperiod wetlands and 253,821 acres of long hydroperiod wetlands (Table 17).

Offsite Wetlands: During the mid 1970s, a significant acreage north of the project area was converted to vegetable crop production. Additional development activities were also occurring to

the west. This resulted in a system of berms being constructed, which effectively funneled the surface water from thousands of acres (which historically occurred as sheet flow over a broad area of about15 miles), into a highly altered flow-way with relatively few outfalls to the Cocohatchee and Immokalee Canals. Seasonal flows entering the project area are regulated by a weir structure at the north end of the site and the onsite pass-through lakes are designed to accept the water and pass it through the site to where it outfalls into the Immokalee Canal. Crest elevations on the weirs and box structures will be high enough above ground level that water will enter the preserves during high water events, but will then drain down naturally through the ground rather than discharge back out through the lakes. These structures are designed to regulate and temper the seasonal changes in hydroperiods and restore these systems to more natural communities. No hydrological changes in offsite wetlands are expected from the proposed action.

Project Development: Short-hydroperiod wetlands in the project development footprint total about 575.66 acres. The loss of the 575.66 acres of short-hydroperiod wetlands represents about 0.25 percent (575.66 / 227,845 = 0.0025) of the short hydroperiod wetlands in the action area. Long-hydroperiod wetlands in the project footprint total about 69.69 acres. This loss of long hydroperiod wetlands represents about 0.003 percent (69.69 / 253,821 = 0.00027) of the long hydroperiod wetlands in the action area.

Project Preserve: The onsite preserves includes 831.35 acres of wetlands with 507.56 acres considered short hydroperiod wetlands and 323.79 acres considered long hydroperiod wetlands. The proposed restoration actions are not changing the existing mosaic of hydroperiods present in the wetland preserves.

Changes in Wood Stork Prey Base: In our assessment of the Mirasol development footprint, we noted that the predominant wetland hydroperiod was a Class 3 (89 percent) with an average of 120 to 180 days inundation. To complete this analysis, we assumed the existing available foraging habitat would be available with or without the project. We calculated the proposed development will result in the loss of 190.06 kg of foraging biomass, of which 166.80 kg represent short hydroperiod wetlands, and 23.26 kg represent long hydroperiod wetlands (Table 32).

In our assessment of the preservation lands (Table 32), we determined that prior to restoration, the wetland preserves provide an existing foraging base of 660.17 kg of biomass and following restoration these lands provide 2,842.04 kg of biomass, an increase of 2,181.87 kg of biomass.

Since the importance of short hydroperiod wetlands in relationship to early nesting productivity of a wood stork colony is extremely critical, as discussed previously, we also calculated the productivity of both short- and long hydroperiod wetlands separately. The existing preserves currently provide 145.97 kg of short hydroperiod biomass with a corresponding long hydroperiod biomass of 514.20 kg. Following restoration, the wetland preserves will provide 1,252.34 kg of shorth hydroperiod biomass and 1,589.70 kg of long hydroperiod biomass.

Following the above analysis, the restoration actions proposed for the wetland preserves will provide an increase of 939.57 kg of short hydroperiod biomass and 1,052.24 kg of long hydroperiod biomass (Table 32). Considering that the expected biomass productivity loss from the proposed development is 190.06 kg, of which 166.80 kg represent short hydroperiod biomass, and 23.26 kg represent long hydroperiod biomass, the proposed restoration actions will provide a

5.63 fold increase (939.57 / 166.80 = 5.63) in short hydroperiod biomass and a 43.24 fold increase (1,052.24 / 23.26 = 43.24) in long hydroperiod biomass.

However, as we discussed previously, biomass production in individual classes of wetland hydroperiods as it relates to nesting productivity of a wood stork colony is extremely critical in the overall success of a colony. Therefore, we also calculated the biomass productivity of both short and long hydroperiod wetlands separately by hydroperiod (Table 32). As shown in Table 32, Class 2 hydroperiod wetlands show an overall loss of 66.69 acres and a corresponding loss of 17.98 kg of biomass. Class 3 hydroperiod wetlands show an overall loss of 508.97 acres of wetlands but with an increase of 957.55 kg of biomass. The biomass increase is associated with the restoration of wetlands within the preserve areas. Class 4 hydroperiod wetlands show an over all loss of 68.63 acres of wetlands with a corresponding increase of 857.44 kg of biomass. Class 5 wetlands show an overall loss of 1.06 acres of wetlands, but with an increase of 194.24 kg of biomass. Again, the biomass increase is associated with the restoration of wetlands within the preserve areas. As shown in Table 32, wood stork biomass foraging losses from the proposed development are compensated for through the enhancements of the wetland preserves with the exception of the losses associated with Class 2 hydroperiod wetlands.

To summarize the discussion above, the project development will result in the loss of 645.35 acres of wetlands. The proposed preservation lands consist of 831.35 acres of wetlands. The hydroperiod class analysis shows that over all, the project development will result in a loss of 190.06 kg of biomass from wetland losses. The proposed restoration will provide an increase of 2,181.87 kg (2,842.05 - 660.18 = 2,181.87) of biomass over existing baseline of the wetlands in the preserve. The net increase is 1,991.81 kg of biomass for the project (2,181.87 - 190.06 = 1,991.81). However, on an individual hydroperiod basis, the project development will result in the loss of 17.98 kg of biomass associated with a Class 2 hydroperiod. All the other hydroperiod classes show an increase in the biomass available for wood stork foraging following enhancement of the preserve wetlands. Since our analysis shows a loss of 17.98 kg of biomass in the Class 2 hydroperiod, this loss represent an adverse effect to wood stork foraging base and is the value for our estimate of incidental take for wood stork nest productivity.

Construction: The timing of construction for this project relative to sensitive periods of the wood stork's lifecycle is unknown. However, it is likely that all land clearing associated with the development will occur in phases over several years. The onsite internal wetland preserve, which provide a foraging prey base for wood storks in a suburban setting, may increase the likelihood of harassment and disturbance to the species. However, this is a common occurrence throughout the species range and is not expected to adversely affect the wood stork. In order to minimize potential human/stork interactions, the applicant is proposing to educate all residents (through literature and signage) as to the potential presence of wood storks around the community. There are no known roosting or colony sites within the project boundaries and based on site surveys of wood stork usage and density of exotics present in onsite wetlands, we believe wood stork usage of the property is limited and we do not believe project construction will result in direct wood stork harassment or mortality.

Reduction in Geographic Distribution of Habitat: The wood stork population in the southeastern United States appears to be continuing to grow. Preliminary population totals indicate that the

stork population has reached its highest level since it was listed as endangered 1984. In all, about 12,720 wood stork pairs nested within their breeding range in the southeastern U.S. (Service 2010). Wood stork nesting was again recorded in North Carolina in 2006, 2007, 2008, and 2009, after it was first documented there in 2005. This suggests the northward expansion of wood stork nesting may be continuing. Several new colonies were located in 2006, including several in Florida. The number of colonies also continues to rise with over 86 nesting colonies reported in 2009, with 12,720 associated nests, which is the highest to date in any one year throughout the southeastern U.S. (Service 2010) The proposed Mirasol project will not significantly reduce the geographic distribution of habitat and the distribution of the species.

Compensation: Wood stork habitat lost by the development will be offset by the preservation and enhancement of about 831.35 acres of wetlands of which about 54.52 acres are within the developed portions of the project and the remaining 776.83 acres are located north and east of the development, forming a contiguous preserve with additional offsite wetland preserves. In addition, the project will provide another 27.68 wetland mitigation credits (about 82.21 acres), and will provide about 291.10 acres of additional wetland preserves that also provide foraging benefit to wood storks. The wetlands proposed for development are hydrologically disturbed and exotic infested. The lands proposed for preservation are connected to other larger tracts of preserve lands and are consistent with the Service's goal to acquire, enhance, preserve, and recover natural hydropatterns to foraging habitat for the wood stork

Interrelated and Interdependent Actions

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. No interrelated or interdependent actions are expected to result from the project.

Species Response to the Proposed Action

The proposed action will result in increased human activity and noise in the project area during construction of the project. However, since wood storks are commonly known to use lands within and adjacent to the project site, activities associated with construction of the Mirasol project are not anticipated to significantly increase risk of disturbance to woood storks, though some temporary disturbance may occur.

The project will result in the direct loss of 645.35 acres of onsite wetlands. Any loss of wood stork foraging habitat attributable to the project will be offset by the preservation and enhancement of 831.35 acres of onsite wetlands.

CUMULATIVE EFFECTS

Florida Panther

Cumulative effects include the effects of future State, Tribal, local, or private actions reasonably certain to occur in the action area considered in this biological opinion. Although future federal actions located within the action area affecting panthers are technically not linked to this project

and will be considered in separate section 7 consultations, the Service notes that several projects, which are also within the same watershed, have been the subject of section 7 consultations resulting in biological opinions and have been included in the environmental baseline. These projects include Bonita Beach Road, Terafina, and Parklands. The Service issued a biological opinion for the Bonita Beach Road project on October 6, 2003, a revised biological opinion for Terafina on August 28, 2007, and a biological opinion for Parklands on March 28, 2008. As shown on Figure 2 and tabulated in Table 10, the combined habitat loss from the three listed projects is 1,967 acres. The impacted lands border existing developments and prior to construction supported a mosaic of habitats that provided foraging for panther prey species and hunting and dispersal habitat to panthers. Existing habitat value to panther prey species (deer and hog), as discussed in the biological opinions for these projects, was degraded by varying levels of exotic species infestations that also diminished the quantity and quality of foraging food base for these prey species.

The 1,921 acres of companion preserves prior to restoration, were also affected by exotic species. Following restoration, primarily the removal of the exotic species, the quality and quantity of forage for panther prey species is expected to improve with a corresponding increase in use and presence by panther prey and the Florida panther. In addition, the proposed 1,921 acres of wetland preserves are interconnected to each other and to the adjacent CREW. These interconnected preserves provide greater access and facilitate panther and panther prey movement in an out of adjacent publicly owned lands and refugia for dispersing panthers. The Service concluded in all of the aforementioned biological opinions that these projects, as proposed, do not jeopardize the survival and recovery of the Florida panther; that the proposed compensation plans provide habitat preservation and restoration within and near the project area; and that the compensation plans benefit the survival and recovery of the Florida panther as referenced in the Panther Recovery Plan (Service 2008) goal 1.1.1.2.3. This goal recommends habitat preservation and restoration within the Primary Zone be provided in situations where land use intensification can not be avoided. The applicant has proposed sufficient habitat protection and restoration, to compensate for both the quantity and functional value of the lost habitat.

To determine the cumulative effects of future private actions that would affect the Florida panther and that may reasonably be certain to occur in the action area, the Service first identified the types of land alteration actions that could occur in the action area, then developed a mechanism to distinguish between those that will require future Federal review and those that are not likely to be a future Federal action, and thus meet the cumulative effects definition. To estimate future non-federal actions, the Service chose to identify and tabulate recent past non-federal actions and project this level of development as representative of future non-federal actions.

Within the action area, past and ongoing State and County actions affecting panther habitat include: (1) State of Florida DRI Orders (2005 to 2010); (2) Comprehensive Plan Amendments (2005 to 2010); and (3) District's Environmental Resource Permits (2005 to 2010). To evaluate these effects, the Service incorporated FLUCCS mapping to determine properties that have no wetland impacts or not considered jurisdictional by the Corps. To determine which of these projects was unlikely to require a section 404 Federal Clean Water Act wetland permit from the Corps, we identified the percentage of the project site that was classified as wetland habitat, based on the FLUCCS mapping units. The mapping units relied on by the Service included the 600 series

(wetland classifications) and the 411 and 419 pine flatwood classifications (hydric pine systems). For our purposes, properties with less than 5 percent wetlands, although subject to Federal review, were deemed unlikely to require a section 404 wetland permit from the Corps as these wetlands could be avoided through project design in compliance with section 404(b)(1) guidelines that require impacts to wetlands be avoided and minimized to the maximum extent practable.

Within the action area, the District has issued ERP permits (2005 to 2010) for 115 projects (17 in 2005, 30 in 2006, 22 in 2007, 21 in 2008, 19 in 2009, 10 in 2010) that impacted 14,958 acres. These projects impacted 1,355 acres of wetlands and provided for the preservation of 2,781 acres of wetlands and uplands. Based on FLUCCS mapping, about 14 of these projects (2 in 2005, 2 in 2006, 2 in 2007, 2 in 2008, 4 in 2009, 2 in 2010), each containing less than 5 percent wetlands, could be expected to be developed without Federal review. These projects through avoidance of wetland impacts would impact 2,712 acres. Over this 5-year period, the District has issued an average of 3 projects per year affecting 542.4 acres of habitat that would not be subject to Federal review.

State and County land alteration permits in southwest Florida, not part of those actions listed above, generally included single-family residential developments within Northern Golden Gate Estates and Lehigh Acres. Vacant lands within the area of Northern Golden Gate Estates (north of I-75), totaled about 35,768 acres as of August 2003. The breakdown is: (1) wetlands, about 17,572 acres; (2) uplands, about 17,990 acres; and (3) open water, about 210 acres. Vacant lands within the area of Northern Golden Gate Estates as of September 2004 totaled 34,028 acres. To evaluate this change, the Service overlaid the plat boundaries on the 2004 aerials, queried the parcel data from Collier County's Property Appraisers Office, noted lots with developments, compared those to 2003 aerials, and noted the changes.

The evaluation process provided an estimate of 417 lots totaling 1,740 acres for Northern Golden Gate Estates. The breakdown of converted acres is: (1) wetlands, 696 acres; (2) uplands, 1,044 acres; and (3) water, 0 acres. Therefore, using NWI mapping for Northern Golden Gate Estates, a total of about 1,740 acres could be expected to be subject to development in a year in these areas without Federal review. We expect that this level of annual development in Northern Golden Gate Estates has not significantly changed between 2004 and 2010. Based on historical records for wetland permits issued by the Corps for these areas, most of these projects will involve the construction of single-family residences in partially developed areas and will involve less than an acre of impact.

Vacant lands within the area of Lehigh Acres totaled about 35,293 acres as of April 2002. The breakdown is estimated as: (1) wetlands, 1,124 acres; (2) uplands, 33,967 acres; and (3) water, 202 acres. Vacant lands within the area of Lehigh Acres totaled about 34,852 acres as of April 2003 To evaluate this change, the Service overlaid the plat boundaries on the 2003 aerials, queried the parcel data from Collier County's Property Appraisers Office, noted lots with developments, compared those to 2002 aerials, and noted the changes.

The evaluation process provided an estimate that 441 acres of land was converted from vacant to occupied during the 1-year period. The breakdown of converted acres is estimated as: (1) wetlands, 66 acres; (2) uplands, 375 acres; and (3) water, 0 acres. Therefore, using NWI

mapping for Lehigh Acres, a total of about 441 acres could be expected to be subject to development in a year in these areas without Federal review. We expect that this level of annual development in Lehigh Acres has not significantly changed between 2003 and 2010.

In conclusion, the Service's cumulative effects analysis has identified about 4,893 acres (2,712+1,740+441=4,893) within the action area that could be developed without the need for a Federal wetland permit. This level of development, which the Service believes is representative of future non-federal actions, is reasonably certain to occur and, therefore, meets the definition of cumulative effect. This level of projected future development represents 16.7 percent (4,893/29,059=0.167) of a female panther's average home range (29,059 acres) and 7.8 percent (4,893/62,542=0.078) of a male panther's average home range (62,542 acres), though the impacts will be scattered and generally located on the fringes of occupied panther habitat. The impacted lands supported primarily disturbed vegetative communities, were in row crops, or were in partially developed areas. These lands represent 0.25 percent (4,893/1,962,294=0.00249) of the non-urban private lands at risk in the Service's panther core area (1,962,294 acres). Based on the above analysis, we believe the loss of the habitat associated with these lands, though insignificant in the short term, may adversely impact the panther as development continues to occur in the future in the action area. The Service has accounted for some habitat loss and changes in habitat quality through its habitat assessment methodology and is encouraging State and County entities responsible for permitting to pursue the section 10 (HCP) process to account and mitigate for adverse effects to the Florida panther.

Wood Stork

Cumulative effects include the effects of future State, Tribal, local, or private actions reasonably certain to occur in the action area considered in this biological opinion. While future Federal actions located within the action area affecting wood storks are technically not linked to this project and will be considered in separate section 7 consultations, the Service notes that several projects formerly linked by the flow-way are currently under review by the Corps and have been the subject of section 7 consultations resulting in biological opinions. These projects include Bonita Beach Road, Forum, Cypress Run, Parklands, and Terafina (Table 20). The Service issued biological opinions for Bonita Beach Road on October 6, 2003, Forum on December 29, 2003, Cypress Run on February 23, 2005, a revised biological opinion for Parklands on March 28, 2008, and a revised biological opinion for Terafina on August 28, 2007. The Service concluded in the biological opinions for these projects, that individually and cumulatively they do not jeopardize the survival and recovery of the wood stork.

The assessment for the above referenced projects identified that the combined wetland loss (2,269 acres) represents a reduction of less than 1 percent (2,269/227,845=0.00995) of the short hydroperiod wetlands within the core foraging area of the affected rookeries. Our assessment also noted a loss of nest productivity from 66 wood stork nests. In addition, we noted a corresponding biomass productivity gain associated with the restoration of 2,019 acres of wetlands and an increase across all hydroperiods of 6,814 kg of biomass.

To determine the cumulative effects of this project, the Service identified and analyzed future actions reasonably certain to occur within an action area. For evaluation purposes, the Service is considering the action area for the wood stork to include the CFAs of all three nesting colonies as they encompass the project area or a portion of it (Figure 6). The process to identify cumulative effects follows the same procedure identified for the Florida panther.

Within the action area, past and ongoing State and County actions affecting wood stork habitat include: (1) State of Florida DRI Orders (2005 to 2010); (2) Comprehensive Plan Amendments (2005 to 2010) and (3) District's Environmental Resource Permits (2005 to 2010). To evaluate these effects, the Service incorporated FLUCCS mapping to determine properties that have no wetland impacts or not considered jurisdictional by the Corps. To determine which of these projects would likely include no wetland impacts and not require a section 404 Federal Clean Water Act wetland permit from theCorps, we identified the percentage of the project site that was classified as wetland habitat, based on the FLUCCS mapping units. The mapping units relied on by the Service included the 600 series (wetland classifications) and the 411 and 419 pine flatwood classifications (hydric pine systems). For listing purposes, properties with less than 5 percent wetlands were considered by the Service, although subject to Federal review, to generally not require a section 404 wetland permit as these quantities of wetlands could be avoided through project design in compliance with section 404(b)(1) guidelines that require impacts to wetlands be minimized to the maximum extent practable.

Within the action area, the District has issued ERP permits (2005 to 2010), for 265 projects (24 in 2005, 60 in 2006, 58 in 2007, 55 in 2008, 44 in 2009, and 23 in 2010) that impacted 11.8 acres of wetlands and provided for the preservation of 27.8 acres of wetlands. We believe these projects could be expected to be development without Federal review. We added to this the 762 acres (696+66=762) of wetlands associated with the proposed developments in Northern Golden Gate Estates and Lehigh Acres for a total of 773.8 acres of wetlands. The Service believes that 773.8 acres of wetlands may be developed without Federal review. This annual cumulative loss in the action area constitutes less than 0.16 percent (773.8/481,666=0.0016) of all wetlands available to wood storks in the three CFAs.

Although these wetlands may be impacted by non-federally reviewed actions and the productivity as a foraging prey base for wood storks may be affected, we believe based on the status of species discussed previously and the status of the species in the action area, the loss/reduction of foraging value to the wood storks associated with these systems is not significant (0.16 percent).

SUMMARY OF EFFECTS

Florida Panther

Panther Usage: The timing of construction for this project, relative to sensitive periods of the panther's lifecycle, is unknown. However, it is likely all land clearing associated with the development will be completed in phases over several years. There are no known den sites within the project boundaries. The project will result in the loss of a relatively small amount (809.83 acres) of potential panther habitat. According to the most current home range estimates

of the Florida panther (Lotz et al. 2005), this loss represents 2.75 percent of a female panther's average home range (29,059 acres) and 1.28 percent of a male panther's average home range (62,542 acres). Since the project area provides panther habitat and panthers have been occasionally documented onsite, the loss of habitat may contribute to an increase in intraspecific aggression and a decrease in the spatial extent of lands available to the panther for hunting, breeding, and dispersing. We anticipate any resident panthers with home ranges overlapping or in the vicinity of the project area will adjust the size and location of their ranges to account for this loss and that adjustment is anticipated to occur in concert with project construction.

Traffic: There will be traffic increases with project development. As discussed above and in previous sections, the lands on the project site have been occasionally used by panthers and the proposed action will further restrict suitability of the site for use by either resident or dispersing panthers. The risk to the panther from collisions with vehicles as a result of the Mirasol project is difficult to quantify. The Service believes that the increase in traffic generated by the project may potentially contribute to mortality of panthers in the action area. Panthers are known to use the lands within the project vicinity and nine panthers were killed within 10 miles of the project action area including 3 in 2011, 3 in 2010, 1 in 2008, 1 in 2006, and 1 in 2002. The closest panther-vehicle collision, UCFP 156 (male), occurred on February 26, 2011, on I-75 at Mile Marker 114 in Collier County at a distance of about 4.1 miles northwest of the site. The most recent collision (FP 83) (female) occurred on March 25, 2011, on US 41; 23.6 miles southeast of the project site; west of Port of the Islands.

Habitat Loss*:* Based on the habitat evaluations discussed previously, the Service believes the project will result in direct and indirect loss of about 809.83 acres of habitat within the Primary Zone (see discussion under Wildlife Assessment). Habitat types are primarily exotic-infested wetlands and other natural communities. The prevalence of exotics within the project area provides reduced foraging value to panther prey species. We believe panther usage of the site is limited; however, the permanent loss is anticipated to adversely affect the panthers in the action area by decreasing the spatial extent of lands available for hunting, breeding, and dispersing. This loss of about 809.83 acres of panther habitat represents 0.04 percent of the 1,962,294 acres of available non-urban private lands in the core area. This loss of non-urban private lands on the western edge of the panther's range is small and will not significantly alter the Service's land conservation and preservation goals.

Compensation: The project will provide for the preservation of about 1,276.97 acres of Primary Zone habitat. The value of the habitats to the panther will be maintained long-term through hydrological restoration and the removal of exotic vegetation. The preservation of these lands in the panther core area represents 0.16 percent of the 799,205 acres of private lands still needed for the population of 90 individuals.

The proposed compensation plan, which provides habitat preservation and restoration inside and outside the project action area, benefits the survival and recovery of the Florida panther as referenced in the Panther Recovery Plan (Service 2008) goal 1.1.1.2.3. This goal recommends that habitat preservation and restoration within the Primary Zone be provided in situations where land use intensification cannot be avoided. The applicant has proposed sufficient habitat protection and restoration, to compensate for both the quantity and value of the lost habitat.

Fragmentation: The project site is also located on the western edge of occupied habitat, is adjacent to other existing and proposed development, and is not located within known dispersal corridors to larger publicly owned managed lands important to the panther. Therefore, fragmentation of panther habitat is not expected to result from project implementation.

Intraspecific Aggression: Potential increases in intraspecific aggression and disturbance to the Florida panther were evaluated. The Service believes, as previously discussed, the habitat on the property provides reduced foraging for prey species, which directly affects the frequency and duration of use of the property by panthers. The risk to the panther from increases in intraspecific aggression as a result of the Mirasol project is difficult to quantify. However, given the limited use of project lands by panthers and no documented panther presence in the development footprint, the risk of increasing intraspecific competition is considered unlikely. Therefore, the relative change or increase in intra-specific aggression among young male panthers as a result of this project is also likely insignificant.

Cumulative Analysis*:* In the cumulative analysis, the Service identified the potential loss of about 4,893 acres annually within the action area that could be developed without Federal review and we believe this level of development represents future non-federal actions. This annual level of development represents a small percentage (0.25 percent of the 1,962,294 acres) of available non-urban private lands in the core area. In general, these lands are primarily within previously impacted areas or are in the western more urbanized portion of the Florida panther's consultation area. Although this small percentage of lands may be lost from the core area of private lands available for panther conservation, the Service believes the loss of these lands will not significantly diminish the Service's conservation and preservation goals for the panther.

Conservation Land Acquisitions: Additional benefits have resulted from the acquisition of high quality habitat through acquisition programs by the other Federal, State, County, and private organizations. For example, Lee County's Conservation Lands Program, since it's inception in 1995 has purchased a total of 23,820 acres, with the most recent acquisition the 1,213 acres adjacent to the Bob Janes Preserve in eastern Lee County. A similar program in Collier County, the Conserve Collier Program, recently purchased 368 acres adjacent to Corkscrew Sanctuary and also purchased the 2,500-acre Pepper Ranch. As of 2010, conservation lands represent about 67 percent of the lands in Collier County and 31 percent of the lands in Lee County (Florida Natural Areas Inventory (FNAI) 2010). Table 33 provides a representative distribution of land ownerships by county. Many of these lands are located within the primary zone of the Florida panther and are intended to be actively managed for the benefit of many wildlife species including the Florida panther. The preservation of these lands in the panther core area will have a beneficial effect on the panther and further the Service's goals for this species.

Wood Storks

Habitat Loss and Compensation: The project will result in the direct loss of 645.35 acres of onsite wetlands. Any loss of wood stork foraging habitat attributable to the project will be offset by the preservation and enhancement of 831.35 acres of onsite wetlands. However, as we discussed previously, we evaluate wood stork biomass productivity per hydroperiod class and based on our analysis, we believe the project will result in the loss of 17.98 kg of biomass associated with Class 2 hydroperiod wetlands.

Fragmentation: The applicant has proposed about 54.52 acres of wetlands internal to the development that provide foraging to wood storks. These wetlands although available for foraging are only indirectly connected to other larger acreages of wetlands and would be considered fragmented habitat. The applicant's remaining proposed onsite preserve (contiguous acreages of 776.35 acres) is adjacent to existing and proposed preserve areas to the west and east. For these reasons, fragmentation of wood stork habitat is not significant.

Changes in the Mosaic of Hydroperiods: No changes are proposed to the existing hydroperiods within the adjacent onsite preserve and based on data provided by the applicant; the proposed changes to the wetlands in the project footprint will not have an adverse affect on surrounding wetlands. The loss of the 575.66 acres of short hydroperiod wetlands represents about 0.25 percent of the short hydroperiod wetlands in the action area. Long-hydroperiod wetlands in the project footprint total about 69.69 acres. This loss of long hydroperiod wetlands represents about 0.003 percent of the long hydroperiod wetlands in the action area.

Cumulative Analysis: In the cumulative analysis, the Service identified the potential loss of about 773.8 acres of wetlands may be developed without Federal review. Although these wetlands may be impacted by non-federal actions and the productivity as a foraging prey base for wood storks may be affected, we believe based on the status of species discussed previously and the status of the species in the action area, the loss/reduction of foraging value to the wood storks associated with these systems is not significant (0.16 percent) (773.8/481,666=0.0016).

Conservation Land Acquisitions: Additional benefits have resulted from the acquisition of high quality habitat through acquisition programs by the other Federal, State, County, and private organizations. For example, Lee County's Conservation Lands Program, since it's inception in 1995 has purchased a total of 23,820 acres, with the most recent acquisition the 1,213 acres adjacent to the Bob Janes Preserve in eastern Lee County. A similar program in Collier County, the Conserve Collier Program, recently purchased 368 acres adjacent to Corkscrew Sanctuary and also purchased the 2,500-acre Pepper Ranch. As of 2010, conservation lands represent about 67 percent of the lands in Collier County and 31 percent of the lands in Lee County (FNAI 2010). Table 33 provides a representative distribution of conservation land ownerships by county. These lands are intended to be actively managed for the benefit of many wildlife species including the wood stork. The preservation of these lands will have a beneficial effect on the wood stork and further the Service's goals for this species.

CONCLUSION

Florida Panther

In the Environmental Baseline, the Service provided data on previous consultations in the action area for 830 projects which impacted 29,724 acres of panther habitat in south Florida between January 1992 and March 2011. The Service also identified that in the action area, an additional 14 actions, affecting 2,712 acres, may have been developed without the need for a Federal wetland permit. The Service also provided data that consultations have also preserved 28,808 acres of habitat, during the same time frame. The Service also noted the installation of wildlife crossings under SR 29 and I-75 within the action area has also benefited the panther by protecting habitat connectivity and reducing panther-vehicle collision mortalities. The Service also noted projects

associated with the Greater Everglades Restoration Program (CERP) will provide the restoration of more than 55,000 acres of lands to near pre-development conditions in PSRP, the restoration of about 4,000 acres of wetlands to near pre-development conditions in CREW, and the preservation and restoration of 2,781 acres of wetlands and 679.23 acres of uplands associated with the District ERP program. The Service also noted the additional land preservation and restoration actions conducted by Lee and Collier Counties provided for the purchase by Lee County of about 23,820 acres and 2,868 acres by Collier County. In conclusion, actions evaluated in the environmental baseline noted the preservation and restoration 117,823 acres of lands that provide benefit to the Florida panther and also noted the loss of 27,280 acres.

Data in the Environmental Baseline also noted that in the same watershed as the proposed project, the Service, since 2003 has provided formal consultations on three projects that have adversely affected panther habitat (Bonita Beach Road, Parklands, and Terafina). These projects impacted 1,967 acres of lands that formerly supported a mosaic of habitats that provided foraging for panther prey species and hunting and dispersal habitat to panthers. The Service also noted existing habitat value to panther prey species (deer and hog) was diminished by varying levels of exotic species, which reduced the quantity and quality of foraging food base for these prey species.

The Service also noted 1,921 acres of lands were preserved and restored to conditions that improved the quality and quantity of forage for panther prey species and the habitat of the Florida panther. In addition, the proposed 1,921 acres of companion preserve lands are interconnected to each other and to the adjacent CREW. These interconnected preserves provide greater access and facilitate panther and panther prey movement in and out of adjacent publicly owned lands and provide refugia for dispersing panthers. The Service concluded in all of the biological opinions for these projects, they will not jeopardize the survival and recovery of the Florida panther; the proposed compensation plans provide habitat preservation and restoration within and near the project area; and that the compensation plans benefits the survival and recovery of the Florida panther as referenced in the Panther Recovery Plan (Service 2008) goal 1.1.1.2.3. This goal recommends habitat preservation and restoration within the Primary Zone be provided in situations where land use intensification can not be avoided. The applicants have proposed sufficient habitat protection and restoration, to compensate for both the quantity and functional value of the lost habitat.

In the Service's discussion of the direct and indirect effects from the proposed Mirasol development, the Service noted that direct effects would occur from the loss of 809.83 acres of lands that provide benefit to Florida panthers and panther prey. The Service also noted existing habitat value to panther prey species (deer and hog), has been reduced and was degraded by varying levels of exotic species infestations that also reduced the quantity and quality of foraging food base for these prey species. The Service also noted about 903.66 acres of adjacent lands will be preserved and restored. In addition, off site acreage of about 355.00 acres will be preserved and restored to benefit both the Florida panther and its prey. The combined restoration associated with the proposed development is about 1,276.97 acres.

The 903.66 acres onsite and the 373.31 acres off site of preserved and restored lands are interconnected to each other and to the adjacent CREW. These interconnected preserves provide greater access and facilitate panther and panther prey movement in and out of adjacent publicly

owned lands and provide refugia for dispersing panthers. The Service's Panther Recovery Plan (Service 2008) goal 1.1.1.2.3 recommends habitat preservation and restoration within the Primary Zone be provided in situations where land use intensification can not be avoided. The Service believes the applicant has proposed sufficient habitat protection and restoration, to compensate for both the quantity and functional value of the lost habitat.

In our assessment of indirect effects, we provided an analysis of habitat fragmentation, risk of roadway mortality, panther/human interactions, and intraspecific aggression. In our discussion of habitat fragmentation, we noted that the proposed project is in an area of increased development pressure and the habitats onsite have been degraded by exotic plants. We also noted no occurrences of panthers have been reported in the proposed development site although presence has been documented on public preserves adjacent to the proposed project. The Service concluded that based on local site conditions, level of development of surrounding lands, habitat impacts and lack of connectivity to wildlife corridors, that habitat fragmentation would not be significant. We anticipate any resident panthers with home ranges overlapping or in the vicinity of the project area will adjust the size and location of their ranges to account for this loss and disturbance and that adjustment is anticipated to occur in concert with project construction.

In our assessment of the risk to panthers from collision with vehicles, we noted that about 80 percent of the projected traffic would be to and from the west into more urban settings and not into more rural portions of the action area. We also noted that the proposed increase over base traffic is about 13 percent for existing roads into the urban area and about 3 percent on road into the more rural portions of the action area. The risk to the panther from collisions with vehicles as a result of the Mirasol project is difficult to quantify. However, the Service believes that the increase in traffic generated by the project may potentially contribute to mortality of panthers in the action area. Historical records of traffic mortality within a 10 mile radius of the project notes the mortality of an average of one panther per year with the closest mortality occurring 4.7 miles southeast of the project.

We also provided an analysis of panther/human interactions and intraspecific aggression. Historical records of documented use of the development lands note limited use by panthers. In addition, as part of the project design, stormwater retention lakes, golf course fairways, and companion buffer strips provide physical separation of residential parcels from adjacent preserve lands. The applicant has also committed to provide additional wildlife deterrent fencing in locations of potential human/panther conflicts, primarily at potential wildlife access points (drainage easements). Based on the above, the Service concluded that panther/human interactions are insignificant.

In our analysis of intraspecific aggression, we noted that the project lands historical telemetry data demonstrated limited panther use and based on the current level of surrounding urban development and habitat value to panther prey species, the risk of increasing intraspecific competition from the loss of 809.83 acres is considered unlikely. Therefore, the relative change or increase in intra-specific aggression among young male panthers as a result of this project is also likely insignificant.

In our cumulative assessment, we noted a potential loss of about 4,893 acres annually within the project action area. This loss represents a small percentage (0.25 percent) of the available non-urban private lands in the core area. Based on the acquisition programs discussed above and in the environmental baseline, and the companion compensation lands associated with federally permited projects, the Service believes this loss will not significantly alter the Service's conservation and preservation goals for the Florida panther.

In conclusion, the Service believes there will be no direct take in the form of mortality or injury of the Florida panther resulting from this project. However, the increase in traffic and potential increase in intraspecific aggression in the action area as a result of the project may adversely affect the Florida panther. We also note that although 809.83 acres of lands that provide benefit to the Florida panther will be lost, the proposed compensation lands (1,276.97 acres) benefit the survival and recovery of the Florida panther as referenced in the Panther Recovery Plan (Service 2008) goal 1.1.1.2.3. This goal recommends habitat preservation and restoration within the Primary Zone be provided in situations where land use intensification can not be avoided. The applicant has proposed sufficient habitat protection and restoration, to compensate for both the quantity and functional value of the lost habitat. Taking all of the above into consideration, the Service believes the proposed Mirasol project is not likely to jeopardize the continued existence of the Florida panther. Critical habitat has not been designated for this species; therefore, none will be affected.

Wood Storks

In the Environmental Baseline, the Service provided data on previous consultations in the action area for 825 projects, which impacted 4,872 acres of wetlands in south Florida since January 1992 through March 2011. The Service also identified that in the action area, an additional 293 non-federal actions, affecting 468 acres, may have been developed without Federal review. The Service also provided data that consultations have also preserved 20,104 acres of habitat, during the same time frame. The Service also noted that projects associated with CERP also provided restoration of more than 55,000 acres of lands to near pre-development conditions in PSRP, the restoration of about 4,000 acres of wetlands to near pre-development conditions in CREW, and the preservation and restoration of 2,781 acres of wetlands and 679.23 acres of uplands lands associated with the District through their ERP program. In addition, the Service noted that land preservation and restoration actions conducted by Lee and Collier Counties provided for the purchase of 23,820 acres by Lee County and 2,868 acres by Collier County. In conclusion, actions evaluated in the environmental baseline noted the preservation and restoration of about 108,573 acres of a combination of wetlands and uplands that provide benefit to the wood stork and other wetland and upland dependent species and also noted the loss of about 5,340 acres.

In the same watershed as the proposed project, the Service, since 2003, has provided formal consultations on five projects that have impacted wood stork foraging habitat (Bonita Beach Road, Forum, Cypress Run, Parklands, andTerafina). These projects directly and indirectly affected 2,269 acres of wetlands that prior to development supported a mosaic of wetland habitats that provided foraging biomass to wood storks. The Service also exempted incidental take productivity associated with 66 nests. Although the Service has noted a reduction in wood stork productivity of 66 nests; the estimated loss is based on a reduction of foraging biomass in wetlands readily

available for wood stork foraging. However, as previously discussed, the listed project wetlands were degraded by exotic species and because of this, the estimated productivity loss is considered a conservative estimate. The Service also noted this wetland impact represents a loss of about 1.7 percent of the available short hydroperiod wetlands within the core foraging areas of the affected rookeries.

The companion conservation lands (2,019 acres of wetlands) will be preserved and restored to conditions that impoved the quality and quantity of forage prey base for the wood stork. Although the restoration benefits to wood stork nest productivity were not quantified for these projects, we provided, based on our biomass assessment methodology, an evaluation of this restoration. We noted the 2,269-acre wetland loss provides a biomass foraging base of 13,266 kg or 5.85 kg per acre. We also noted the 2,019 acres of preserved wetlands, prior to restoration, provided a foraging base of 11,812 kg and following restoration would provide a biomass foraging base of 31,892 kg or 15.76 kg per acre. We concluded in our assessment, that although a loss of wetlands would occur in the core foraging areas of the affected rookeries, the proposed preservation and restoration would provide an overall increase in biomass. The existing foraging base available to wood storks is expected to increase above base by an estimated increase of 6,814 kg (31,892 - 11,812 - 13,266 = 6,814).

In our discussion of the direct and indirect effects from the proposed action, the Service noted that direct effects would occur from the loss of 645.35 acres of wetlands with 575.66 acres representing short hydroperiods and 69.69 acres representing long hydroperiods. The wetland losses are within the core foraging area of the Corkscrew Sanctuary rookeries and the wetland loss represents about 0.42 percent (575.66 / 137,269 = 0.0042) of the short and 0.06 percent (69.69 / 122,444 = 0.00059) of the long hydroperiods of the affected rookeries. We noted in our assessment that these wetlands, based on existing hydrology and exotic species density (stem density), provide a combined biomass foraging value to wood storks of about 190.06 kg. A companion component of the Mirasol project, about 831.35 acres of onsite and adjacent lands will be preserved and restored. The Service noted that prior to restoration these lands provided biomass foraging benefit of 660.18 kg and following restoration (primarily exotic species removal) a foraging benefit of 2,842.05 kg, a net increase of 2,181.87 kg over baseline biomass in the preserves. Our summary assessment across all hydroperiods and including both the biomass losses from the impacted wetlands and the biomass gains from the restored wetlands resulted in a net increase of 1,991.81 kg with individual hydroperiod showing positive gains with the exception of hydroperiod 2 that received a net loss of 17.98 kg or the loss of the productivity of 0.4 nest. Our discussion of direct and indirect effects noted that an additional off site acreage of about 373.31 acres will also be preserved and restored primarily to benefit the Florida panther. However, these lands also include wetland acreages that, following restoration, will also provide additional foraging biomass to wood storks.

In our environmental baseline and in our direct and indirect effects discussions, we note the Mirasol project is also in the same watershed as the five listed projects in the environmental baseline and in the core foraging area of the Corkscrew Sanctuary rookeries. We have incorporated the wetland loss estimates, estimates of incidental take, and estimates of restoration lands into the summary table provided in the Environmental Baseline, Table 34.

Following the assessment provided in the Environmental Baseline, the addition of the Mirasol development to the previous projects resulted in a loss from an existing base of 2,269 acres to a loss of 2,914 acres (2,269 + 645 = 2,914) with a corresponding biomass of 17,047 kg (2,914 * 5.85 = 17,047). The restoration lands increased from 2,019 acres to 2,850.35 acres (2,019 + 831.35 = 2850.35) with a corresponding biomass base increase to 16,672.5 kg (2,850.35 * 5.85 = 16,672.5). Following restoration the biomass increased to 44,916 kg (2,850*15.76=44,916). We also note that the summed wetland losses represents about 2.13 percent (2,914 / 137,269 = 0.0213) of the short hydroperiod wetlands in the core foraging area of the Corkscrew Sanctuary rookeries. Although a loss of wetlands occurs in the core foraging areas of the affected rookeries, the proposed preservation and restoration provides an increase in biomass and the existing foraging base available to wood storks is expected to increase above base by 11,196.5 kg (44,916 - 16,672 - 17,047 = 11,196.5).

We also provided an assessment of the three most recent projects, the project under review, *i.e.*, Mirasol, and Terafina, and Parklands, as these projects are adjacent to each other and were also assessed with the current wood stork biomass methodology. The data show that across all hydroperiods, the projects with proposed restoration, would provide an overall increase in biomass for both short and long hydroperiods and that individually, only a loss occurs in hydroperiod 2, which is associated with the Mirasol project, Table 35.

In our cumulative assessment, we noted a potential loss of about 773.8 acres annually within the project action area. This loss represents a small percentage (0.16 percent) (773.8 / 48,666 = 0.0016) of all wetlands available to wood storks in the three CFAs. Based on the acquisition programs discussed above and in the environmental baseline, the Service believes this loss of lands from the core foraging areas of the three wood stork rookeries is not significant.

In conclusion, the Service believes there will be no direct take in the form of mortality or injury of wood storks resulting from this project. The proposed restoration will provide a net increase of 1,991.81 k grams of biomass across all hydroperiods. However, on an individual hydroperiod basis, the project development will result in the loss of 17.98 kgrams of biomass associated with a Class 2 hydroperiod. All the other hydroperiod classes show an increase in the biomass available for wood stork foraging following enhancement of the wetland preserves.

After reviewing the status of 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 development of the Mirasol project, as proposed, is not likely to jeopardize the continued existence of the wood stork. No critical habitat has been designated for this species; therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. "Take" is defined as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct." "Harm" is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly

impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking, that is incidental to and not intended as part of the agency action, is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The terms and conditions described below are nondiscretionary and must be undertaken by the Corps so they become binding conditions of any grant or permit issued to IM Collier Joint Venture, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require IM Collier Joint Venture, to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protection coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps or IM Collier Joint Venture, 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)].

AMOUNT OF TAKE

Florida Panther

The Service anticipates incidental take of the Florida panther will be difficult to detect for the following reasons: (1) the Florida panther is wide-ranging; (2) the lands on the project site provide limited value to the Florida panther and panther prey species; and (3) lands adjacent to the project site consist of existing and proposed urban development that reduce their suitability for use by either resident or dispersing panthers. Therefore, the Service does not anticipate construction of the project will result in the direct mortality or injury of any Florida panthers. However, the Service anticipates indirect take of the panther in the form of harassment and harm due to potential increases in traffic and interspecific aggression within the 25-mile radius action area. Traffic and interspecific aggression are risks to the panther that are cumulative in nature, and, as such, they are difficult to quantify or to tie to any specific project.

Although there is a potential for indirect take to occur as described above, we believe that the level of incidental take resulting from the loss of 809.83 acres of panther habitat within the Primary Zone is moderated by the preservation and enhancement of 1,276.97 acres of panther habitat in the Primary Zone. The impact areas have an equivalent loss of 3,884.12 PHUs; which, once the 2.5 base multiplier is applied, results in a recommended compensation value of 9,710.30 Primary Zone equivalent PHUs, which has been provided by the applicant in their compensation and mitigation proposal (Table 16).

The loss of 809.83 acres of panther habitat is equivalent to 2.76 percent of a female panther's home range (29,056 acres) and 1.3 percent of a male panther's home range (62,528 acres). Since the acreage being lost is at the edge of urbanization and equates to a fraction of a panther's home

range, and given the proposed mitigation is providing panther habitat value over and above what is being lost, the Service believes that the level of incidental take exempted by this permit will not result in jeopardy of the species.

Wood Storks

The Service anticipates incidental take of wood storks will be difficult to detect for the following reasons: (1) wood storks forage over a wide area; (2) the CFA includes all wetlands within 18.6 miles (30 km) of the colony site; and (3) losses in nesting productivity may be masked by seasonal fluctuations in numbers based on other natural causes affecting food availability, such as drought or flooding, which will also affect foraging efficiency and nesting success. However, based on the analysis provided in this biological opinion, we estimate take of less than one nest (0.4 nest) from biomass losses associated with Class 2 hydroperiod wetlands. Across all hydroperiods, the proposed action with mitigation is estimated to provide an increase of 18.8 nests associated with short hydroperiod wetlands, and 7.0 nests associated with long hydroperiod wetlands, with a combined increase of 1,991.81 kg of foraging biomass (Table 32).

The 1,991.81 kg of biomass represents 939.57 kg of short hydroperiod and 1,052.24 kg of long hydroperiod biomass productivity. Since we believe, in general, short hydroperiod wetlands are important limiting factors in the action area, the proposed action, with its preserve enhancements, is estimated to provide a net increase in nest productivity associated with short hydroperiod wetlands of about 18.8 nests over base conditions (939.57 / 50 = 18.8). We also note a corresponding increase of 1,052.24 kg of long hydroperiod wetland biomass corresponding to an increase in nest productivity of 7.0 nests (1,052.24 / 151 = 7.0).

In addition to direct effects, increases in foraging opportunities resulting from the proposed action may also decrease the likelihood that non-nesting wood storks will compete for prey with nesting wood storks. Because we cannot reliably predict the degree of competition or the number of non-nesting storks that forage in this area, we are unable to quantify any incidental take resulting from competition. The Service will not refer the incidental take of any migratory bird or bald eagle for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703-712), or the Bald Eagle Protection Act of 1940, as amended (16 U.S.C. 668-668d), if such take is in compliance with the terms and conditions (including amount and/or number) specified herein.

EFFECT OF TAKE

In the accompanying biological opinion, the Service determined this level of anticipated take is not likely to result in jeopardy to listed species or destruction or adverse modification of critical habitat to either species.

REASONABLE AND PRUDENT MEASURES

The Service believes the Corps and the applicant have developed a project that has conservation measures necessary and appropriate to minimize the effect of incidental take of the Florida panther and wood stork. In summary, to compensate for impacts to 809.83 acres of habitat, IM Collier Joint Venture proposes to enhance and preserve 903.66 acres on the project site, 291.10 acres offsite and about 82.21 acres of habitat associated with 27.68 mitigation bank credits at PIMB in Collier County, for a total preservation proposal of 1,276.97 acres. The applicant has also

provided mitigation and monitoring plans that include management actions and the establishment of escrow funds for perpertual management of the mitigation lands. Annual reports to the Service are a component of the management plans.

To minimize take of wood storks and panthers, the Service considers it necessary and appropriate to collect hydrological and biological data referenced in the preserve mitigation plans to ensure hydrological and habitat impacts do not occur to the preserves.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures, described above and outline reporting/monitoring requirements. The terms and conditions described below are non-discretionary, and must be undertaken by the Corps so they become binding conditions of any grant or permit issued to IM Collier Joint Venture, as appropriate, for the exemption in section 7(o)(2) to apply.

The Corps has a continuing duty to regulate the activity covered by this Incidental Take Statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require IM Collier Joint Venture, to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the permit or grant document, the protection coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps or IM Collier Joint Venture, 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)).

1. The preservation sites will be managed in perpetuity for the control of invasive exotic vegetation as defined by the Florida Exotic Pest Plant Council's Pest Plant List Committee's 2001 List of Invasive Species (Category 1)(2005) and managed for the benefit of the Florida panther and wood stork in accordance to the management and monitoring plans provided as part of this action;

2. The method of preservation for the proposed mitigation parcels shall be a conservation easement for the 903.66 acres onsite and the 291.10 acres elsewhere in the panther primary zone. Once the exotic vegetation has been removed and the native vegetation restored, the lands are to be donated to CREW or another appropriate public entity for perpetual preservation. In addition to the donation of the property to an appropriate public entity, the applicant will also establish an escrow fund for the long-term maintenance of the preserve. The amount of the escrow fund will be determined at the time the preserves are turned over and based on the expected long-term maintenance requirements. However, until such time as that may happen, the entirety of the preserves shall be placed into conservation easements, and enforcement right shall be granted to the District, Corps, and Collier County. The conservation easement for these areas will be filed and recorded within 1 year after the initial clearing activities associated with the project are started. It is also the responsibility of the applicant to reach the success criteria outlined in the Mirasol Mitigation and Monitoring Plans before donation and maintain the preserve until donation.

3. The Corps will provide a copy of the final permit to the Service upon issuance. The Corps will monitor the permit conditions regarding conservation measures to minimize incidental take of panthers and wood storks by providing the Service a report on implementation and compliance with the conservation measures within 1 year of the issuance date of the permit;

4. The Corps will provide documentation to the Service of all proposed onsite and off site restoration and verification of the execution and terms of the conservation easements within 1 year of completion of the restoration;

5. Upon locating a dead, injured, or sick threatened or endangered species, initial notification must be made to the nearest Service Law Enforcement Office; Fish and Wildlife Service; 9549 Koger Boulevard, Suite 111; St. Petersburg, Florida 33702; 727-570-5398. Secondary notification should be made to the FWC; South Region; 3900 Drane Field Road; Lakeland, Florida; 33811-1299; 1-800-282-8002; and

   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 individuals or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Corps' administration of the Federal CWA section 404 permit program provides direct benefit to the wood stork and indirect benefit to the Florida panther. The Federal permit program generally requires compensation of wetland function loss through enhancement of wetland function of similar type of wetlands within the same watershed. The enhancements may include exotic species removal, hydrological restoration, and funding for longterm management of the compensation wetlands. In many projects, the compensation lands are located adjacent to other preserved lands, thus providing preservation of additional habitat and protection of wildlife corridors.

In addition, the Service in 2000, in coordination with the Corps, developed the Florida panther SLOPES (Service 2000b). The Florida panther SLOPES include a focus area map that identifies an action area where the Service believes land alteration projects may affect the Florida panther. This document also provides guidance to the Corps and permit applicants for assessing project affects to the Florida panther and provides recommended actions to minimize these effects.

The Service, in 2007, with assistance from the Corps, developed the Wood Stork Slopes and Effect Determination Key (Service 2007), which was updated in 2010 (Service 2010). The document

provides guidance to the Corps for effect determinations for the wood stork and guidance to the Corps and permit applicants on methods to measure foraging biomass changes associated with loss and restoration of wetlands, including assessments of hydrological changes and exotic species densities.

The Service is not proposing any further conservation recommendations.

REINITIATION NOTICE

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

Thank you for your cooperation and effort in protecting fish and wildlife resources. If you have any questions regarding this project, please contact Allen Webb at 772-469-4246.

Sincerely yours,

Spencer Simon
Acting Field Supervisor
South Florida Ecological Services Office

cc: electronic only
Corps, Fort Myers, Florida (Skip Bergman)
EPA, West Palm Beach, Florida (Ron Meidema)
FWC, Naples, Florida (Darrell Land)
FWC, Tallahassee, Florida (FWC-CPS, Mary Ann Poole, Traci Wallace)
FWC, Tallahassee, Florida (Kipp Frohlich)
Service, Atlanta, Georgia (Ken Graham)
Service, Florida Panther NWR, Naples, Florida (Kevin Godsea)

LITERATURE CITED

Ackerman, B. B., F. G. Lindzey, and T. P. Hemker. 1986. Predictive energetics model for cougars. Pages 333-352 in S. D. Miller and D. D. Everett (eds). Cats of the world: biology, conservation, and management. National Wildlife Federation and Caesar Kleberg Wildlife Research Institute, Washington, D. C. and Kingsville, TX.

Acosta, C.A. and S.A. Perry. 2002. Spatio-temporal variation in crayfish production in disturbed marl prairie marshes of the Florida Everglades. Journal of Freshwater Ecology 17(4):641-650.

Akçakaya, H.R. 2002. RAMAS GIS: Linking spatial data with population viability analysis (version 4.0). Applied Biomathetics, Setauket, New York.

American Ornithologists Union. 1983. Checklist of North American birds. Sixth Edition. American Ornithologists Union; Baltimore, Maryland.

Anderson, A.E. 1983. A critical review of literature on puma (*Felis concolor*). Special Report No. 54. Colorado Division of Wildlife, Fort Collins, Colorado.

Audubon. 2010. Wood Stork Nesting Data. Web site. http://www.corkscrew.audubon.org/Wildlife/Birds/Nesting_Data.html

Ballou, J.D., T.J. Foose, R.C. Lacy, and U.S. Seal. 1989. Florida panther (*Felis concolor coryi*) population viability analysis and recommendations. Captive Breeding Specialist Group, Species Survival Commission, IUCN, Apple Valley, Minnesota.

Bangs, O. 1899. The Florida puma. Proceedings of the Biological Society of Washington 13:15-17.

Beier P., M.R. Vaughan, M.J. Conroy, and H. Quigley. 2003. An analysis of scientific literature related to the Florida panther. Final report, Project NG01-105, Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

Beier P., M.R. Vaughan, M.J. Conroy, and H. Quigley. 2006. Evaluating scientific inferences about the Florida panther. Journal of Wildlife Management.

Beier, P. 1995. Dispersal of juvenile cougars in fragmented habitat. Journal of Wildlife Management 59:228-237.

Beissinger, S.R. and M.I. Westphal. 1998. On the use of demographic models of population viability in endangered species management. Journal Wildlife Management 62:821-841.

Belden, R.C. 1986. Florida panther recovery plan implementation - a 1983 progress report. Pages 159-172 *in* S.D. Miller and D.D. Everett (eds). Cats of the world: biology, conservation, and management. National Wildlife Federation and Caesar Kleberg Wildlife Research Institute, Washington, D.C. and Kingsville, Texas.

Belden, R.C. 1988. The Florida panther. Pages 515-532 *in* Audubon Wildlife Report 1988/1989. National Audubon Society, New York, NY.

Belden, R.C., and R.T. McBride. 1983a. Florida panther surveys - Big Cypress National Preserve. Final report to Hughes and Hughes Oil and Gas Company.

Belden, R.C., and R.T. McBride. 2005. Florida panther peripheral areas survey final report 1998-2004. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

Belden, R.C., W.B. Frankenberger, and J.C. Roof. 1991. Florida panther distribution. Final Report 7501, E-1 II-E-1. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

Belden, R.C., W.B. Frankenberger, R.T. McBride, and S.T. Schwikert. 1988. Panther habitat use in southern Florida. Journal of Wildlife Management 52:660-663.

Benson, J.F., M.A. Lotz, and D. Jansen. 2008. Natal den selection by Florida panthers. Journal of Wildlife Management 72:405-410.

Benson, J.F., J.A. Hostetler, D.P. Onorato, W.E. Johnson, M.E. Roelke, S.J. O'Brien, D. Jansen, and M.K. Oki. 2009. Chapter 2: Survival and cause-specific mortality of sub-adult and adult Florida panthers. Pages 10 – 61 *in* J.A. Hostetler, D.P. Onorato, and M.K. Oli, (eds). Population ecology of the Florida panther. Final report submitted to Florida Fish and Wildlife Conservation Commission and U. S. Fish and Wildlife Service.

Bent, A.C. 1926. Life histories of North American marsh birds. U.S. National Museum Bulletin 135; Washington, D.C.

Berglund, F. and M. Berlin. 1969. Risk of methylmercury cumulation in man and mammals and the relation between body burden of methylmercury and toxic effects. *In* M. W. Miller and G. G. Berg (eds). Chemical fallout. Charles C. Thomas, Springfield, IL.

Beyer, D.E., Jr., and J.B. Haufler. 1994. Diurnal versus 24-hour sampling of habitat use. Journal of Wildlife Management 58:178-180.

Borkhataria, R., P. Frederick, and B. Hylton. 2004. Nesting success and productivity of South Florida wood storks in 2004. Unpublished report to the U.S. Fish and Wildlife Service, Jacksonville, Florida.

Borkhataria, R.R., P.C. Frederick, and A.L. Bryan, Jr. 2006a. Use of the Lake Belt by Juvenile Wood Storks (*Mycteria americana*) equipped with satellite transmitters report.

Borkhataria, R., P.C. Frederick, and A.L. Bryan. 2006b. Analysis of wood stork (*Mycteria americana*) locations in Florida and throughout the southeast from satellite transmitters and band returns. Unpublished report to the U.S. Fish and Wildlife Service

Brook, B. 2000. Pessimistic and optimistic bias in population viability analysis. Biology Conservation 14:564-566.

Brook, B.W., L. Lim, R. Harden, and R. Frankham. 1997. Does population viability analysis software predict the behaviour of real populations? A retrospective study of the Lord Howe Island Woodhen Tricholimnas sylvestris (Sclater). Biology Conservation 82:119-128.

Browder, J.S. 1978. A modeling study of water, wetlands, and wood storks. *In* Wading Birds. A. Sprunt IV, J.C. Ogden, and S. Winckler (Eds). National Audubon Society. Research Report Number 7: 325-346.

Browder, J.S. 1984. Wood stork feeding areas in southwest Florida. Florida Field Naturalist 12:81 96.

Browder, J.S., C. Littlejohn, and D. Young. 1976. The Florida Study. Center for Wetlands, University of Florida, Gainesville, and Bureau of Comprehensive Planning, Florida Department of Administration, Tallahassee.

Brower, J.E., J.H. Zar, and C.N. von Ende. 1990. Analysis of Communities (unit 5). In: Field and Laboratory Methods for General Ecology. Third Edition, K. Kane (Ed.). Wm. C. Brown Publishers, Dubuque, Iowa.

Brown, M.A., M.W. Cunningham, A.L. Roca, J.L. Troyer, W.E. Johnson, and S.J. O'Brien. 2008. Genetic characterization of Feline Leukemia Virus from Florida panthers. Emerging Infectious Diseases 14:252-259.

Bryan, A.L., Jr. and M.C. Coulter. 1987. Foraging characteristics of wood storks in East-Central Georgia, U.S.A. Colonial Waterbirds 10(2):157-161.

Bryan, A.L., Jr., M.C. Coulter, and C.J. Pennycuick. 1995. Foraging strategies and energetic costs of foraging flights by breeding wood storks. The Condor 97(1):133-140.

Bryan, A.L., Jr. and J.C. Gariboldi. 1997. Foraging of nestling wood storks in Coastal Georgia, U.S.A. Colonial Waterbirds 21(2):152-158.

Bryan, A.L., Jr. and J.R. Robinette. 2008. Breeding success of wood storks nesting in Georgia and South Carolina. *In* L.W. Walker and H. Rauschenberger, eds., Proceedings of the Wood Stork Ecology Workshop, October 15, 2005, Jekyll Island, Georgia. Waterbirds Special Edition.

Burger, J., J.A. Rodgers, Jr., and M. Gochfeld. 1993. Heavy metal and selenium levels in endangered woods storks Mycteria americana from nesting colonies in Florida and Costa Rica. Arch. Environ. Contam. Toxicol. 24:417-420.

Carlson, J.E. and M.J. Duever. 1979. Seasonal fish population fluctuation in south Florida swamps. Proceedings of Annual Conference of Southeastern Association of Fish and Wildlife Agencies 31: 603-611.

Ceilley, D.W. and S.A. Bortone. 2000. A survey of freshwater fishes in the hydric flatwoods of flint pen strand, Lee County, Florida. Proceedings of the 27th Annual Conference on Ecosystems Restoration and Creation, 70-91. Hillsborough Community College.

Ceilley, D.W., G.G. Buckner II, J.R. Schmidt, and B.W. Smith. 2005. A survey of the effects of invasive exotic vegetation on wetland functions: aquatic fauna and wildlife. Final report prepared for the Charlotte Harbor National Estuary Program, Fort Myers, Florida.

Chapman, P. and K. Warburton. 2006. Post flood movements and population connectivity in gambusia (*Gambusia holbrooki*). Ecology of Freshwater Fish. 15:357-365.

Chick, J.H., S. Coync, and J.C. Trexler. 1999. Effectiveness of airboat electrofishing for sampling fishes in shallow, vegetated habitats. North American Journal of Fisheries Management 19: 957-967.

Chick, J.H., C.R. Ruetz, III, and J.C. Trexler. 2004. Spatial Scale and abundance patterns of large fish communities in freshwater marshes of the Florida Everglades. Wetlands. 24 (3):652-644. American Journal of Fisheries Management 19: 957-967.

Clark, E.S. 1978. Factors affecting the initiation and success of nesting in an east-central Florida Wood Stork colony. Proceedings of the Colonial Waterbird Group 2: 178-188.

Clark J.D., D. Huber, and C. Servheen. 2002. Bear reintroductions: lessons and challenges. Ursus 13:335-345.

Comiskey, E.J., A.C. Eller, Jr., and D.W. Perkins. 2004. Evaluating impacts to Florida panther habitat: how porous is the umbrella? Southeastern Naturalist 3:51-74.

Comiskey, E.J., L.J. Gross, D.M. Fleming, M.A. Huston, O.L. Bass, Jr., H. Luh, and Y. Wu. 1994. A spatially-explicit individual-based simulation model for Florida panther and white-tailed deer in the Everglades and Big Cypress landscapes. Pages 494-503 *in* D. Jordan (ed). Proceedings of the Florida Panther Conference. U.S. Fish and Wildlife Service, Gainesville, Florida.

Comiskey, E.J., O.L. Bass, Jr., L.J. Gross, R.T. McBride, and R. Salinas. 2002. Panthers and forests in south Florida: an ecological perspective. Conservation Ecology 6:18.

Cone, W.C. and J.V. Hall. 1970. Wood ibis found nesting in Okeefenokee Refuge. Oriole 35:14.

Cook, M.I. and E. M. Call. 2005. South Florida Wading Bird Report, Volume 10. Unpublished Report, South Florida Water Management District. September 2005.

Cook, M.I. and H.K. Herring. 2007. South Florida Wading Bird Report, Volume 13, October 2007. South Florida Water Management District, West Palm Beach, Florida.

Cook, M.I. and M. Kobza. 2008. South Florida Wading Bird Report, Volume 14, November 2008. South Florida Water Management District, West Palm Beach, Florida.

Cook, M.I. and M. Kobza. 2009. South Florida Wading Bird Report, Volume 15, November 2009. South Florida Water Management District, West Palm Beach, Florida.

Cory, C.B. 1896. Hunting and fishing in Florida. Estes and Lauriat, Boston, Massechusettes.

Coulter, M.C. 1987. Foraging and breeding ecology of wood storks in East-Central Georgia. Pages 21-27 *in* R.R. Odom, K.A. Riddleberger, and J.C. Ozier, eds. Proceedings of the Third Southeastern Nongame and Endangered Wildlife Symposium. Georgia Department of Natural Resources, Game and Fish Division.

Coulter, M.C. and A.L. Bryan, Jr. 1993. Foraging ecology of wood storks (*Mycteria americana*) in east central Georgia: Characteristics of foraging sites. Colonial Waterbirds 16:59-70.

Coulter, M.C., J.A. Rodgers, J.C. Ogden, and F.C. Depkin. 1999. Wood stork (*Mycteria americana*). *In* The Birds of North America, No. 409 9. A. Poole and F. Gill, eds. The Birds of North America, Inc., Philadelphia, PA.

Cox J., R. Kautz, M. MacLaughlin, and T. Gilbert. 1994. Closing the gaps in Florida's wildlife habitat conservation system. Florida Game and Fresh Water Fish Commission, Tallahassee, FL.

Cox, J.J., D.S. Maehr, and J.L. Larkin. 2006. Florida panther habitat use: New approach to an old problem. Journal of Wildlife Management 70:1778-1785.

Crozier, G.E. and D.E. Gawlik. 2003. South Florida Wading Bird Report, Volume 9. Unpublished report, South Florida Water Management District. November 2003.

Crozier, G.E. and M.I. Cook. 2004. South Florida Wading Bird Report, Volume 10. Unpublished report, South Florida Water Management District. November 2004.

Culver, M., W.E. Johnson, J. Pecon-Slattery, and S.J. O'Brien. 2000. Genomic ancestry of the American puma (*Puma concolor*). Journal of Heredity 91:186-197.

Culver, M., P.W. Hedrick, K. Murphy, S. O'Brien, and M.G. Hornocker. 2008. Estimation of the bottleneck size in Florida panthers. Animal Conservation (2008):1-7.

Cunningham, M.W. 2005. Epizootiology of feline leukemia virus in the Florida panther. M.S. Thesis. University of Florida, Gainesville, Florida.

Cunningham, M.W., M.A. Brown, D.B. Shindle, S.P. Terrell, K.A. Hayes, B.C. Ferree, R.T. McBride, E.L. Blankenship, D. Jansen, S.B. Citino, M.E. Roelke, R.A. Kiltie, J.L. Troyer, and S.J. O'Brien. 2008. Journal of Wildlife Diseases 44:537-552.

Dahl, T.E. 1990. Wetlands losses in the United States 1780s to 1980s. U.S. Department of the Interior, U.S. Fish and Wildlife Service; Washington, D.C.

Dalrymple, G.H. and O.L. Bass. 1996. The diet of the Florida panther in Everglades National Park, Florida. Bulletin of the Florida Museum of Natural History 39:173-193.

Dees, C.S., J.D. Clark, and F.T. Van Manen. 2001. Florida panther habitat use in response to prescribed fire. Journal of Wildlife Management 65:141-147.

Depkin, F.C., M.C. Coulter, and A.L. Bryan, Jr. 1992. Food of nesting wood storks in East-Central Georgia. Colonial Waterbirds 15(2): 219-225.

Dickson, B.G., J.S. Jenness, and P. Beier. 2005. Influence of vegetation, topography, and roads on cougar movement in Southern California. Journal of Wildlife Management 69:264-276.

Duever, M.J., J.E. Carlson, J.F. Meeder, L.C. Duever, L.H. Gunderson, L.A. Riopelle, T.R. Alexander, R.L. Myers, and D.P. Spangler. 1986. The Big Cypress National Preserve. Research Report 8. National Audubon Society, New York, New York.

Duever, M.J., J.E. Carlson, J.F. Meeder, L.C. Duever, L.H. Gunderson, L.A. Riopelle, T.R. Alexander, R.F. Myers, and D.P. Spangler. 1979. Resource Inventory and Analysis of the Big Cypress National Preserve. Ecosystem Research Unit, National Audubon Society, New York, New York.

Dunbar, M.R. 1995. Florida panther biomedical investigations. Annual performance report. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

Dusi, J.L. and R.T. Dusi. 1968. Evidence for the breeding of the wood stork in Alabama. Alabama Birds 16:14 16.

Fieberg, J. and S.P. Ellner. 2000. When is it meaningful to estimate an extinction probability? Ecology 81:2040-2047.

Fleming, M., J. Schortemeyer, and J. Ault. 1994. Distribution, abundance, and demography of white-tailed deer in the Everglades. Pages 247-274 *in* D. Jordan (ed). Proceedings of the Florida Panther Conference. U.S. Fish and Wildlife Service, Gainesville, Florida.

Fleming, W.J., J.A. Rodgers, Jr., and C.J. Stafford. 1984. Contaminants in wood stork eggs and their effects on reproduction, Florida, 1982. Colonial Waterbirds 7:88-93.

Flemming, D.M., W.F. Wolff, and D.L. DeAngelis. 1994. Importance of landscape heterogeneity to wood storks. Florida Everglades Management 18: 743-757.

Florida Exotic Pest Plant Council's Pest Plant List Committee. 2005. List of Invasive Species. Florida Exotic Pest Plant Council. April 2005. Gainesville, Florida. [online] URL: http://www.fleppc.org/Plantlist/list.htm.

Florida Fish and Wildlife Conservation Commission. 2006a. Annual report on the research and management of Florida panthers: 2005-2006. Fish and Wildlife Research Institute and Division of Habitat and Species Conservation. Naples, Florida.

Florida Fish and Wildlife Conservation Commission. 2006b. Use of least cost pathways to identify key highway segments for panther conservation. Tallahassee, Florida.

Florida Fish and Wildlife Conservation Commission. 2007. Annual report on the research and management of Florida panthers: 2006-2007. Fish and Wildlife Research Institute and Division of Habitat and Species Conservation. Naples, Florida.

Florida Fish and Wildlife Conservation Commission. 2010a. Annual report on the research and management of Florida panthers: 2009-2010. Fish and Wildlife Research Institute and Division of Habitat and Species Conservation. Naples, Florida.

Florida Fish and Wildlife Conservation Commission. 2010b. Statement on estimating panther population size. Tallahassee, Florida. http://myfwc.com/news/resources/fact-sheets/panther-population/

Florida Fish and Wildlife Conservation Commission. 2010c. Statement on capture and collar of male panther near recent calf depredations. Tallahassee, Florida. http://myfwc.com/news/news-releases/2010/november/03/panther/

Florida Fish and Wildlife Conservation Commission. 2011. Mortality data via email transmittal. Fish and Wildlife Research Institute and Division of Habitat and Species Conservation. Naples, Florida.

Florida Natural Areas Inventory. 2010. Acres of conservation lands by county, August 2010. Tallahassee, Florida. http://www.fnai.org/conservationlands.cfm

Forrester, D.J. 1992. Parasites and diseases of wild mammals in Florida. University Press of Florida, Gainesville, Florida.

Forrester, D.J., J.A. Conti, and R.C. Belden. 1985. Parasites of the Florida panther (*Felis concolor coryi*). Proceedings of the Helminthological Society of Washington 52:95-97.

Foster, G.W., M.W. Cunningham, J.M. Kinsella, G. McLaughlin, and D.J. Forrester. 2006. Gastrointestinal helminthes of free-ranging Florida panthers (*Puma concolor coryi*) and the efficacy of the current anthelminic treatment protocol. Journal of Wildlife Diseases 42:402-406.

Frederick, P.C. and K.D. Meyer. 2008. Longevity and size of wood stork (*Mycteria americana*) colonies in Florida as guides for an effective monitoring strategy in the Southeastern United States. Waterbirds 31 (Special Publication 1): 12 -18.

Frederick, P.C., M.G. Spalding, and R. Dusek. 2002. Wading birds as bioindicators of mercury contamination in Florida, USA; annual and geographic variation. Environmental Toxicology and Chemistry 21:163-167.

Gawlik, D.E. 2002. The effects of prey availability on the numerical response of wading birds. Ecological Monographs 72(3): 329-346.

Georgia Department of Natural Resources. 2009. Estimated number of wood stork nest in Georgia reaches a record high. Georgia Department of Natural Resources Press Release. www.highbeam.com/doc/1G1-201034686.html

Glass, C. M., R.G. McLean, J.B. Katz, D.S. Maehr, C.B. Cropp, L.J. Kirk, A.J. McKeirnan, and J.F. Evermann. 1994. Isolation of pseudorabies (Aujeszky's disease) virus from a Florida panther. Journal of Wildlife Diseases 30:180-184.

Hamilton, S. and H. Moller. 1995. Can PVA models using computer packages offer useful conservation advice? Sooty shearwaters Puffinus griseus in New Zealand as a case study. Biological Conservation 73:107-117.

Harlow, R.F. 1959. An evaluation of white tailed deer habitat in Florida. Florida Game and Fresh Water Fish Commission Technical Bulletin 5. Tallahassee, Florida.

Harlow, R.F., and F.K. Jones. 1965. The white-tailed deer in Florida. Florida Game and Fresh Water Fish Commission Technical Bulletin 9. Tallahassee, Florida.

Harris, L.D. 1984. The fragmented forest: island biogeography theory and the preservation of biotic diversity. University of Chicago Press, Chicago, Illinois.

Harrison, R.L. 1992. Toward a theory of inter-refuge corridor design. Conservation Biology 6:293-295.

Hefner, J.M., B.O. Wilen, T.E. Dahl, and W.E. Frayer. 1994. Southeast wetlands; status and trends, mid-1970s to mid-1980s. U.S. Department of the Interior, Fish and Wildlife Service; Atlanta, Georgia.

Herring, H.K. 2007. Foraging habitat selection modeling and nesting ecology of wood storks in Everglades National Park. Masters Thesis. Florida Atlantic University, Boca Raton, Florida.

Hendrix, A.N. and W.F. Loftus. 2000. Distribution and relative abundance of the crayfishes *Procambarus alleni* (Faxon) and *Procambarus fallax* (Hagen) in southern Florida. Wetlands 20(1):194-199.

Hollister, N. 1911. The Louisiana puma. Proceedings of the Biological Society of Washington 24:175-178.

Hostetler, J.A., D.P. Onorato, and M.K. Oli (eds). 2009. Population ecology of the Florida panther. Final report submitted to Florida Fish and Wildlife Conservation Commission and U. S. Fish and Wildlife Service.

Holt, E.G. 1929. In the haunts of the Wood Ibis. Wilson Bulletin 41:3-18.

Hopkins, M.L., Jr. and R.L. Humphries. 1983. Observations on a Georgia Wood Stork colony. Oriole 48: 36- 39.

Howell, A.H. 1932. Florida bird life. Coward McCann; New York, New York.

Hylton, R.A., P.C. Frederick, T.E. De La Fuente, and M.G. Spalding. 2006. Effects of nestling health on postfledging survival of wood storks. Condor 108:97-106.

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

Janis, M.W., and J.D. Clark. 1999. The effects of recreational deer and hog hunting on the behavior of Florida panthers. Final report to Big Cypress National Preserve, National Park Service, Ochopee, Florida

Janis, M.W., and J.D. Clark. 2002. Responses of Florida panthers to recreational deer and hog hunting. Journal of Wildlife Management 66:839-848.

Jansen, D. 2005. Wildlife Biologist, National Park Service, Big Cypress National Preserve. Ochopee, FL. E-mail to Chris Belden, Cindy Schulz, and Paula Halupa dated September 10, 2005

Jansen, D. K., S.R. Schulze, and A.T. Johnson. 2005. Florida panther (*Puma concolor coryi*) research and monitoring in Big Cypress National Preserve. Annual report 2004-2005. National Park Service, Ochopee, Florida.

Johnson, W. 2005. Personal communication. Wildlife Geneticist, Laboratory of Genomic Diversity, National Cancer Institute, Frederick, MD. Information presented at A Symposium: Conservation Science and The Florida Panther, Insights From Genetic Restoration and Related Research. White Oak Plantation, Yulee, Florida. April 14-17, 2005

Johnson, W.E., D.P. Onorato, M.E. Roelke, E.D. Land, M. Cunningham, R.C. Belden, R. McBride, D. Jansen, M. Lotz, D. Shindle, J. Howard, D.E. Wildt, L.M. Penfold, J.A. Hostetler, M.K. Oli, and S.J. O'Brien. 2010. Genetic restoration of the Florida panther. SCIENCE 329:1641-1645.

Jordan, A.R., D.M. Mills, G. Ewing and J.M. Lyle. 1998. Assessment of inshore habitats around Tasmania for life-history stages of commercial finfish species, Published by Tasmanian Aquaculture and Fisheries Institute, University of Tasmania, Hobart.

Kahl, M.P. 1962. Bioenergetics and growth of nestling Wood Storks. Condor 64:169-183.

Kahl, M.P., Jr. 1964. Food ecology of the wood stork (*Mycteria americana*) in Florida. Ecological Monographs 34:97 117.

Kautz, R.S., and J.A. Cox. 2001. Strategic habitats for biodiversity conservation in Florida. Conservation Biology 15:55-77.

Kautz, R., R. Kawula, T. Hoctor, J. Comiskey, D. Jansen, D. Jennings, J. Kasbohm, F. Mazzotti, R. McBride, L. Richardson, and K. Root. 2006. How much is enough? Landscape-scale conservation for the Florida panther. Biological Conservation.

Kerkhoff, A.J., B.T. Milne, and D.S. Maehr. 2000. Toward a panther-centered view of the forests of south Florida. Conservation Ecology 4:1.

Kushlan, J.A. 1979. Prey choice by tactile foraging wading birds. Proceedings of the Colonial Waterbird Group 3:133 142.

Kushlan, J.A. 1990. Freshwater Marshes. *In* R.L. Myers and J.J. Ewel. Ecosystems of Florida. University of Central Florida, Orlando, Florida.

Kushlan, J.A. and P.C. Frohring. 1986. The history of the southern Florida wood stork population. Wilson Bulletin 98(3):368-386.

Kushlan, J.A., J.C. Ogden, and A.L. Higer. 1975. Relation of water level and fish availability to wood stork reproduction in the southern Everglades, Florida. U.S. Geological Survey open file report 75 434. U.S. Government Printing Office; Washington, D.C.

Kushlan, J.A., S.A. Voorhees, W.F. Loftus, and P.C. Frohring. 1986. Length, mass and caloric relationships of Everglades animals. Florida Scientist 49(2):65-79.

Labisky, R.F., C.C. Hurd, M.K. Oli, and R.S. Barwick. 2003. Foods of white-tailed deer in the Florida Everglades: the significance of Crinum. Southeastern Naturalist 2:261-270.

Labisky, R.F., M.C. Boulay, K.E. Miller, R.A. Sargent, Jr., and J.M. Zultowskil. 1995. Population ecology of white-tailed deer in Big Cypress National Preserve and Everglades National Park. Final report to National Park Service, Ochopee, Florida.

Land, D. and S.K. Taylor. 1998. Florida panther genetic restoration and management annual report 1997-98. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

Land, D., B. Shindle, D. Singler, and S. K. Taylor. 1999. Florida panther genetic restoration annual report 1998-99. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

Land, D., D. Shindle, M. Cunningham, M. Lotz, and B. Ferree. 2004. Florida panther genetic restoration and management annual report 2003-04. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

Land, E.D., D.B. Shindle, R.J. Kawula, J.F. Benson, M.A. Lotz, and D.P. Onorato. Florida panther habitat selection analysis of Concurrent GPS and VHF telemetry data. Journal of Wildlife Management 72:633-639.

Land, D., M. Cunningham, R. McBride, D. Shindle, and M. Lotz. 2002. Florida panther genetic restoration and management annual report 2001-02. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

Land, E.D. 1994. Response of the wild Florida panther population to removals for captive breeding. Final Report 7571. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

Lauritsen, J. 2006. Wood stork foraging assessment (Pilot Study); and an analysis of the historic data from Corkscrew's stork colony in light of hydrologic conditions. Unpublished report to the U.S. Fish and Wildlife Service, South Florida Ecological Services Office; Vero Beach, Florida.

Lauritsen, J. 2007. Personal communication. Biologist. E-mail to the U.S. Fish and Wildlife Service dated March, 22, 2007; Corkscrew Sanctuary; Naples, Florida.

Loftus, W.F. and A. Eklund. 1994. Long-term dynamics of an Everglades small-fish assemblage Pp. 461-484 in Everglades: The ecosystem and its restoration, Davis, S.M. and Ogden, J. C. (Eds.) St. Lucie Press, Delray, Florida.

Logan, T.J., A.C. Eller, Jr., R. Morrell, D. Ruffner, and J. Sewell. 1993. Florida panther habitat preservation plan - south Florida population. Prepared for the Florida Panther Interagency Committee.

Lotz, M., D. Land, M. Cunningham, and B. Ferree. 2005. Florida panther annual report 2004-05. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

Loveless, C.M. 1959. The Everglades deer herd life history and management. Florida Game and Fresh Water Fish Commission Technical Bulletin 6, Tallahassee, Florida.

Mac, M.J., P.A. Opler, C.E. Puckett Haecker, and P.D. Doran. 1998. Status and trends of the nation's biological resources. 2 volumes. U.S. Department of the Interior, U.S. Geological Survey, Reston, Virginia.

Maehr, D.S. 1990. Florida panther movements, social organization, and habitat utilization. Final Performance Report 7502. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

Maehr, D.S. 1992. Florida panther. Pages 176 189 *in* S.R. Humphrey (ed). Rare and endangered biota of Florida. Volume I: mammals. University Press of Florida, Gainesville, Florida.

Maehr, D.S. 1997. The comparative ecology of bobcat, black bear, and Florida panther in south Florida. Bulletin of the Florida Museum of Natural History 40:1-176. Maehr, D.S. and J.A. Cox. 1995. Landscape features and panthers in Florida. Conservation Biology 9:1008-1019.

Maehr, D.S. and J.L. Larkin. 2004. Do prescribed fires in south Florida reduce habitat quality for native carnivores. Natural Areas Journal 24:188-197.

Maehr, D.S., E.C. Greiner, J.E. Lanier, and D. Murphy. 1995. Notoedric mange in the Florida panther (*Felis concolor coryi*). Journal of Wildlife Diseases 31:251-254.

Maehr, D.S., E.D. Land, and J.C. Roof. 1991. Social ecology of Florida panthers. National Geographic Research and Exploration 7:414-431.

Maehr, D.S., E.D. Land, D.B. Shindle, O.L. Bass, and T.S. Hoctor. 2002a. Florida panther dispersal and conservation. Biological Conservation 106:187-197.

Maehr, D.S., R.C. Lacy, E.D. Land, O.L. Bass, T.S. Hoctor. 2002b. Populaton viability of the Florida Pa nther: A multi-perspective approach. *In* S. Beissinger and D. McCullough (Eds). Population Viability Analysis. Univeristy of Chicago Press, Chicago., Illinois.

Maehr, D.S., R.C. Belden, E.D. Land, and L. Wilkins. 1990a. Food habits of panthers in southwest Florida. Journal of Wildlife Management 54:420-423.

Maehr, D.S., E.D. Land, J.C. Roof, and J.W. McCown. 1990b. Day beds, natal dens, and activity of Florida panthers. Proceedings of Annual Conference of Southeastern Fish and Wildlife Agencies 44:310-318.

Maehr, D.S., J.C. Roof, E.D. Land, and J.W. McCown. 1989. First reproduction of a panther (*Felis concolor coryi*) in southwestern Florida, U.S.A. Mammalia 53: 129-131.

Mansfield, K.G., and E.D. Land. 2002. Chryptorchidism in Florida panthers: prevalence, features, and influence of genetic restoration. Journal of Wildlife Diseases 38:693-698.

McBride, R.T. 1985. Population status of the Florida panther in Everglades National Park and Big Cypress National Preserve. Report to National Park Service in fulfillment of Contract #RFP 5280-84 04, Homestead, Florida.

McBride, R.T. 2000. Current panther distribution and habitat use: a review of field notes, fall 1999-winter 2000. Report to Florida Panther Subteam of MERIT, U.S. Fish and Wildlife Service, Vero Beach, Florida.

McBride, R.T. 2001. Current panther distribution, population trends, and habitat use: report of field work: fall 2000-winter 2001. Report to Florida Panther Subteam of MERIT, U.S. Fish and Wildlife Service, Vero Beach, Florida.

McBride, R.T. 2002. Current panther distribution and conservation implications -- highlights of field work: fall 2001 -- winter 2002. Report to Florida Panther Subteam of MERIT, U.S. Fish and Wildlife Service, Vero Beach, Florida.

McBride, R.T. 2003. The documented panther population (DPP) and its current distribution from July 1, 2002 to June 30, 2003. Appendix IV in D. Shindle, M. Cunningham, D. Land, R. McBride, M. Lotz, and B. Ferree. Florida panther genetic restoration and management. Annual report 93112503002. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

McBride, R.T. 2006. Personal communication. Professional Tracker-Houndsman. Rancher's Supply Incorporated, P.O. Box 725, Alpine, Texas 79831.

McBride, R.T. 2008. Personal communication. Professional Tracker-Houndsman. Rancher's Supply Incorporated, P.O. Box 725, Alpine, Texas 79831.

McBride, R.T. 2010. Synoptic survey of Florida panthers 2010. Annual Report submitted to U.S. Fish and Wildlife Service (Agreement #401817G005). Rancher’s Supply, Incorporated, Alpine, Texas.

McBride, R.T., R.T. McBride, R.M. McBride, and C.E. McBride. 2008. Counting pumas by categorizing physical evidence. Southeastern Naturalist 7:381-400.

McCown, J.W. 1994. Big Cypress deer/panther relationships: deer herd health and reproduction. Pages 197-217 *in* D.B. Jordan (ed). Proceedings of the Florida Panther Conference. U.S. Fish and Wildlife Service, Gainesville, Florida.

McCown, J.W. 1991. Big Cypress Deer/Panther Relationships: Deer Herd Health and Reproduction. Final Report. Study Number: 7508. Bureau of Wildlife Research, Florida Game and Fresh Water Fish Commission; Tallahassee, Florida.

Meyer, K.D. and P.C. Frederick. 2004. Survey of Florida's wood stork (*Mycteria americana*) nesting colonies, 2004. Unpublished report to the U.S. Fish and Wildlife Service, Jacksonville, Florida.

Miller, K.E. 1993. Habitat use by white-tailed deer in the Everglades: tree islands in a seasonally flooded landscape. M.S. Thesis. University of Florida, Gainesville, Florida.

Mitchell, W.A. 1999. Species profile: Wood stork (*Mycteria americana*) on military installations in the southeastern United States. Technical Report SERDP-99-2. U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Murphy, T. and J.W. Coker. 2008. A Twenty-five year history of Wood Storks in South Carolina. *In* L.W. Walker and H. Rauschenberger, eds., Proceedings of the Wood Stork Ecology Workshop, October 15, 2005, Jekyll Island, Georgia. Waterbirds 31 (Special Publication 1).

Nelson, E.W. and E. A. Goldman. 1929. List of the pumas with three described as new. Journal of Mammalogy 10:345-350.

Newell, D. 1935. Panther. The Saturday Evening Post. July 13:10-11, 70-72.

Noss, R.F. 1992. The wildlands project land conservation strategy. Wild Earth (Special Issue):10-25.

Noss, R.F. and A.Y. Cooperrider. 1994. Saving Nature's Legacy: Protecting and Restoring Biodiversity. Island Press, Washington, D.C.

Nowak, R.M., and R.T. McBride. 1974. Status survey of the Florida panther. Project 973. World Wildlife Fund Yearbook 1973-74:237-242.

Nowak, R.M., and R.T. McBride. 1975. Status of the Florida panther. Project 973. World Wildlife Fund Yearbook 1974-75:245-46.

Nowell, K. and P. Jackson. 1996. Status survey and conservation action plan: Wild cats. International Union for Conservation of Nature and Natural Resources. Burlington Press, Cambridge, U.K.

Oberholser, H.C. 1938. The bird life of Louisiana. Louisiana Department of Conservation, Bulletin 28.

Oberholser, H.C. and E.B. Kincaid, Jr. 1974. The bird life of Texas. University of Texas Press; Austin, Texas.

O'Connell, A.F. Jr., L. Ilse, and J. Zimmer. 1999. Annotated bibliography of methodologies to census, estimate, and monitor the size of white-tailed deer Odocoileus virginianus populations. Department of the Interior, National Park Service, Boston Support Office. Technical Report NPS/BSO-RNR/NRTR/00-2.

Ogden, J.C. 1991. Nesting by wood storks in natural, altered, and artificial wetlands in central and northern Florida. Colonial Waterbirds 14:39 45.

Ogden, J.C. 1994. A comparison of wading bird nesting colony dynamics (1931-1946 and 1974-1989) as an indication of ecosystem condition in the southern Everglades. Pages 533-570 *in* Everglades: the ecosystem and its restoration (S.M. Davis and J.C. Ogden, eds.). St. Lucie Press, Delray Beach, Florida.

Ogden, J.C. 1996. Wood Stork *in* J.A. Rodgers, H. Kale II, and H.T. Smith, eds. Rare and endangered biota of Florida. University Press of Florida; Gainesville, FL.

Ogden, J.C. and S.A. Nesbitt. 1979. Recent wood stork population trends in the United States. Wilson Bulletin. 91(4): 512-523.

Ogden, J.C., J.A. Kushlan, and J.T. Tilmant. 1976. Prey selectivity by the wood stork. The Condor 78(3):324-330.

Ogden, J.C., J.A. Kushlan, and J.T. Tilmant. 1978. The food habits and nesting success of wood storks in Everglades National Park in 1974. U.S. Department of the Interior, National Park Service, Natural Resources Report No. 16.

Ogden, J.C., D.A. McCrimmon, Jr., G.T. Bancroft, and B.W. Patty. 1987. Breeding populations of the wood stork in the southeastern United States. Condor. 89:752759.

O'Hare, N.K. and G.H. Dalrymple, 1997. Wildlife in Southern Everglades Invaded by Melaleuca (*Melaleuca quinquenervia*). 41 Bulletin of the Florida Museum of Natural History 1-68. University of Florida; Gainesville, Florida.

Ohlendorf, H.M., E.E. Klass, and T.E. Kaiser. 1978. Environmental pollutants and eggshell thinning in the black-crowned night heron. *In* Wading Birds. A. Sprunt IV, J.C. Ogden, and S. Winckler (Eds). National Audubon Society. Research Report Number 7:63-82.

Olmstead, R.A., R. Langley, M.E. Roelke, R.M. Goeken, D. Adger-Johnson, J.P. Goff, J.P. Albert, C. Packer, M.K. Laurenson, T.M. Caro, L. Scheepers, D.E. Wildt, M. Bush, J.S. Martenson, and S.J. O'Brien. 1992. Worldwide prevalence of lentivirus infection in wild feline species: epidemiologic and phylogenetic aspects. Journal of Virology 66:6008-6018.

Onorato, D., C. Belden, M. Cunningham, D. Land, R. McBride, and M. Roelke. 2010. Long-term research on the Florida panther (*Puma concolor coryi*): historical findings and future obstacles to population persistence. Pp. 453-469 *in* D. Macdonald and A. Loveridge (eds.). Biology and conservation of wild felids. Oxford University Press, Oxford, UK.

Palmer, R.S. 1962. Handbook of North American birds, Volume 1, Loons through Flamingos. Yale University Press; New Haven, Connecticut.

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

Passarella and Associates, Incorporated. 2004. White-Tailed Deer Census Report. Collier Regional Medical Center Development. PAI and Associates, Incorporated; Fort Myers, Florida.

Pratt, P.D., M.B. Rayamajhi, T.K. Van, T.D. Center, and P.W. Tipping. 2005. Herbivory alters resource allocation and compensation in the invasive tree *Melaleuca quinquenervia.* Ecological Entomology 30, 316-326.

Rand, A.L. 1956. Foot stirring as a feeding habit of wood ibis and other birds. American Midland Naturalist 55:96 100.

Reed, J.M., P.D. Doerr, and J.R. Walters. 1988. Minimum viable population size of the red-cockaded woodpecker. Journal of Wildlife Management 50:239-247.

Rayamajhi, M.B., T.K. Van, P.D. Pratt, T.D. Center, and P.W. Tipping. 2007. *Melaleuca quinquenervia* dominated forest in Florida: analysis of natural-enemy impacts on stand dynamics. Plant Ecology 192(1):119-132.

Rayamajhi, M.B., T.K. Van, P.D. Pratt, and T.D. Center. 2008a. Aboveground biomass components of invasive tree, *Melaleuca quinquenervia*, before and after the natural enemy release in monoculture stands. Weed Science 56(3):451-456.

Rayamajhi, M.B., P.D. Pratt, and T.D. Center. 2008b. Natural enemies thin melaleuca-canopy and help increase plant diversity in the melaleuca stands. Florida Exotic Pest Plant Council.

Reeves, K.A. 1978. Preliminary investigation of the Florida panther in Big Cypress Swamp. Unpublished report. Everglades National Park, Homestead, Florida.

Rehage, J.S. and J.C. Trexler. 2006. Assessing the Net Effect of Anthropogenic Disturbance on Aquatic Communities in Wetlands: Community Structure Relative to Distance from Canals. Hydrobiologia.

Rodgers, J.A. and S.T. Schwikert. 1997. Breeding success and chronology of wood storks (*Mycteria americana*) in northern and central Florida, USA. Ibis 139:76-91.

Rodgers, J.A., Jr. 1990. Breeding chronology and clutch information for the wood stork from museum collections. Journal of Field Ornithology 61(1):47 53.

Rodgers, J.A., Jr., A.S. Wenner, and S.T. Schwikert. 1987. Population dynamics of wood storks in north and central Florida. Colonial Waterbirds 10:151 156.

Rodgers, J.A., Jr., S.T. Schwikert, and A. Shapiro-Wenner. 1996. Nesting habitat of wood storks in north and central Florida, USA. Colonial Waterbirds 19(1):1-21.

Rodgers, J.A., S.T. Schwikert, G.A. Griffin, W.B. Brooks, D. Bear-Hull, P.M. Elliott, K.J. Eberson, and J. Morris. 2008. Productivity of wood storks (*Mycteria americana*) in north and centeral Florida. *In* L.W. Walker and H. Rauschenberger, eds., Proceedings of the Wood Stork Ecology Workshop, October 15, 2005, Jekyll Island, Georgia. Waterbirds 31 (Special Publication 1): 25-34.

Roelke, M. E. 1990. Florida panther biomedical investigation. Final Performance Report 7506. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

Roelke, M. E. 1991. Florida panther biomedical investigation. Annual performance report, Study no. 7506. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

Roelke, M.E., D.J. Forrester, E.R. Jacobsen, G.V. Kollias, F.W. Scott, M.C. Barr, J.F. Evermann, and E.C. Pirtle. 1993b. Seroprevalence of infectious disease agents in free-ranging Florida panthers (*Felis concolor coryi*). Journal of Wildlife Diseases 29:36-49.

Roelke, M.E., J.S. Martenson, and S.J. O'Brien. 1993a. The consequences of demographic reduction and genetic depletion in the endangered Florida panther. Current Biology 3:340-350.

Root, K. 2004. Florida panther (*Puma concolor coryi*): Using models to guide recovery efforts. Pages 491-504 *in* H.R. Akcakaya, M. Burgman, O. Kindvall, C.C. Wood, P. Sjogren-Gulve, J. Hatfield, and M. McCarthy (eds). Species Conservation and Management, Case Studies. Oxford University Press, New York, New York.

Rotstein, D.S., R. Thomas, K. Helmick, S.B. Citino, S.K. Taylor, and M.R. Dunbar. 1999. Dermatophyte infections in free-ranging Florida panthers (*Felis concolor coryi*). Journal of Zoo and Wildlife Medicine 30:281-284.

Sarkar, S. 2004. Conservation Biology: The Stanford Encyclopedia of Philosophy (Winter 2004 Edition), E.N. Zalta (ed). [online] URL: http://plato.stanford.edu/archives/win2004/entries/conservation-biology

Schortemeyer, J.L., D.S. Maehr, J.W. McCown, E.D. Land, and P.D. Manor. 1991. Prey management for the Florida panther: a unique role for wildlife managers. Transactions of the North American Wildlife and Natural Resources Conference 56:512-526.

Seal, U.S. (ed). 1994. A plan for genetic restoration and management of the Florida panther (*Felis concolor coryi*). Report to the Florida Game and Fresh Water Fish Commission, by the Conservation Breeding Specialist Group, Species Survival Commission, IUCN, Apple Valley, Minnesota.

Seal, U.S. and R.C. Lacy (eds). 1989. Florida panther (*Felis concolor coryi*) viability analysis and species survival plan. Report to the U. S. Fish and Wildlife Service, by the Captive Breeding Specialist Group, Species Survival Commission, IUCN, Apple Valley, Minnesota.

Seal, U.S. and R.C. Lacy (eds). 1992. Genetic management strategies and population viability of the Florida panther (*Felis concolor coryi*). Report to the U. S. Fish and Wildlife Service, by the Captive Breeding Specialist Group, Species Survival Commission, IUCN, Apple Valley, Minnesota.

Seidensticker, J.C., IV, M.G. Hornocker, W.V. Wiles, and J.P. Messick. 1973. Mountain lion social organization in the Idaho primitive area. Wildlife Monographs 35:1-60.

Shaffer, M.L. 1981. Minimum population sizes for species conservation. BioScience

Shaffer, M.L. 1987. Minimum viable populations: coping with uncertainty. Pages 69-86 *in* M.E. Soulé (ed). Viable populations for conservation. Cambridge University Press, New York.

Shaffer, M.L. 1978. Determining Minimum Viable Population Sizes: A Case Study of the Grizzly Bear. Ph. D. Dissertation, Duke University.

Shindle D., M. Cunningham, D. Land, R. McBride, M. Lotz, and B. Ferree. 2003. Florida panther genetic restoration and management. Annual Report 93112503002. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

Shindle, D., D. Land, K. Charlton, and R. McBride. 2000. Florida panther genetic restoration and management. Annual Report 7500. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

Shindle, D., D. Land, M. Cunningham, and M. Lotz. 2001. Florida panther genetic restoration and management. Annual Report 7500. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

Smith, D.J., R.F. Noss, and M.B. Main. 2006. East Collier County wildlife movement study: SR 29, CR 846, and CR 858 wildlife crossing project. Unpublished report. University of Central Florida, Orlando, Florida.

Smith, T.R., and O.L. Bass, Jr. 1994. Landscape, white-tailed deer, and the distribution of Florida panthers in the Everglades. Pages 693-708 *in* S.M. Davis and J.C. Ogden (eds). Everglades: the ecosystem and its restoration. Delray Beach, Florida.

Steelman, H.G., J.A. Bozzo, and J.L. Schortemeyer. 1999. Big Cypress National Preserve Deer and Hog Annual Report.

Swanson, K., D. Land, R. Kautz and R. Kawula. 2005. Use of least cost pathways to identify key highway segments for Florida panther conservation. Pages 191-200 *in* R.A. Beausoleil and D.A. Martorello, editors. Proceedings of the Eighth Mountain Lion Workshop, Olympia, Washington.

Taylor, S.K., C.D. Buergelt, M.E. Roelke-Parker, B.L. Homer, and D.S. Rotstein. 2002. Causes of mortality of free-ranging Florida panthers. Journal of Wildlife Diseases 38:107-114.

Thatcher, C., F.T. van Manen, and J.D. Clark. 2006. Identifying suitable sites for Florida panther reintroduction. Journal of Wildlife Management.

Tinsley, J.B. 1987. The puma: legendary lion of the Americas. Texas Western Press, University of Texas, El Paso, Texas.

Tinsley, J.B. 1970. The Florida panther. Great Outdoors Publishing Company, St. Petersburg, Florida.

Titus, J.G. and V.K. Narayanan. 1995. The probability of sea level rise. EPA 230-R95-008. U.S. Environmental Protection Agency, Washington, D.C.

Trexler, J.C. and C.W. Goss. 2009. Aquatic Fauna as Indicators for Everglades Restoration: Applying Dynamic Targets in Assessments. Ecological Indicators, Vol 9: 108-119.

Trexler, J.C., W.F. Loftus, F. Jordan, J.H. Chick, K.L. Kandl, T.C. McElroy, and O.L. Bass. 2002. Ecological scale and its implications for freshwater fishes in the Florida Everglades. Pages 153-182 *in* The Everglades, Florida Bay, and Coral Reefs of the Florida Keys: An ecosystem sourcebook (J.W. Porter and K.G. Porter, eds.). CRC Press, Boca Raton, Florida.

Turner, A. and J.C. Trexler. 1997. Sampling invertebrates from the Florida Everglades: a comparison of alternative methods. Journal of the North American Benthological Society 16:694-709

Turner, A.W., J.C. Trexler, C.F. Jordan, S.J. Slack, P. Geddes, J.H. Chick, and W.F. Loftus. 1999. Targeting ecosystem features for conservation: standing crops in the Everglades. Conservation Biology 13(4):898-911.

Turrell and Associates, Incorporated. 2001. White-tailed deer census report. Mirasol Development. Turrell and Associates, Incorporated; Naples, Florida.

Turrell and Associates, Incorporated. 2007. Wildlife survey data. Mirasol Development. Turrell and Associates, Incorporated; Naples, Florida.

Tyson, E.L. 1952. Estimating deer populations from tracks. Annual Conference of Southeastern Association of Fish and Wildlife Agencies 6: 3-15.

University of Florida. 2009. Bureau of Economic and Business Research, Population Projections Bulletin 151. Gainesville, Florida. www.leecountybusiness.com/ pdf/FB_community.pdf

U.S. Fish and Wildlife Service. 1997. Revised recovery plan for the U.S. breeding population of the wood stork. U.S. Fish and Wildlife Service; Atlanta, Georgia.

U.S. Fish and Wildlife Service. 1999. Multi-species recovery plan (MSRP) for south Florida. U.S. Fish and Wildlife Service; Vero Beach, Florida.

U.S. Fish and Wildlife Service. 2000. Florida panther final interim standard local operating procedures (SLOPES) for endangered species. U.S. Fish and Wildlife Service; Vero Beach, Florida.

U.S. Fish and Wildlife Service. 2003. Wood Stork Report. Volume 2, Number 1. March 2003. U.S. Fish and Wildlife Service, Jacksonville, Florida.

U.S. Fish and Wildlife Service. 2004. Wood stork report. Volume 3, Number 1. April 2004. U.S. Fish and Wildlife Service; Jacksonville, Florida.

U.S. Fish and Wildlife Service. 2006a. Lake Belt Mining Plan, Biological Opinion. South Florida Ecological Srevices Office. Vero Beach, Florida.

U.S. Fish and Wildlife Service. 2006b. Draft Florida panther recovery plan: third revision. January 2006. Prepared by the Florida Panther Recovery Team and the South Florida Ecological Services Office. U.S. Fish and Wildlife Service; Atlanta, Georgia.

U.S. Fish and Wildlife Service. 2007. Wood stork (*Mycteria americana*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Atlanta, Georgia.

U.S. Fish and Wildlife Service. 2008. Florida panther recovery plan: third revision. January 2006. Prepared by the Florida Panther Recovery Team and the South Florida Ecological Services Office. U.S. Fish and Wildlife Service; Atlanta, Georgia.

U.S. Fish and Wildlife Service. 2010. Wood stork (*Mycteria americana*) nests data. Excel spreadsheet. U.S. Fish and Wildlife Service, Jacksonville, Florida.

Van Dyke, F.G., R.H. Brocke, and H.G. Shaw. 1986a. Use of road track counts as indices of mountain lion presence. Journal Wildlife Management 50:102-109.

Van Dyke, F.G., R.H. Brocke, H.G. Shaw, B.B. Ackerman, T.P. Hemker, and F.G. Lindzey. 1986b. Reactions of mountain lions to logging and human activity. Journal of Wildlife Management 50:95-102.

Wanless, H.R., R.W. Parkinson, and L.P. Tedesco. 1994. Sea level control on stability of Everglades wetlands. Pages 199-223 *in* Everglades: the ecosystem and its restoration (S.M. Davis and J.C. Ogden, eds.). St. Lucie Press, Delray Beach, Florida.

Wanless, H.R. 2008. Statement on sea level in the coming century. Report from the Miami-Dade County Climate Change Advisory Task Force to the Board of County Commissioners. Miami, Florida.

Wayne, A.T. 1910. Birds of South Carolina. Contributions to the Charleston Museum No.1.

Wehinger, K.A., M.E. Roelke, and E.C. Greiner. 1995. Ixodid ticks from Florida panthers and bobcats in Florida. Journal of Wildlife Diseases 31:480-485.

Wilkins, L., J.M. Arias-Reveron, B. Stith, M.E. Roelke, and R.C. Belden. 1997. The Florida panther (*Puma concolor coryi*): a morphological investigation of the subspecies with a comparison to other North and South American cougars. Bulletin of the Florida Museum of Natural History 40:221-269.

Winn, B., D. Swan, J. Ozier, and M.J. Harris. 2008. Wood stork nesting in Georgia: 1992-2005. *In* L.W. Walker and H. Rauschenberger, eds., Proceedings of the Wood Stork Ecology Workshop, October 15, 2005, Jekyll Island, Georgia. Waterbirds 31 (Special Publication 1): 8-11.

Wozencraft, W.C. 1993. Order Carnivora. Pages 286-346 *in* D.E. Wilson and D.M. Reeder, (eds.). Mammal species of the world, 2nd edition. Smithsonian, Washington, D.C.

Young, S.P., and E.A. Goldman. 1946. The puma-mysterious American cat. American Wildlife Institute, Washington, D.C.

Table 1. Project Acreage and Compensation Summary

		Upland (ac)	Wetlands (ac)	Total (ac)
Project Acreage (ac)		236.74	1,476.71	1,713.45
Development Footprint	Total	129.86	699.87	829.73
	Development	127.62	645.35	772.97
	Development Preserve	2.24	54.52	56.76
Development Preserve	Total	2.24	54.52	56.76
	Golf Course Buffer	2.24	28.26	30.50
	Internal Lakes Buffer	0	26.26	26.26
Adjacent Preserve		106.88	776.83	883.71
Summary Preserve (Adjacent+Development Preserve)		109.12	831.35	940.47
Off site Preserve (Panther Island)			82.21	82.21
Off site Preserve (Primary Zone Lands)			291.10	291.10
Combined Preserves (Onsite and Off site)		109.12	1,204.66	1,313.78

Table 1a. Project Acreage and Compensation – Florida Panther

Panther Impacts	Upland (ac)	Wetlands (ac)	PHU	Total (ac)
Development	127.62	645.35		772.97
Internal and Buffer Preserves		36.86		36.86
Total	127.62	682.21	3,884.12	809.83
Compensation Need 2.5 times PHU total			9,710.30	
Onsite Panther Preserve	Upland (ac)	Wetlands (ac)	PHU	Total (ac)
Adjacent Preserve	106.88	776.83		883.71
Golf Course Buffer	2.24	17.71		19.95
Total Onsite	109.12	794.54	6,671.75	903.66
Off Site Panther Preserve	Upland (ac)	Wetlands (ac)	PHU	Total (ac)
Panther Island Mitigation Bank		82.21	708.88	
Primary and/or Dispersal Zone Lands		291.10	2,329.67	
Total Off site		373.31	3038.55	373.31
Total Compensation Provided	109.12	1,167.85	9,710.30	1,276.97

Table 1b. Project Acreage and Compensation – Wood Stork

Wood Stork	Wetland Acres		Biomass (kg)
Development	Total	645.35	190.06
	Short	575.66	166.80
	Long	69.69	23.26
	Loss		190.06
Onsite Preserve	Total	54.52	
	Short	44.41	
	long	10.11	
Adjacent Site Preserve	Total	776.83	
	Short	463.15	
	Long	313.69	
Adjacent Plus Onsite	Total	831.35	2,181.87*
	Short	507.56	1,106.37*
	Long	323.79	1,075.50*
	Gain		1,991.81****

* Gain over existing baseline biomass following restoration.

Table 2. 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

Table 3. Habitat preservation efforts resulting from formal and informal consultations with the Service for projects affecting Florida panther habitat from March 1984 to September 2010.

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
03/29/84	4-1-83-195	83M-1317	CMC Development Corporation (Ford Test Track)	Collier	530	0	0	0
02/21/85	4-1-85-018	FAP #?	USDOT, FHA (conversion of Hwy 84 to I-75)	Broward Collier	1,517	0	0	0
10/17/86	4-1-87-016 4-1-87-017	unknown	NPS, BCNP (Exxon Master Plan Modification)	Collier	9	0	0	0
01/07/87	4-1-86-303	86IPM-20130	Collier Enterprises (citrus grove)	Collier	11,178	0	0	0
01/11/88	4-1-88-029	unknown	NPS, BCNP (NERCO - Clements Energy, Inc.)	Collier	3	0	0	0
02/23/88	4-1-88-055	unknown	NPS, BCNP (Shell Western E&P, Inc.)	Collier Dade Monroe	0	0	0	0
02/10/89	4-1-89-001	FAP IR-75-4(88)81	USDOT, FHA (SR 29/I-75 Interchange)	Collier	350	0	0	0
08/15/90	4-1-90-289	unknown	NPS, BCNP [I-75 Rec. Access Plan (MM 31, 38, 49)]	Collier	150	0	0	0
09/24/90	4-1-90-212	89IPD-20207	U.S. Sugar Corp (46 mi2 ag conversion)	Hendry	28,740	700	0	700
03/12/91	4-1-91-229	90IPO-02507	Lourdes Cereceda (commercial rock mine)	Dade	97	0	0	0
01/14/92	4-1-91-325	199101279 (IP-HH)	Dooner Gulf Coast Citrus (32 acre citrus grove)	Collier	40	40	0	40
09/25/92	4-1-92-340	unknown	BIA, STOF, BCSIR (1,995 acre citrus grove)	Hendry	1,995	0	0	0
06/18/93	4-1-93-217	199200393 (IP-SL)	Lee County DOT (Corkscrew Road)	Lee	107	0	0	0
02/25/94	4-1-94-209	199301131 (IP-KC)	Lee County DOT (Daniels Road extension)	Lee	65	0	0	0
05/09/94	4-1-93-251	199202019 (IP-KA)	Corkscrew Enterprises (The Habitat)	Lee	900	100	100	200

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
10/27/94	4-1-94-430	199302371 (IP-BB) 199400807 (IP-BB) 199400808 (IP-BB)	Timberland and Tiburon Florida Gulf Coast University Treeline Boulevard	Lee	1,088	526	0	526
05/24/95	4-1-95-230	199302130 (IP-TB)	FDOT, I-75 (Turner River access @ MM 70)	Collier	1,936	0	0	0
08/07/95	4-1-95-274	199405501 (IP-AW)	Bonita Bay Properties, Inc. (golf course)	Collier	509	491	0	491
08/15/95	4-1-94-214	199301495 (IP-MN)	SWFIA, Northeast Access Road	Lee	14	0	0	0
09/19/96	4-1-95-F-230	199302052 (IP-TB) 199301404 (IP-TB)	FDOT, I-75 (Central and West Broward access) FDOT, I-75 (Miami Canal Access)	Broward	116	0	0	0
03/10/98	4-1-98-F-3	L30(BICY)	NPS, BCNP (Calumet Florida, Inc. seismic testing)	Collier Dade Broward	0	0	0	0
03/27/98	4-1-97-F-635	199604158 (IP-SB)	Bonness, Joseph D., Jr. Trustee (Willow Run Quarry)	Collier	359	190	0	190
06/11/99	4-1-98-F-398	199800622 (IP-SS)	STOF, BCSIR (water conservation plan)	Hendry	1,091	0	0	0
09/27/99	4-1-98-F-310	199130802 (IP-SB)	Lee County DOT (Daniels Parkway extension)	Lee	2,093	0	94	94
12/08/99	4-1-98-F-517	199607574 (IP-MN)	Kaufmann Holdings, Inc. (Cypress Creek Farms)	Collier	239	0	24	24
04/17/00	4-1-98-F-428	199507483 (IP-AM)	Miromar Development, Inc. (Miromar Lakes)	Lee	1,323	0	194	194
06/09/00	4-1-99-F-553	199900619 (IP-SB)	Vineyards Development Corp. (Naples Reserve GC)	Collier	833	0	320	320
02/21/01	4-1-00-F-135	199803037 (IP-SR)	Wortzel & Landl, Co-Trustees (Corkscrew Ranch)	Lee	106	0	0	0
04/17/01	4-1-00-F-584	200001436 (IP-MN)	WCI Communities, Inc. (Sun City - Ft. Myers)	Lee	1,183	0	408	408

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
07/30/01	4-1-94-357	199003460 (IP-TB)	Naples Golf Estates	Collier	439	175	0	175
08/31/01	4-1-00-F-183	199900411 (IP-SR)	Worthington Communities, Inc. (Colonial G&CC)	Lee	1,083	0	640	640
12/14/01	4-1-00-F-585	199301156 (IP-MN)	SWFIA, Mid-field Terminal Expansion	Lee	8,058	0	6,986	6,986
03/07/02	4-1-00-F-178	199901251 (IP-MH)	Benton, Charles (Southern Marsh GC)	Collier	121	75	80	155
04/24/02	4-1-01-F-148	199901378 (IP-SR)	Schulman, Robert, Trustee (Hawk's Haven)	Lee	1,531	267	0	267
09/24/02	4-1-01-F-135	200001574 (IP-DY)	State Road 80, LLC (Verandah)	Lee	1,456	0	320	320
10/08/02	4-1-02-F-014	199602945 (IP-DY)	Barron Collier Company (Winding Cypress)	Collier	1,088	840	1,030	1,870
05/19/03	4-1-02-I-1741	200200970 (IP-DEY)	Apex Center	Lee	95	10	18	28
06/10/03	4-1-01-F-1955	200003795 (IP-DY)	Walnut Lakes	Collier	157	21	145	166
06/18/03	4-1-01-F-136	199701947 (IP-SR)	Twin Eagles Phase II	Collier	593	57	98	155
06/23/03	4-1-01-F-143	199905571 (IP-SR)	Airport Technology Center	Lee	116	55	175	230
07/02/03	4-1-98-F-428	199507483 (IP-MN)	Addition to Miromar Lakes	Lee	342	158	340	498
09/04/03	4-1-02-F-1486	200206725 (IP-MN)	State Road 80 Widening	Lee	33	2	12	14
10/06/03	4-1-02-F-0027	200102043 (IP-MN)	Bonita Beach Road Development	Lee	1,117	145	640	785
12/29/03	4-1-02-F-1743	200202926 (IP-MGH)	The Forum - Saratoga Investments	Lee	650	0	310	310
01/18/05	4-1-04-F-4259	199702228 (TWM)	Bonita Springs Utilities	Lee	79	0	108	108
03/31/05	4-1-04-F-5656	200306759 (NW-MAE)	Gateway Shoppes II	Collier	82	0	122	122
04/08/05	4-1-04-F-8176	2004-5312 (AEK)	Big Cypress Rock Mine	Broward	110	0	220	220
04/29/05	4-1-04-F-5780 4-1-04-F-5982	2003-5331 (IP-TWM) 2003-6965 (IP-TWM)	Worthington Holdings Arborwood & Treeline Avenue Extension	Lee	2,330	0	1,700	1,700
06/06/05	4-1-03-F-7855	2003-11156 (IP-RMT)	Collier Regional Medical Center	Collier	44	0	64	64

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
06/29/05	4-1-03-F-3915	199806220 (IP-MAE)	Wenthworth Estates - V.K. Development	Collier	917	0	458	458
07/15/05	4-1-04-F-5786	199405829 (IP-CDC)	Land's End Preserve	Collier	231	0	61	61
09/26/05 10/26/05	4-1-04-F-9348	2004-1122 (IP-RMT)	Super Target Brentwood Land Partners	Collier	34	0	20	20
11/23/05	4-1-04-F-6043	20039414	Waterways Join Venture IV	Collier	108	0	61	61
11/29/05	4-1-04-F-8847	20048995	Seminole Tribe of FL Administrative Complex	Collier	6	0	8	8
12/06/05	4-1-03-F-3483	200302409	Southwest Florida Investment Property, LLC	Lee	207	0	305	305
12/6/05	4-1-04-F-6691	200310689	Rattlesnake Hammock Road	Collier	23	0	23	23
01/04/06	4-1-04-F-8388	2004554	Immokalee Regional Airport - Phase I	Collier	67	0	43	43
01/04/06	4-1-04-F-9777	20048577	Logan Boulevard Extension	Collier	40	0	10	10
01/13/06	4-1-04-F-6707	20042404	Journey's End	Collier	66	0	34	34
01/26/06	4-1-04-F-8940	20047053	The Orchard	Lee	93	0	81	81
02/09/06	4-1-05-11724	2005384	Firano at Naples	Collier	24	0	19	19
02/22/06	4-1-04-F-6505	200101122	Corkscrew Road	Lee	20	0	47	47
02/23/06	4-1-04-F-5244	200312276	Summit Church	Lee	10	0	13	13
03/31/06	4-1-05-PL-11343	20051909	Coral Keys Homes	Dade	41	0	61	61
02/25/05 03/*16*/05 06/29/05 04/04/06	4-1-04-F-6866	200309416 (NW-MAE)	Ava Maria University	Collier	5,027	0	6,114	6,114
05/05/06	41420-2006-I-0274	2005-6176	Santa Barbara , Davis to Radio Road, Widening	Collier	6	0	3	3
05/09/06	41420-2006-F-0089	200403248	Collier Boulevard, Immokalee Rd. to Goldengate Blvd.	Collier	14	0	16	16
05/09/06	41420-2006-I-0263	200506248	Santa Barbara Radio Road, Widening.	Collier	29	0	20	20
05/16/06	4-1-05-F-10309	19971924	Sabal Bay	Collier	1,017	1,313	223	1,536
06/05/06	4-1-05-PL-8486	20041688	Seacrest School	Collier	31	0	16	16
06/09/06	4-1-05-PL-10965	200303733	HHJ Development	Dade	3	0	4	4
06/14/06	4-1-05-F-11855	200411010	Keysgate School Site	Dade	39	0	62	62

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
06/15/06	41420-2006-I-0362	20056176	Collier County Wellfield	Collier	29	0	36	36
07/12/06	41420-2006-F-0282	200311150	Cypress Shadows	Lee	244	0	326	326
07/28/06	4-1-05-F-12330	20047920	Hamilton Place	Dade	10	0	50	50
07/28/06	4-1-04-F-7279	20041695	Raffia Preserve	Collier	131	0	119	119
08/15/06	41420-2006-I-0151	20031963	Naples Custom Homes	Collier	10	0	9	9
08/21/06	4-1-03-F-3127	19956797	Atlantic Civil Ag Permit Extension	Collier	981	0	1,553	1,553
08/21/06	41420-2006-I-0540	20041813	ASGM Business Park	Dade	41	0	25	25
09/12/06	41420-2006-F-0554	20057414	Miccosukee Government Complex	Dade	17	0	37	37
09/22/06	41420-2006-I-0355	20040047	Immokalee Seminole Reservation Road Improvements	Collier	17	0	35	35
10/05/06	41420-2006-I-0616	20065295	New Curve on Corkscrew Road	Lee	12	0	18	18
10/16/06	41420-2006-F-0667	199507483	Miromar Addition	Lee	366	0	390	390
10/18/06	41420-2007-F-0026	2004777	Treeline Preserve	Lee	97	0	95	95
10/25/06	41420-2006-F-0442	20047046	Koreshan Boulevard Extension	Lee	14	0	30	30
10/26/06	41420-2006-F-0787	200306755	Jetway Tradeport	Collier	38	0	52	52
10/26/06	41420-2006-I-0849	20055702	Marina Del Lago	Lee	49	0	36	36
10/27/06	41420-2006-I-0203	20057180	Living Word Family Church	Collier	18	0	35	35
10/27/06	41420-2006-I-0607	20064878	Seminole Reservation Access Road	Hendry	2	0	5	5
11/15/06	41420-2006-TA-0727	N/A	Liberty Landing	Collier	27	0	19	19
11/15/06	41420-2007-FA-0222	200412415	Barry Goldmeier 5th Avenue Estates	Dade	15	0	18	18
11/16/06	41420-2006-TA-0060	N/A	Collier County Elementary School K	Collier	26	0	17	17
12/05/06	41420-2006-FA-1179	20057179	The Roberts Group CPD	Lee	58	0	29	29
12/07/06	41420-2006-FA-0781	20041689	Cypress Landing	Collier	46	0	18	18
01/19/07	41420-2006-I-0871	20061359	Brighton Veterans Center	Glades	9	0	8	8

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
03/09/07	41420-2006-F-0850	200312445	Airport Interstate Commerce Park	Lee	323	0	371	371
03/09/07	41420-2007-I-0581	1999-4313	Savanna Lakes	Lee	124		140	140
03/09/07	41420-2007-TA-0623	NA	Abercia North	Collier	25		31	31
04/13/07	41420-2007-TA-0618	NA	Collier County School Site J - Everglades Blvd.	Collier	39		56	56
05/01/07	41420-2006-I-0992	20045223	Seminole Motocross	Hendry	58	5	19	23
06/19/07	41420-2007-I-0997	2006-2583	Caloosa Reserve	Collier	111		139	139
07/03/07	41420-2007-TA-0818	NA	Woodcrest Development	Collier	11	0	15	15
07/17/07	41420-2007-I-0330	2006-6377	Faith Landing	Collier	35	0	18	18
07/30/07	41420-2007-I-0866	2006-7022	Collier County School Site L	Collier	32	0	21	21
06/14/04 03/21/05 08/24/07	4-1-04-F-5744	199603501 (IP-TWM)	Terafina	Collier	437	210	261	471
09/05/07	41420-2006-I-0051	2005-4186	Gulf Coast Landfill Expansion	Lee	123	0	65	65
10/31/07	41420-2007-F-1035	2004-3931	Big Cypress Regional General Permit - 83	Hendry Broward	2,337	4,144	0	4,144
11/13/07	41420-2006-FA-1430	2005-782	Summit Lakes	Collier	138	0	134	134
1/22/2008	41420-2008-FA-0021 41420-2008-I-005	2007-4503	I-75 from Collier County Line to South of Corkscrew Road	Lee	7	0	44	44
1/30/2008	41420-2008-FA-0009 41420-2008-I-003	2007-4884	I-75 from Corkscrew Road to Daniels Parkway	Lee	7	0	12	12
02/07/2008	41420-I-0015	200502117	Cleveland Clinic	Lee	36	0	22	22
2/7/2008	41420-2007-FA-1120 41420-2007-I-0862	1993-0862	Poinciana Parkway	Polk	187	0	236	236
9/8/2005 02/15/08	4-1-04-F-5260 and 41420-2008-F-0112	200106580	Parklands Collier	Collier	487	157	434	591
04/28/2008	41420-2008-I-0313	2007-6414	Immokalee Rd Substation	Collier	1	0	1	1
6/26/2008	41420-2007-FA-1150 41420-2007-F-1144	2007-2175	Immokalee Master Plan	Collier	506	0	1,015	1,015

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
7/2/2008	41420-2007-FA-0592 41420-2007-F-0491	2005-7439	Kaicasa	Collier	72		183	183
07/14/2008	41420-2008-I-0508	2005-6488	Amerimed Medical Center	Collier	19	0	14	14
07/14/2008	41420-2008-I-0509	2007-4314	Gridley Medical Building	Collier	4	0	2	2
03/09/07 07/23/08	4-1-04-F-6112	20021683	Alico Airpark (Haul Ventures)	Collier	166		315	315
7/23/2008	41420-2006-FA-0165 41420-2006-F-0846	2004-182	Premier Airport Park	Lee	180		211	211
09/04/2008	41420-2008-FA-0415 41420-2008-I-0211	1984-4913	Colonial Boulevard Widening	Lee	35	0	39	39
09/25/08	41420-2008-FA-0702 41420-2008-I-0806	1988-1061	Alligator Alley Commercial Center	Collier	41	0	18	18
12/17/2008	41420-2006-FA-0023 41420-2008-F-0018	1999-4926	Sembler Partnership McMullen Parcel	Collier	40	0	49	49
01/13/09	41420-2007-FA-1111 41420-2007-I-1083	2007-1264	Big Corkscrew Island Fire Control & Rescue	Collier	5	2	5	7
01/30/02 02/12/09	4-1-98-F-372 and 41420-2006-F-0267	199402492 (IP-ML)	Florida Rock Industries, Inc. (Fort Myers Mine #2)	Lee	2,913	1,960	0	1,960
2/26/2009	41420-2006-FA-0548 41420-2006-F-1011	2006-7018	Oil Well Road Widening	Collier	329	0	356	356
11/06/2009	41420-2006-FA-0548 41420-2006-I-0262	2009-00315	Alligator Alley Service Plaza Expansion	Broward	25		35	35
0709/2009	41420-2009-FA-0522	Seminole Tribe	Stanlo Compost Facility	Glades	2	0	8	8
06/10/2009	41420-2008-FA-0804	2007-7467	Greenfrog Substation	Miami-Dade	3	0	6	6
6/29/2009	41420-2007-FA-1534 41420-2007-I-1186	2007-1676	Tamiami Crossing Commercial Development	Collier	25	0	19	19

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
7/10/2009	41420-2007-FA-0283 41420-2007-I-0367	2008-4470	Home Center Plaza	Collier	16	0	5	5
11/03/2009	41420-2007-FA-0620 41420-2007-I-0262	none	Tiger Camp Expansion	Miami-Dade	1	0	1	1
1/05/2010	41420-2009-FA-0523 41420-2009-I-0262	2005-2117	Bonita Beach Road East Water Storage Tank	Lee	15	0	5	5
1/28/2010	41420-2010-CPA-0081 41420-2010-I-0068	2009-03039	Snake Road Improvements	Broward /Hendry	18	0	20	20
3/03/2010	41420-2010-CPA-0154 41420-2010-I-0129	2009-03450	Naples Landfill Gas to Energy	Collier	1	0	2	2
6/21/2010	41420-2008-FA-0798 41420-2008-I-0928	2008-2429	Shaggy Sypress Ag. Operation	Collier	10	0	22	22
6/21/2010	41420-2008-FA-0799 41420-2008-I-0929	2008-2429	Camp Keais Strand Ag. Operation	Collier	6	0	36	36
02/21/03 03/09/05 03/02/07 05/03/07 04/21/11 06/03/11	41420-2006-F-0674	2000-1926 (IP-SB)	Mirasol	Collier	810	904	373	1,277
				Total	96,167	12,547	29,568	42,114

Table 4. Targeted and Acquired Acreage Totals of Conservation Lands in South Florida Directly Affecting the Panther within the Consultation Area.

Name	Targeted[1] Acreage	Acquired Acreage	Indian Reservation
Federal Conservation Lands			
Everglades National Park	1,508,537	1,508,537	--
Big Cypress National Preserve	720,000	720,000	--
Florida Panther National Wildlife Refuge	26,400	26,400	--
Subtotal	**2,254,937**	**2,254,937**	--
State of Florida: Florida Forever Program			
Belle Meade	28,505	19,107	--
Corkscrew Regional Ecosystem Watershed	69,500	24,028	--
Twelvemile Slough	15,653	7,530	--
Panther Glades	57,604	22,536	--
Devil's Garden	82,508	0	--
Caloosahatchee Ecoscape	18,497	2,994	--
Babcock Ranch	91,361	0	--
Fisheating Creek	176,760	59,910	--
Subtotal	**540,388**	**136,105**	--
State of Florida: Other State Acquisitions			
Water Conservation Area Number 3	491,506	491,506	--
Holey Land Wildlife Management Area	33,350	33,350	--
Rotenberger Wildlife Management Area	25,019	20,659	--
Fakahatchee Strand State Preserve	74,374	58,373	--
Picayune Strand State Forest	55,200	55,200	--
Okaloacoochee Slough State Forest and WMA	34,962	34,962	--
Babcock-Webb Wildlife Management Area	79,013	79,013	--
Subtotal	**793,424**	**773,063**	--
Indian Reservations[2]			
Miccosukee Indian Reservation	--	--	81,874
Big Cypress Seminole Indian Reservation	--	--	68,205
Brighton Seminole Indian Reservation	--	--	37,447
Subtotal	**--**	**--**	**187,526**
GRAND TOTALS	**3,588,749**	**3,164,105**	**187,526**

1 Targeted acres not available for all lands. In Such cases, targeted equals acquired acreage.

2 Indian lands are included due to their mention in the MSRP. Acreages taken from GIS data.

* Table 4 was excerpted from the Brief of Amicus (2003). However, the lands shown as acquired in this Table may include some private in-holdings and may include lands currently under sales negotiations or condemnation actions.

Table 5. Land Held for Conservation within the Florida Panther Core Area

	Acres	Primary Equivalent Factor	Primary Equivalent Acres
Primary	1,659,657	1.00	1,659,657
Dispersal	0	1.00	0
Secondary	308,623	0.69	212,950
Other	609,872	0.33	201,258
Total	2,578,152		2,073,865

Table 6. Undeveloped Privately Owned Land within Florida Panther Core Area

	Acres	Primary Equivalent Factor	Primary Equivalent Acres
Primary	610,935	1.00	610,935
Dispersal	27,883	1.00	27,883
Secondary	503,481	0.69	347,402
Other	655,996*	0.33	216,479
Total	1,798,295		1,202,699

*** About 819,995 acres are at risk in the other zone with about 80 percent with resource value**

Table 7. Wood Stork Nesting Data in the Southeastern U.S. (Gawlik 1987, Service 2006)

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	2,365	19	275	2	11	1		
1982	3,575	22	778	19	135	2	20	1		
1983	5,983	25	2,350	22	363	2	20	1		
1984	6,245	29	1,550	25	576	3	22	1		
1985	5,193	23	1,455	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	2,293	23	969	9	664	3		
1992			**		1,091	9	475	3		
1993	6,729	43	4,262	28	1,661	11	806	3		
1994	5,768	47	3,589	26	1,468	14	712	7		
1995	7,853	54	5,617	33	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	7341	42	1,139	13	520	8		
2000			**		566	7	1,236	11		
2001	5,582	44	3,246	23	1,162	12	1,174	9		

YEAR	TOTAL		FLORIDA		GEORGIA		SOUTH CAROLINA		NORTH CAROLINA	
	Nesting Pairs	Colonies	Nesting Pairs	Colonies	Nesting Pairs	Colonies	Nesting Pairs	Colonies	Nesting Pairs	Colonies
2002	7,855	70	5,463	46	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	2,034	13		
2005	5,572	73	2,304	40	1,817	19	1,407	14	32	1
2006	11,279	82	7,216	47	1,928	21	1,963	12	132	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	24	1,839	16	149	1
2009	12,720	86	9,428	54	1,676	19	1,482	12	134	1

**Some data from Florida not readily available due to inconsistent survey or reporting.

Table 8. Total Number of Wood Stork Nesting Pairs within the Everglades and Big Cypress Basins, 1996 to Present

Year	Nesting Pairs	Colonies	3-Year Running Average	
			Nesting Pairs	Colonies
1996	1,215	1	--	--
1997	445	4	--	--
1998	478	3	713	3
1999	2,674	16	1,199	8
2000	3,996	8	2,383	9
2001	2,888	9	3,186	11
2002	3,463	11	3,449	9
2003	1,747	9	2,669	10
2004	1,485	9	2,232	10
2005	591	3	1,274	7
2006	2,648	9	1,575	7
2007	696	7	1,312	6
2008	344	4	1,229	7
2009	5,816	25	2,285	12
Average	2,035	8	1,961	8

Table 9. Panther-Vehicle Collisions within the Mirasol Action Area as of March 31, 2011.

Distance from Project	Roadway	Year	Sex	Panther	Result
24 miles southeast	SR 29	1979	F	UCFP04	Death
22 miles east	SR 29	1980	M	UCFP05	Death
22 miles southeast	SR 84	1983	M	FP01	Death
20 miles southeast	SR 84	1984	F	UCFP12	Death
20 miles southeast	SR 84	1985	F	UCFP13	Death
21 miles southeast	SR 84	1985	M	FP04	Death
14 miles south	CR 951	1985	F	NONE	Injury
20 miles southeast	SR 84	1986	F	UCFP15	Death

Distance from Project	Roadway	Year	Sex	Panther	Result
23 miles east	CR 858	1987	M	FP20	Injury
22 miles east	SR 29	1988	M	FP13	Death
18 miles north	Daniels Road	1989	M	FP28	Injury
17 miles northeast	CR 850	1989	M	UCFP18	Death
24 miles southeast	SR 29	1990	M	FP37	Death
22 miles east	SR 29	1991	F	UCFP20	Death
14 northwest	Alico Road	1992	M	NONE	Injury
22 miles east	SR 29	1992	F	UCFP21	Death
18 miles northwest	Daniels Road	1993	M	UCFP22	Death
25 miles northeast	CR 846	1993	M	FP50	Death
22 miles east	SR 29	1994	F	FP31	Death
23 miles northeast	CR 846	1995	F	FP52	Death
23 miles southeast	SR 29	1998	M	FP51	Injury
22.1 miles east	US 41	2000	M	FP63	Death
21 miles east	CR 858	2000	M	K76	Death
21 miles northeast	CR 846	2000	M	UCFP35	Death
24 miles northeast	CR 846	2000	F	UCFP37	Death
22 miles east	SR 29	2001	M	UCFP41	Death
22 miles east	SR 29	2002	M	FP98	Death
22 miles northeast	CR 846	2002	F	UCFP49	Death
7 miles east	CR 846	2002	M	FP99	Death
14 miles northeast	CR 846	2003	M	UCFP50	Death
22 miles east	SR 29	2003	F	FP106	Death
22 miles east	SR 29	2003	F	UCFP53	Death
22 miles east	SR 29	2003	M	UCFP54	Death
14 miles northeast	CR 846	2003	F	UCFP58	Death
21 miles east	CR 858	2003	F	UCFP59	Death
23 miles southeast	US 41	2003	M	UCFP60	Death
10 miles southeast	I-75	2004	M	UCFP63	Death
23 miles southeast	SR 29	2004	M	UCFP65	Death
14 miles southeast	I-75	2004	M	UCFP66	Death
11 miles south	I-75	2004	M	K94	Death
22 miles east	SR 29	2004	F	UCFP69	Death
22 miles east	SR 29	2004	F	UCFP70	Death
14 miles south	CR 951	2005	M	UCFP73	Death
22 miles northeast	SR 29	2005	M	UCFP75	Death
11 miles south	CR 951	2005	M	K153	Death
17 miles south	US 41	2005	M	UCFP76	Death
7 miles east	CR 846	2006	F	UCFP79	Death
25 miles north	I-75	2006	M	UCFP81	Death
11 miles north	Corkscrew Road	2006	M	UCFP87	Death
17 miles south	US 41	2006	F	UCFP88	Death
10.6 miles southeast	I-75	2007	M	UCFP94	Death
22.1 miles east-northeast	SR 29	2007	M	UCFP100	Death
11.5 miles north-northwest	I-75	2007	M	UCFP93	Death
11.1 miles north	Corkscrew Road	2007	F	UCFP97	Death

Distance from Project	Roadway	Year	Sex	Panther	Result
19.5 miles north	SR 82	2007	M	UCFP99	Death
5.4 mile south	Pine Ridge Road	2008	M	UCFP103	Death
21 miles north	Leonard Boulevard	2008	M	UCFP106	Death
17.2 miles south	US 41	2008	F	UCFP107	Death
14.5 miles north-northeast	Imokalee Road	2008	F	UCFP108	Death
22.9 miles east	SR 29	2008	F	UCFP111	Death
14 mile north	Alico Road	2008	M	UCFP113	Death
19.1 miles east	CR 858	2008	F	UCFP114	Death
24.4 miles southeast	I_75	2009	M	K253	Death
22.3 miles east-northeast	SR 29	2009	F	UCFP116	Death
17 miles north-northwest	Treeline Avenue	2009	M	UCFP118	Death
18.8 miles east-northeast	Immolakee Road	2009	M	UCFP122	Death
16.3 mile southeast	I-75	2009	F	UCFP124	Death
11.96 miles southeast	I-75	2009	F	UCFP125	Death
22.8 miles east-northeast	CR 846	2009	M	UCFP129	Death
22.9 miles east-northeast	CR 846	2009	F	UCFP130	Death
14.8 miles northeast	Corkscrew Road	2009	M	UCFP134	Death
10.7 miles southeast	County Barn Road	2009	F	UCFP136	Death
17.8 miles northeast	Corkscrew Road	2010	F	UCFP139	Death
12.3 miles southeast	I-75	2010	M	FP174	Death
4.6 miles northwest	I-75	2010	M	UCFP140	Death
21.6 miles northeast	Church Road	2010	F	UCFP141	Death
7.1 miles southeast	Golden Gate Boulevard	2010	F	UCFP142	Death
22.2 miles south-southeast	US 41	2010	F	FP158	Death
16.7 miles southeast	US 41	2010	M	UCFP143	Death
22.1 miles east-northeast	SR 29	2010	M	UCFP145	Death
22.9 miles east-northeast	SR 29	2010	F	UCFP146	Death
6.1 miles southeast	Golden Gate Boulevard	2010	M	UCFP149	Death
9.7 miles southeast	I-75	2011	F	UCFP152	Death
9.4 miles southeast	I-75	2011	M	UCFP153	Death
4.1 miles northwest	I-75	2011	M	UCFP156	Death
23.6 miles southeast	US 41	2011	F	FP83	Death

Table 10. Formal Consultations within the Mirasol Project Watershed - Panthers

					County	Habitat Impacts	Habitat Preserved
BO	10/06/03	4-1-02-F-0027	200102043	Bonita Beach Road Development	Lee	1,117	785
BO	03/28/08	4-1-04-F-5260	20016580	Parklands	Collier	487	591
BO	08/28/07	4-1-04-F-5744	199603501	Terafina	Collier	363	545
Total						1,967	1,921

Table 11. Original panther habitat unit values for use in assessing habitat value to the Florida panther.

Land Cover Type	Value	Land Cover Type	Value	Land Cover Type	Value
Water	0	STA	4.5	Cypress swamp	9
Urban	0	Shrub swamp	5	Sand pine scrub	9
Coastal strand	1	Shrub and brush	5	Sandhill	9
Reservoir	1.5	Dry prairie	6	Hardwood-Pine forest	9
Mangrove swamp	2	Grassland/pasture	7	Pine forest	9
Salt marsh	2	Freshwater marsh	9	Xeric oak scrub	10
Exotic/nuisance plants	3	Bottomland hardwood	9	Hardwood forest	10
Cropland	4	Bay swamp	9		
Orchards/groves	4	Hardwood swamp	9		

Table 12. Panther Habitat Selection Analyses – Habitat Papers Comparison.

Panther Habitat Selection Analyses – Habitat Papers Comparison – Table 2													
Habitats	Kautz compositional second order	rank	Kautz Euclidean second order	rank	Habitats	Cox Euclidean second order	rank	Cox Euclidean third order	rank	Habitats	Land VHF Euclidean third order	rank	Land GPS Euclidean third order	rank
Hardwood swamp	1	A	3	A	Coniferous forest	1	A	1	A	Upland forest	1	A	1	A
Pineland	2	A	2	AB	pineland					pine/hardwood				
Cypress swamp	3	AB	1	BC	Hardwood forest	3	C	2	A	hardwood hammock				
Upland forest	1	B	4	CD	hardwood hammock					pinelands				
Dry prairie	5	B	5	DE	mixed pine/hardwood					tropical hammock				
Shrub and brush	4	C	7	EF	palm/oak					palm/hardwood				
Xeric scrub	3	CD	9	F	tropical hammock					Wetland forest	2	A	2	AB
Marsh	5	CD	9	F	Forested wetland	2	B	3	A	cypress swamp				
Unimproved pasture	7	DE	7	G	cypress swamp					cypress/pine/palm				
Barren	6	E	9	G	mixed forest					mixed swamp				
Improved pasture	9	EF	6	G	shrub swamp					hardwood swamp				
Urban	8	F	8	G	hardwood swamp					Dry prairie/grass	3	B	3	BC
Cropland	9	F	8	H	other wet forest					grassland				
Citrus	10	G	8	H	Dry prairie/grass	4	C	4	B	unimproved pasture				
Coastal wetlands	11	G	8	H	dry prairie					improved pasture				
Open water	10	H	10	I	grassland					Marsh/shrub	6	B	4	C
Exotic plants					Open wetland	7	E	7	C	marsh/wet prairie				
STA					marsh and wet prairie					sawgrass				
Reservoir					sawgrass					cattail				
					cattail					shrub swamp				
					Agricultural	5	D	5	B	Other	4	B	5	C
second order - selection of home range with entire study area					improved pasture					open water				
third order - selection of habitats within home range					citrus					shrub/brush				
Bold (black) - habitat used more than availability (selection)					row crop					barren				
Bold (red) - habitat used less than availability (avoidance)					other agriculture					high impact urban				
rank - habitats with same letters did not differ in preference					Urban/barren	6	E	6	B	low impact urban				
					bare soil					extractive				
					high-impact urban					Agriculture	5	B	6	C
					low-impact urban					citrus				
					extractive					row crop				
										other agriculture				

Table 13. Summary of Ranking Values.

Habitats	Kautz compositional second order	Kautz Euclidean second order	Cox Euclidean second order	Cox Euclidean third order	Land VHF Euclidean third order	Land GPS Euclidean third order	Average
Hardwood swamp	10	7	9	10	10	9	9.2
Pineland	9	8	10	10	10	10	9.5
Cypress swamp	8	9	9	10	10	9	9.2
Upland forest	10	6	8	10	10	10	9.0
Dry prairie	6	5	8	6	6	7	6.3
Shrub and brush	7	3	no data	no data	6	6	5.5
Xeric scrub	8	1	no data	no data	no data	no data	4.5
Marsh	6	1	6	3	6	6	4.7
Unimproved pasture	4	3	8	6	6	7	5.7
Barren	5	1	7	6	6	6	5.2
Improved pasture	2	4	7	6	6	6	5.2
Urban	3	2	7	6	6	6	5.0
Cropland	2	2	7	6	6	6	4.8
Citrus	1	2	7	6	6	6	4.7
Coastal wetlands	0	2	no data	no data	no data	no data	1.0
Open water	1	0	no data	no data	6	6	3.3
Exotic plants							
STA							
Reservoir							
		habitat selection		7,8,9,10			
		neither selected nor avoided		4,5,6			
		habitat avoidance		0,1,2,3			

Table 14. Revised panther habitat unit values for use in assessing habitat value to the Florida panther.

Land Cover Type	Value	Land Cover Type	Value	Land Cover Type	Value
Reservoirs	*	Xeric scrub	4.5	Dry prairie	6.3
STAs	**	Orchards/groves	4.7	Upland Hardwood Forest	9.0
Urban	0	Marsh/ wet prairie	4.7	Cypress swamp	9.2
Water	0	Cropland	4.8	Hardwood swamp	9.2
Barren/Disturbed lands	3	Improved pasture	5.2	Hardwood-Pine	9.3
Coastal wetlands	3	Shrub swamp/brush	5.5	Upland-Hydric Pine forest	9.5
Exotic/nuisance plants	3	Unimproved pasture	5.7		

* PHU values for reservoirs are evaluated based on open water for the main water areas and the appropriate categories for berms and other non-water sections. Refer to the accompanying text for guiding criteria for these systems.

** PHU values for stormwater treatment areas vary depending on design criteria, mode of operation, location in native or non-native habitats, and other landscape features. Refer to the accompanying text for guiding criteria for these systems.

Table 15. Landscape Compensation Multipliers

Zone of Impacted Lands	Zone of Compensation Lands	Multiplier
Primary	Secondary	1.45
Secondary	Primary	0.69
Other	Secondary	0.48
Other	Primary	0.33

Table 16
Florida Panther Habitat Matrix
Panther Habitat Units

Land Cover Types	Habitat Values	Project Development 809.83 acres				Onsite Preserve 903.66 acres***				Offsite Preserve PIMB** 82.21 acres				Offsite Preserve Primary Zone 291.10 acres			
		Functional Units Needed 9,710.30				Functional Units Provided 6671.75*				Functional Units Provided 708.88				Functional Units Provided 2,329.67****			
		PHU Loss 3,884.12				Average PHU 6,671.251/903.66 = 7.38				Average PHU 708.88/82 = 8.62				Average PHU's per acre (7.38+8.62)/2=8.0			
		Pre		Post		Pre		Post		Pre		Post		Pre		Post	
		Acres	PHU	Acres	PHU	Acres	PHU	Acres	PHU	Acres	PHU	Acres	PHU	Acres	PHU	Acres	PHU
Water/Urban	0		0.00	809.79	0.00	0.27	0.00	0.00	0.00								
Exotic Plants	3	579.09	1,737.27		0.00	572.64	1,717.92	0.00	0.00								
Disturbed Land	3	3.20	9.60		0.00	0.00	0.00	0.00	0.00								
Hardwood Swamp	9.2	0.81	7.45		0.00	0.09	0.83	0.14	1.29								
Cypress Swamp	9.2	18.04	165.97		0.00	95.91	882.37	105.88	974.10								
Cypress-Pine	9.3	11.06	102.86		0.00	29.93	278.35	57.68	536.42								
Pine Forest	9.5	194.19	1,844.81		0.00	202.54	1,924.13	737.41	7,005.40								
Marsh/Wet Prairie	4.7	3.44	16.17		0.00	2.28	10.72	2.55	11.99								
Subtotal		809.83	3,884.12	809.79	0.00	903.66	4,814.32	903.66	8,529.19								

* Functional Units provided are one-half of the difference between pre and post enhancement values added to the pre value

** As part of the compensation proposal, the appicant is proposing the purchase of 27.68 wetland credits from PIMB to meet the wetland impact mitigation neeeds. The 27.68 credits represent 82.21 acres with a corresponding primary equivalent PHU value of 708.88 units.

*** Includes 19.95 acres of golf course buffer preserve.

**** To meet the recommended PHU compensation of 9,710.30 PHUs, an additional 2,329.67 primary equivalent PHUs are required. The applicant is proposing the acquisition of sufficient PHUs in the primary and/or dispersal zone. The 291.10-acre estimate is the additional PHU needs divided by the average PHU value per acre of the 903.66 onsite preserve and the average PHU value of PIMB. Total preserve acreage is 1,276.97 acres (903.66+82.21+291.10=1,1,276.97)

Table 17. Hydroperiod classes of wetlands in the action area

Hydroperiod	Core Foraging Area Acreage			
	CorkScrew I	Corkscrew II	North Catheline	Combined
Class 1 - 0 to 60 days	138,286	136,251	271,569	227,845
Class 2 - 60 to 120 days				
Class 3 - 120 to 180 days				
Class 4 - 180 to 240 days	121,496	123,391	247,160	253,821
Class 5 - 240 to 300 days				
Class 6 - 300 to 330 days				
Class 7 - 330 to 365 days				
TOTAL	259,783	259,641	518,727	481,666

Table 18. Hydroperiod classes of wetlands in the development footprint

Hydroperiod	Development Footprint	Internal & Golf Course Preserve
Class 1 - 0 to 60 Days		
Class 2 - 60 to 120 Days	66.69	1.1
Class 3 - 120 to 180 Days	508.97	43.31
Class 4 - 180 to 240 Days	68.63	9.98
Class 5 - 240 to 300 Days	1.06	0.13
Class 6 - 300 to 330 Days		
Class 7 - 330 to 365 days		
Short Hydrperiod	575.66	44.41
Long Hydroperiod	69.69	10.11
Total	645.35	54.52

Table 19. Hydroperiods of wetland preserves, includes internal and golf course preserves

Hydroperiod	Preserve Area Footprint Pre-Enhancement	Preserve Area Footprint Post-Enhancement
Class 1 - 0 to 60 Days		
Class 2 - 60 to 120 Days	17.01	17.01
Class 3 - 120 to 180 Days	490.55	490.55
Class 4 - 180 to 240 Days	238.46	238.46
Class 5 - 240 to 300 Days	85.06	85.06
Class 6 - 300 to 330 Days	0.27	0.27
Class 7 - 330 to 365 days		
Short Hydroperiod	507.56	507.56
Long Hydroperiod	323.79	323.79
TOTAL	831.35	831.35

Table 20. Formal Consultations on Projects within the Action Area – Wood Storks.

BO Date	FWS No.	Corps No.	Project Name	County	Direct Impact (acres)	Indirect Impact (acres)	Conserved (acres)	Nests
10/06/03	4-1-02-F-0027	200102043	Bonita Beach Rd. Development	Lee	99	1,500	531	50
12/29/03	4-1-02-F-1743	200202926	Forum/Saratoga Investments	Lee	137	-	600	14
02/23/04	4-1-02-F-015	200105926	Cypress Run	Collier	28	-	25	1
03/28/08	4-1-04-F-5260	20016580	Parklands	Collier	209	-	541	0
08/28/07	4-1-04-F-5744	199603501	Terafina	Collier	296	-	322	1
Sub-total					769	1,500	2,019	66
Total					2,269		2,019	66

Table 21. Vegetation cover types from O'Hare and Dalrymple (1997).

DMM	75-100 percent mature dense melaleuca coverage
DMS or (SDM)	75-100 percent sapling dense melaleuca coverage
P75	50-75 percent melaleuca coverage
P50	0-50 percent melaleuca coverage
MAR (Marsh)	0-10 percent melaleuca coverage

Table 22. Foraging suitability value.

Cover type	No. of species (S)	No. of individuals (I)	S*I	Foraging suitability
DMM	1	2	2	0.001
DMS	4	10	40	0.025
P75	10	59	590	0.372
P50	11	92	1,012	0.639
MAR	12	132	1,584	1.000

Table 23. Foraging suitability index.

Exotic percentage	Foraging suitability (percent)
Between 0 and 25 percent exotics	100
Between 25 and 50 percent exotics	64
Between 50 and 75 percent exotics	37
Between 75 and 90 percent exotics	3
Between 90 and 100 percent exotics	0

Table 24. Foraging suitability index.

Exotic percentage	Foraging suitability (percent)
Between 0 and 25 percent exotics	100
Between 25 and 50 percent exotics	64
Between 50 and 75 percent exotics	37
Between 75 and 90 percent exotics	3
Between 90 and 100 percent exotics	3

Table 25. District hydroperiod classes – Everglades protection area.

Hydroperiod class	Days inundated
Class 1	0-60
Class 2	60-120
Class 3	120-180
Class 4	180-240
Class 5	240-300
Class 6	300-330
Class 7	330-365

Table 26. Fish densities per hydroperiod from Trexler et al. (2002).

Hydroperiod class	Days inundated	Fish density
Class 1	0-120	2.0 fish/m^2
Class 2	120-180	3.0 fish/m^2
Class 3	180-240	4.0 fish/m^2
Class 4	240-300	4.5 fish/m^2
Class 5	300-330	4.8 fish/m^2
Class 6	330-365	5.0 fish/m^2

Table 27. Extrapolated fish densities for District hydroperiods.

Hydroperiod class	Days inundated	Extrapolated fish density
Class 1	0-60	2 fish/m^2
Class 2	60-120	4 fish/m^2
Class 3	120-180	9 fish/m^2
Class 4	180-240	16 fish/m^2
Class 5	240-300	20 fish/m^2
Class 6	300-330	23 fish/m^2
Class 7	330-365	25 fish/m^2

Table 28. Extrapolated mean annual fish biomass for District hydroperiods.

Hydroperiod class	Days inundated	Extrapolated fish biomass
Class 1	0-60	0.5 gram/m^2
Class 2	60-120	1.0 gram/m^2
Class 3	120-180	2.3 grams/m^2
Class 4	180-240	4.2 grams/m^2
Class 5	240-300	5.2 grams/m^2
Class 6	300-330	6.0 grams/m^2
Class 7	330-365	6.5 grams/m^2

Table 29. Primary fish species consumed by wood storks from Ogden et al. (1976).

Common name	Scientific name	Percent individuals	Percent biomass
Sunfishes	*Centrarchidae* spp.	14	44
Yellow bullhead	*Italurus natalis*	2	12
Marsh killifish	*Fundulus confluentus*	18	11
Flagfish	*Jordenella floridae*	32	7
Sailfin molly	*Poecilia latipinna*	20	11

Table 30. Wood stork suitable prey base (fish biomass per hydroperiod).

Hydroperiod class	Days inundated	Fish biomass
Class 1	0-60	0.26 gram/m^2
Class 2	60-120	0.52 gram/m^2
Class 3	120-180	1.20 grams/m^2
Class 4	180-240	2.18 grams/m^2
Class 5	240-300	2.70 grams/m^2
Class 6	300-330	3.12 grams/m^2
Class 7	330-365	3.38 grams/m^2

Table 31. Wood stork suitable prey base (fish and crayfish biomass per hydroperiod).

Hydroperiod class	Fish biomass	Crayfish biomass	Total biomass	Percent change
Class 1	0.26 gram/m^2	0.05 gram/m^2	0.31 gram/m^2	19.2
Class 2	0.52 gram/m^2	0.10 gram/m^2	0.62 gram/m^2	19.2
Class 3	1.19 grams/m^2	0.13 gram/m^2	1.32 grams/m^2	10.5
Class 4	2.18 grams/m^2	0.15 grams/m^2	2.34 grams/m^2	7.0
Class 5	2.70 grams/m^2	0.23 grams/m^2	2.93 grams/m^2	8.4
Class 6	3.12 grams/m^2	0.24 gram/m^2	3.36 gram/m^2	7.7
Class 7	3.38 grams/m^2	0.25 gram/m^2	3.63 gram/m^2	7.4

Table 32. Acreage and Biomass in Individual Hydroperiod Classes of Wetlands Suitable for Wood Stork Foraging in the Development and the pre and post Restoration of the Preserves.

Hydroperiod	Existing Footprint		Preserve Area				Net Change*		
			Pre Enhancement		Post Enhancement				
	Acres	Kg	Acres	Kg	Acres	Kg	Acres	Kg	Nests
Class 1: 0 to 60 Days									
Class 2: 60 to 120 Days	66.69	31.13	17.01	5.40	17.01	18.55	(66.69)	-17.98	-0.4
Class 3: 120 to 180 Days	508.97	135.67	490.55	140.57	490.55	1,233.79	(508.97)	957.55	19.2
Class 4: 180 to 240 Days	68.63	20.90	238.46	236.25	238.46	1,114.59	(68.63)	857.44	5.7
Class 5: 240 to 300 Days	1.06	2.36	85.07	276.76	85.07	473.37	(1.06)	194.24	1.3
Class 6: 300 to 330 Days	0	0	0.27	1.19	0.27	1.74	0.00	0.55	0.0
Class 7: 330 to 365 Days	0	0	0	0			0.00		0.0
Short Hydroperiod	575.66	166.80	507.56	145.97	507.56	1,252.34	(575.66)	939.57	18.8
Long Hydroperiod	69.69	23.26	323.79	514.20	323.79	1,589.70	(69.69)	1,052.24	7.0
TOTAL	645.35	190.06	831.35	660.17	831.35	2,842.04	(645.35)	1,991.81	9.9

- The acreage net change is based on the overall increase/decrease in suitable wood stork foraging habitat within the project. The project will result in the loss of 645 acres of wetlands. The preserves include 831 acres of wetlands that will be restored.
- The biomass net change is based on the overall increase/decrease of biomass available to wood storks. The proposed development will provide a loss of 190.06 kg of biomass. The preserves, prior to enhancement, provide a biomass of 660.18 kg, with a post enhancement value of 2,842.04 kg, equating to an increase of 2,842.04 kg of biomass. Subtraction the development loss from the biomass increase from the preserve restoration, the proposed action provides a net increase of 1,991.81 kg of biomass available for wood stork foraging.

Table 33. Conservation Lands Collier and Lee Counties (Acres) (FNAI 2010).

Ownership	Acreages	Percent Total
Collier County – Total Land Acreage - 1,296,640		
County	4,410	0.3%
State	209,820	16.2%
Federal	647,260	49.9%
Private	11,070	0.9%
Total Conservation Lands	872,560	67.3%
Lee County – Total Land Acreage - 347,520		
County	24,460	7.0%
State	49,650	14.3%
Federal	5,270	1.5%
Private	9,050	2.6%
Total Conservation Lands	108,810	31.3%

Table 34. Formal Consultations on Projects within the Action Area – Wood Storks.

BO Date	FWS No.	Corps No.	Project Name	County	Direct Impact Acres	Indirect Impact Acres	Conserved Acres	Nest Take
10/06/03	4-1-02-F-0027	200102043	Bonita Beach Rd.	Lee	99	1,500	531	50
12/29/03	4-1-02-F-1743	200202926	The Forum -	Lee	137	0	600	14
02/23/04	4-1-02-F-015	200105926	Cypress Run	Collier	28	0	25	1
03/28/08	4-1-04-F-5260	20016580	Parkland	Collier	209	0	541	0
08/28/07	4-1-04-F-5744	199603501	Terafina	Collier	296	0	322	1
04/21/11	41420-2006-F-0674	2000-1926	Mirasol	Collier	645	0	831	1
Sub-total					1,414	1,500	2,850	67
Total					2,914		2,850	67

Table 35. Formal Consultations on Projects within the Action Area – Wood Storks.

Hydroperiod	Terafina, Parklands & Mirasol		Preserve Areas				Net Change*		
			Pre Enhancement		Post Enhancement				
	Acres	Kg	Acres	Kg	Acres	Kg	Acres	Kg	Nests
Class 1: 0 to 60 Days									
Class 2: 60 to 120 Days	66.69	31.13	17.01	5.40	17.01	18.55	(66.69)	(17.98)	(0.36)
Class 3: 120 to 180 Days	1,013.33	494.22	1,195.14	757.91	1,191.63	2,997.10	(1,016.84)	1,744.97	34.90
Class 4: 180 to 240 Days	68.63	20.90	298.78	519.32	310.64	1,451.92	(56.77)	911.70	6.04
Class 5: 240 to 300 Days	1.06	2.36	85.07	276.76	85.07	473.37	(1.06)	194.25	1.29
Class 6: 300 to 330 Days			0.27	1.19	0.27	1.74	0.00	0.55	
Class 7: 330 to 365 Days									
Short	1,080.02	525.35	1,212.15	763.31	1,208.64	3,015.65	(1,083.53)	1,726.99	34.54
Long	69.69	23.26	384.12	797.27	395.98	1,927.03	(57.83)	1,106.50	7.33
TOTAL	1,149.71	548.61	1,596.27	1,560.58	1,604.62	4,942.68	(1,141.36)	2,833.49	14.10

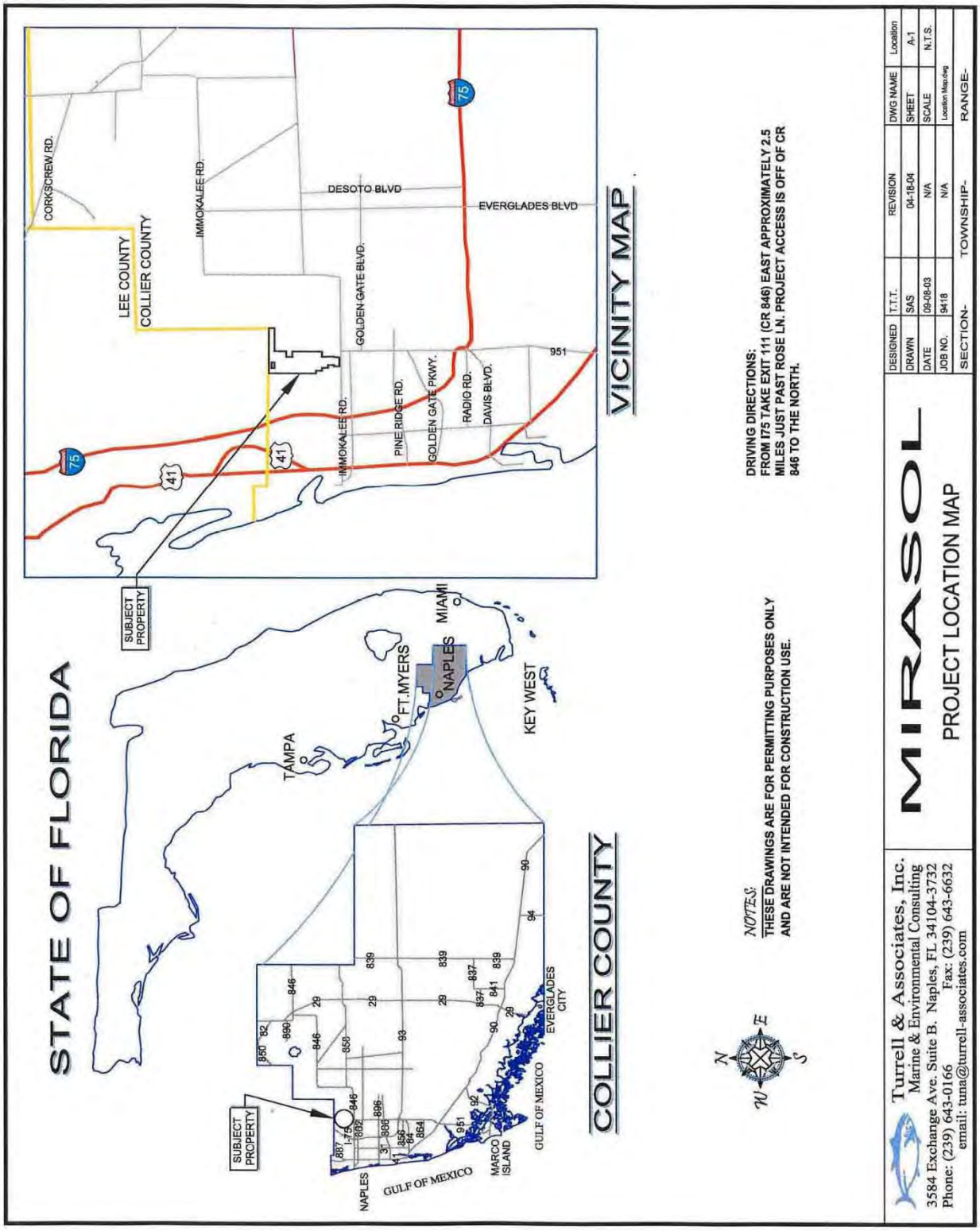

Figure 1. Location of proposed Mirasol project site.

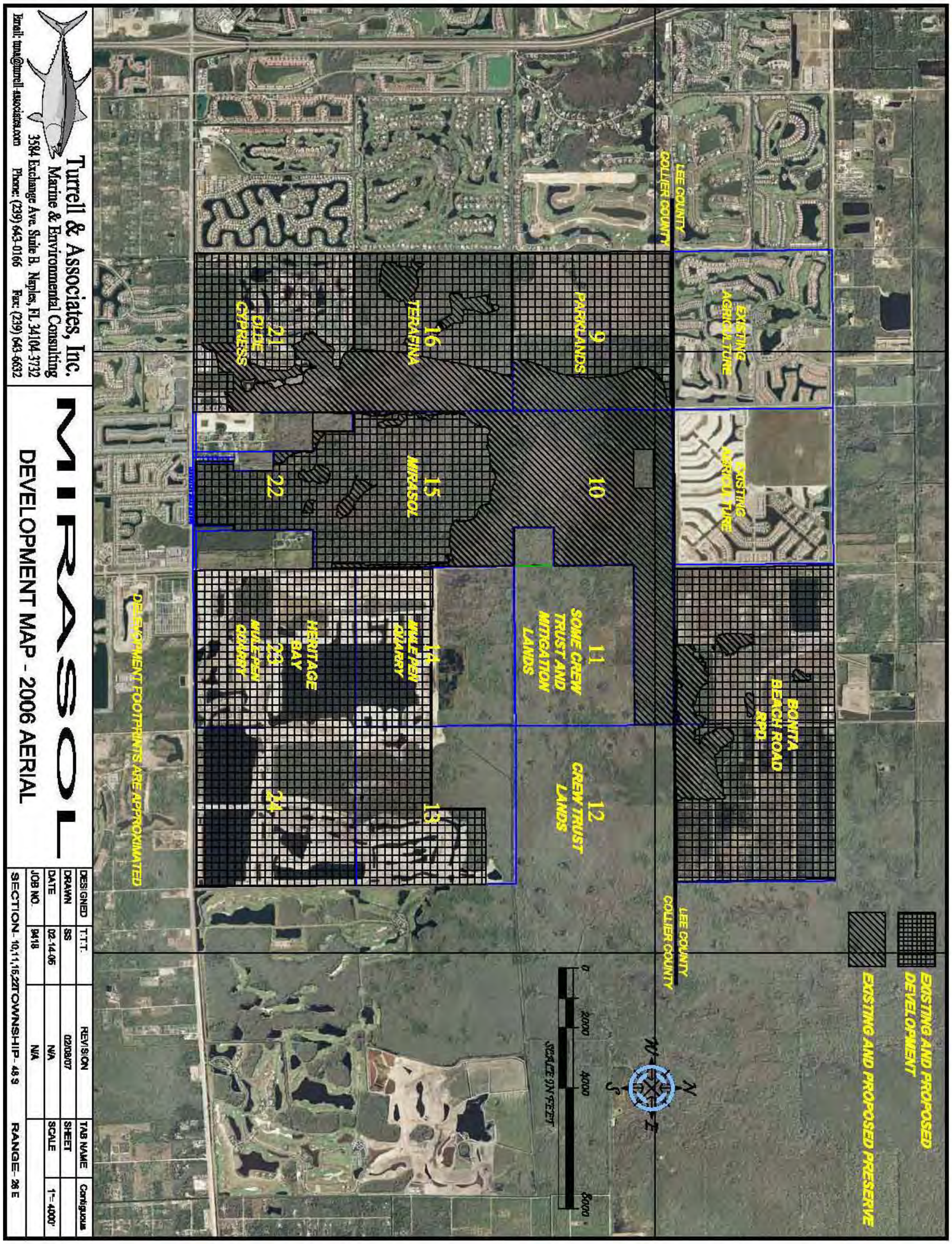

Figure 2. Site plan for Mirasol project.

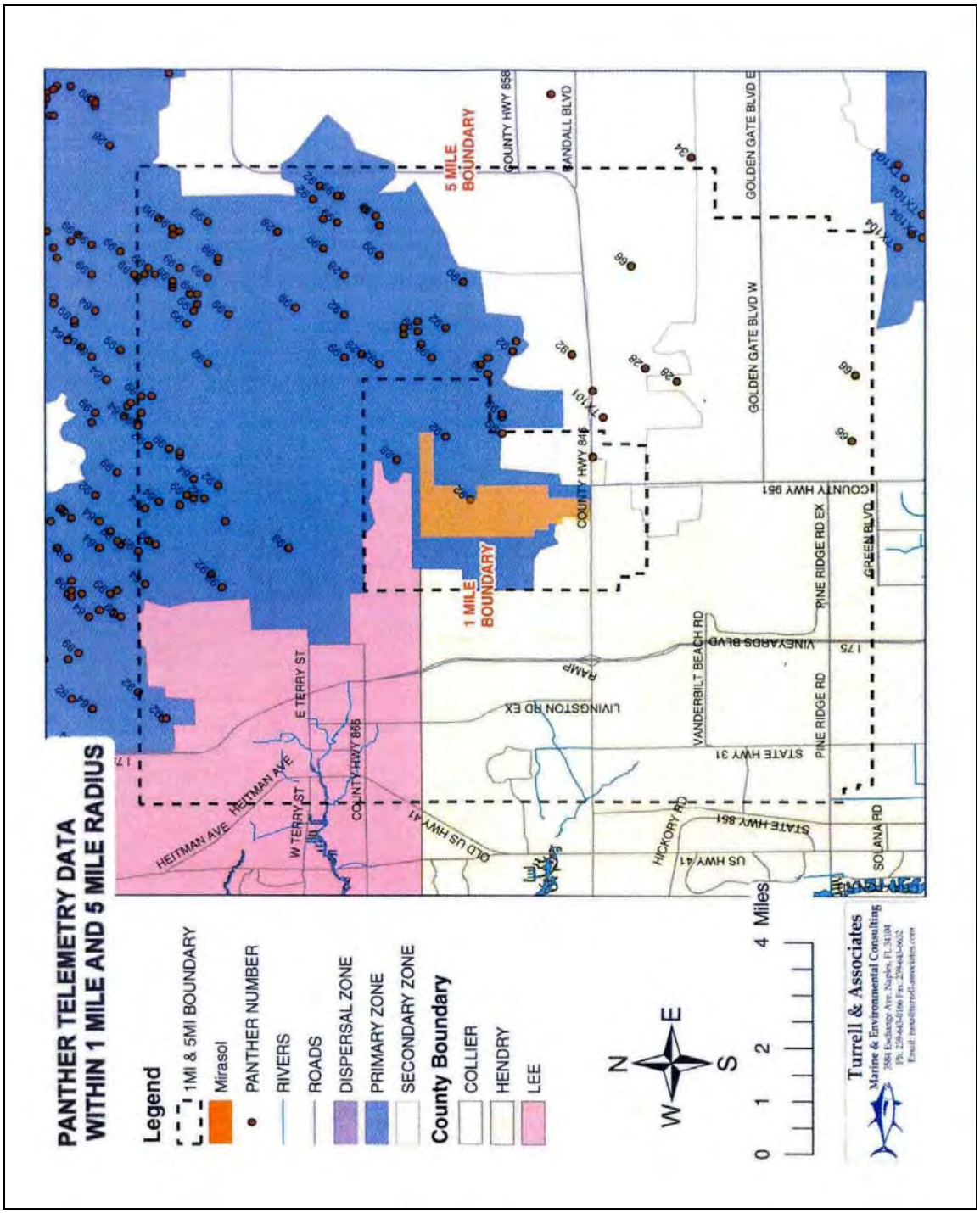

Figure 3. Mirasol project site in relation to panther Primary and Secondary Zones.

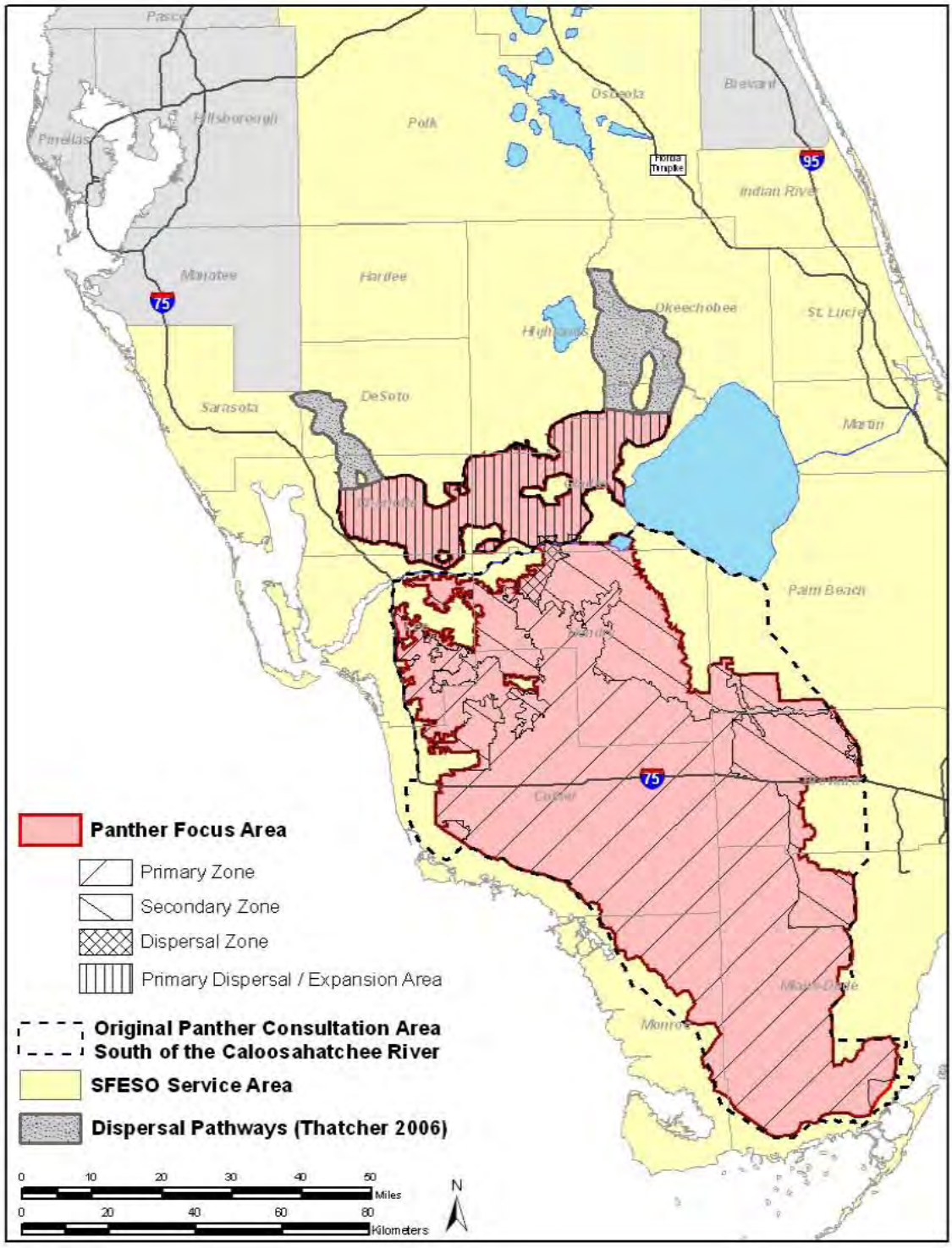

Figure 4. Florida Panther Focus Area.

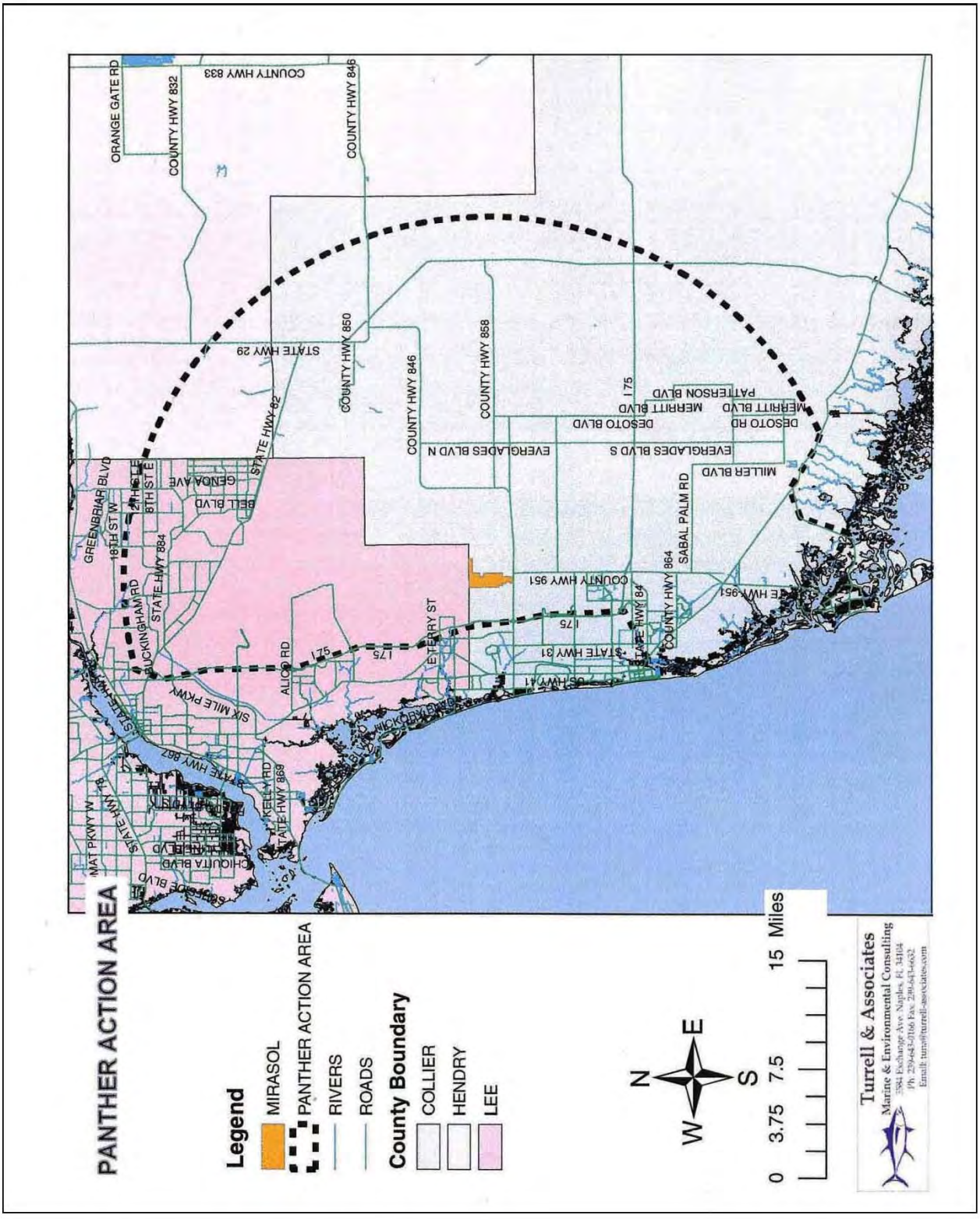

Figure 5. 25-mile Florida Panther Action Area for the Mirasol Project.

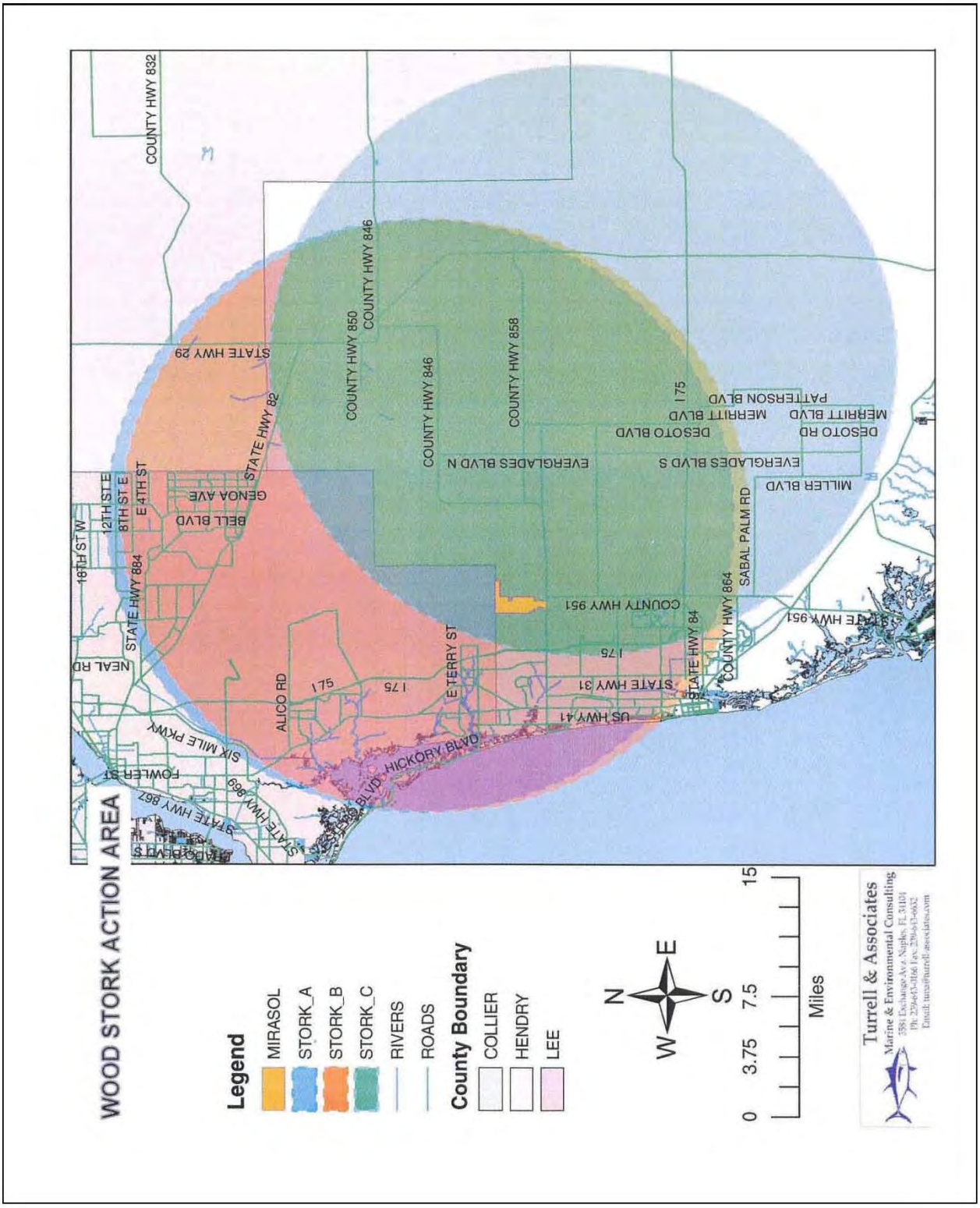

Figure 6. Action Area for the Wood Stork.

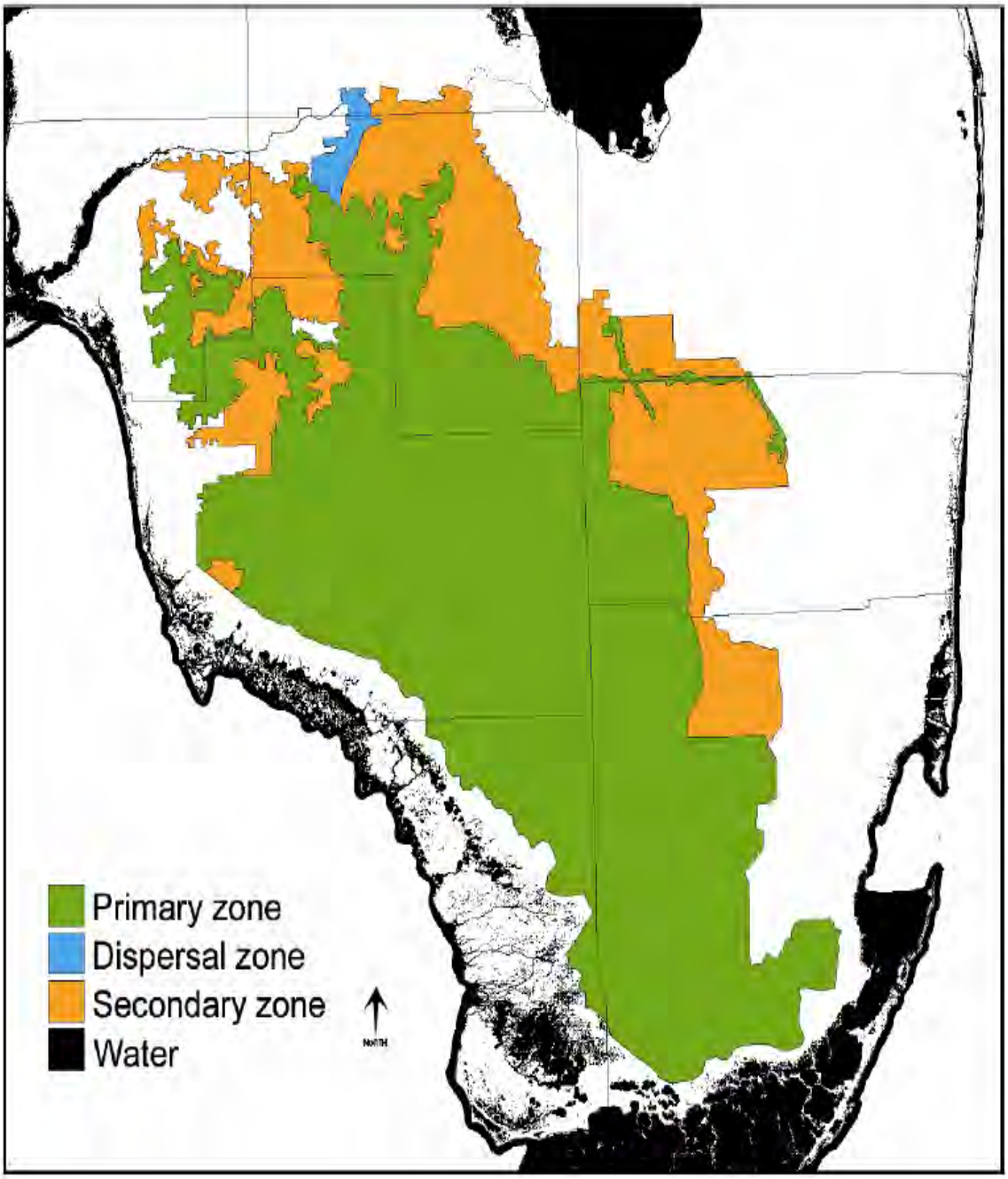

Figure 7. Florida Panther Zones (Kautz et al. 2006).

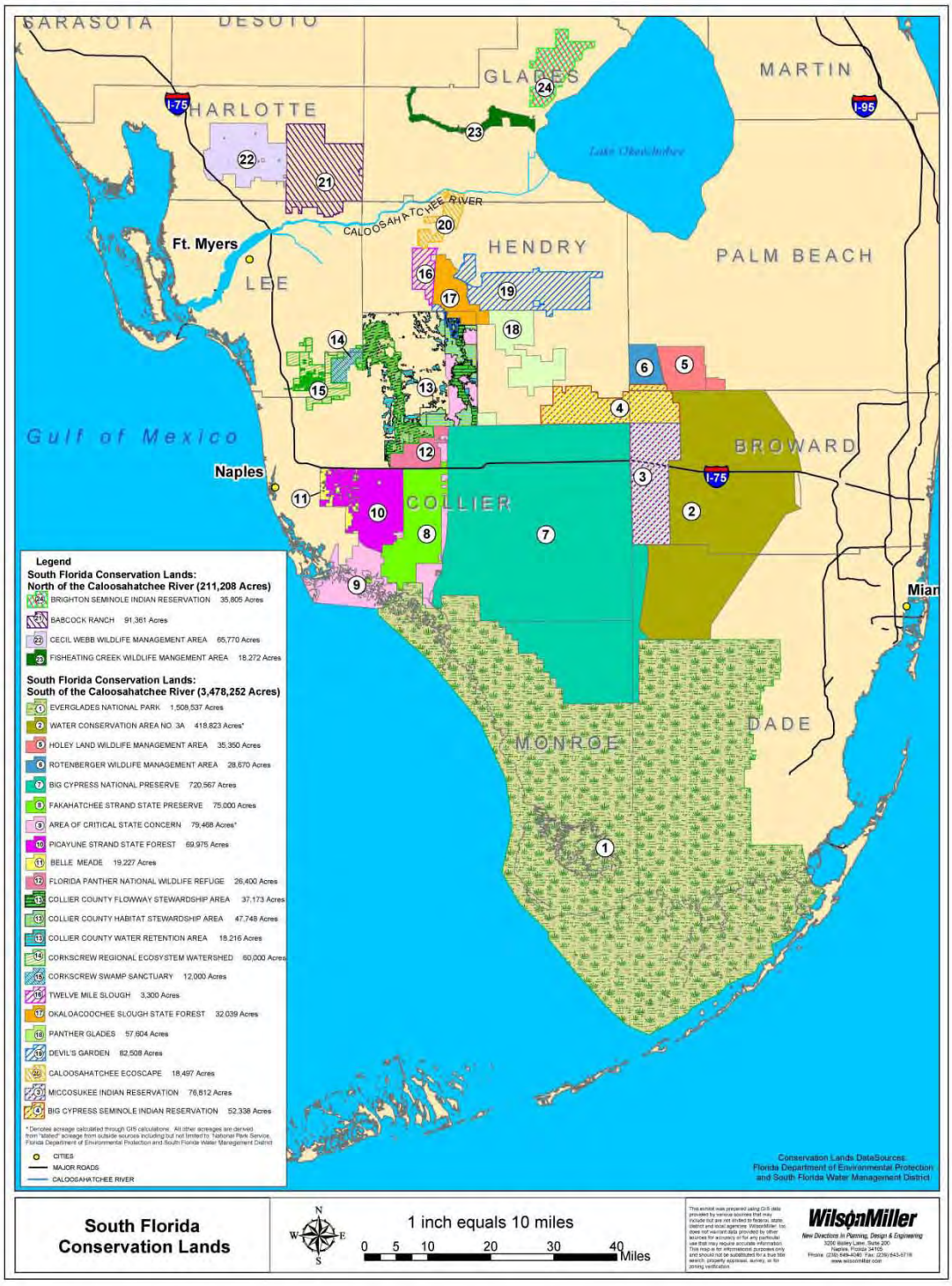

Figure 8. South Florida conservation lands.

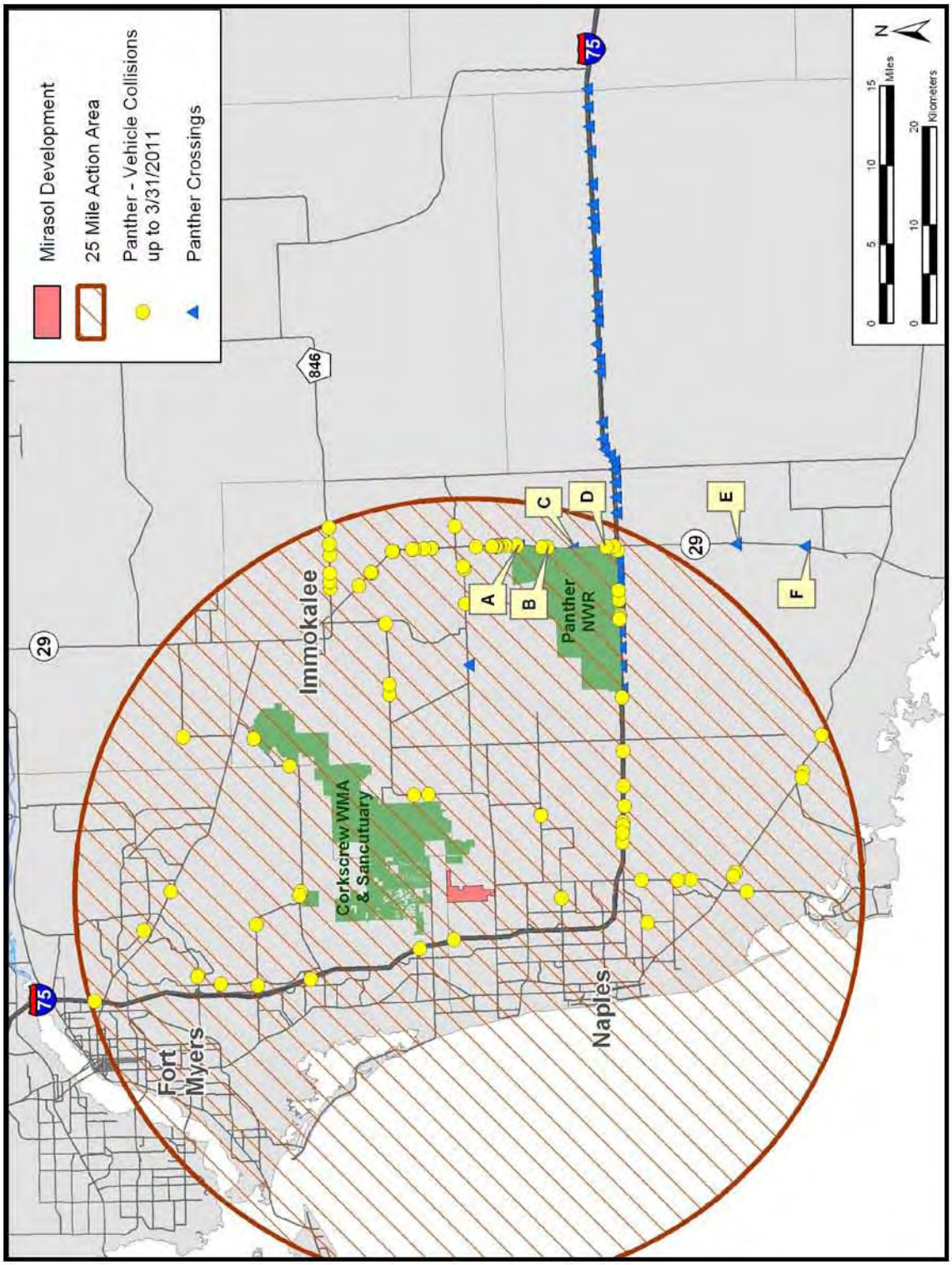

Figure 9. Panther-vehicle collisions and wildlife crossings within panther action area as of March 31, 2011.

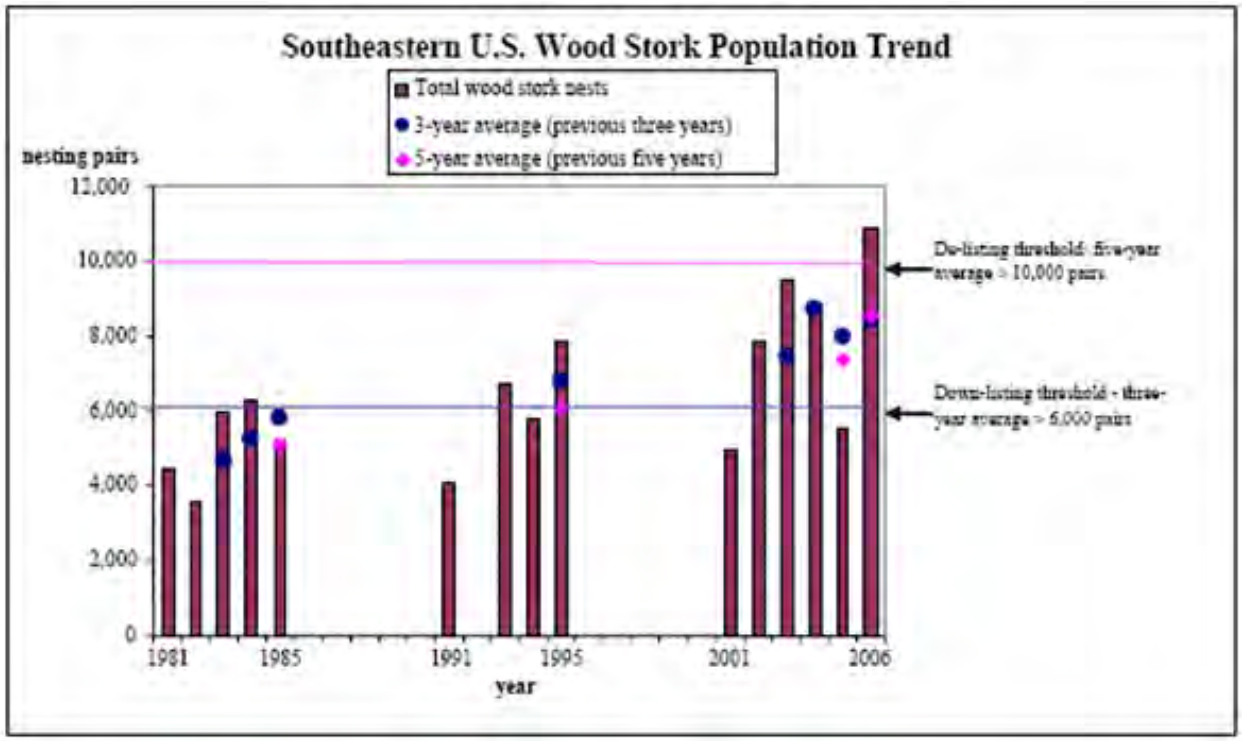

Figure 10. Total Wood Stork Nesting in the Southeastern U.S. in Relation to Recovery Criteria.

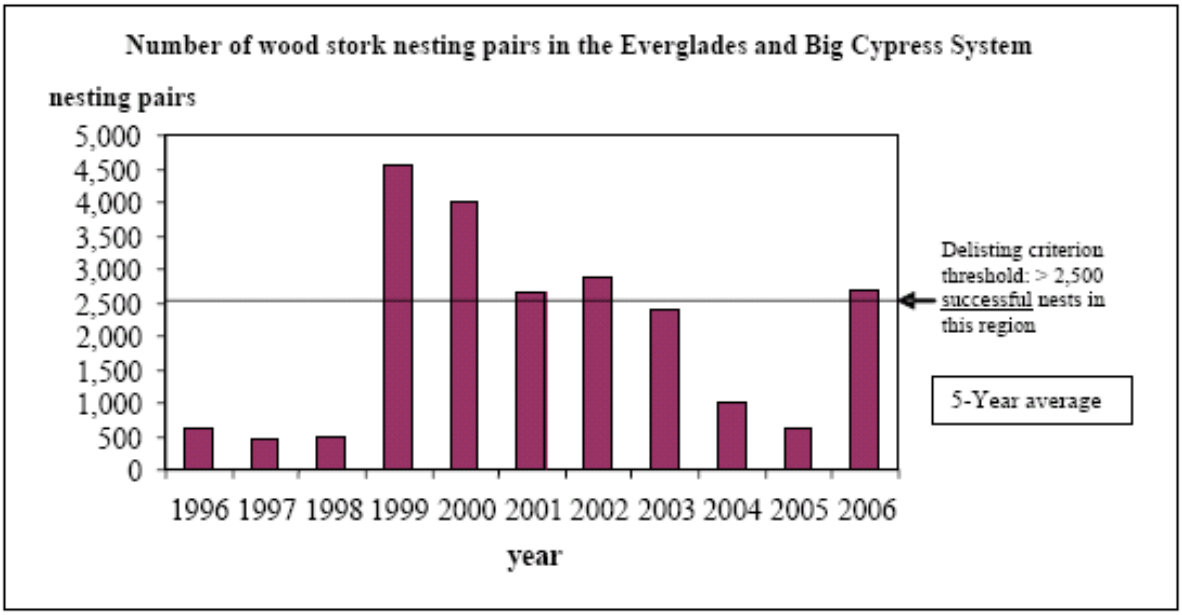

Figure 11. Graph of Wood Stork Nesting in Everglades and Big Cypress System**.**

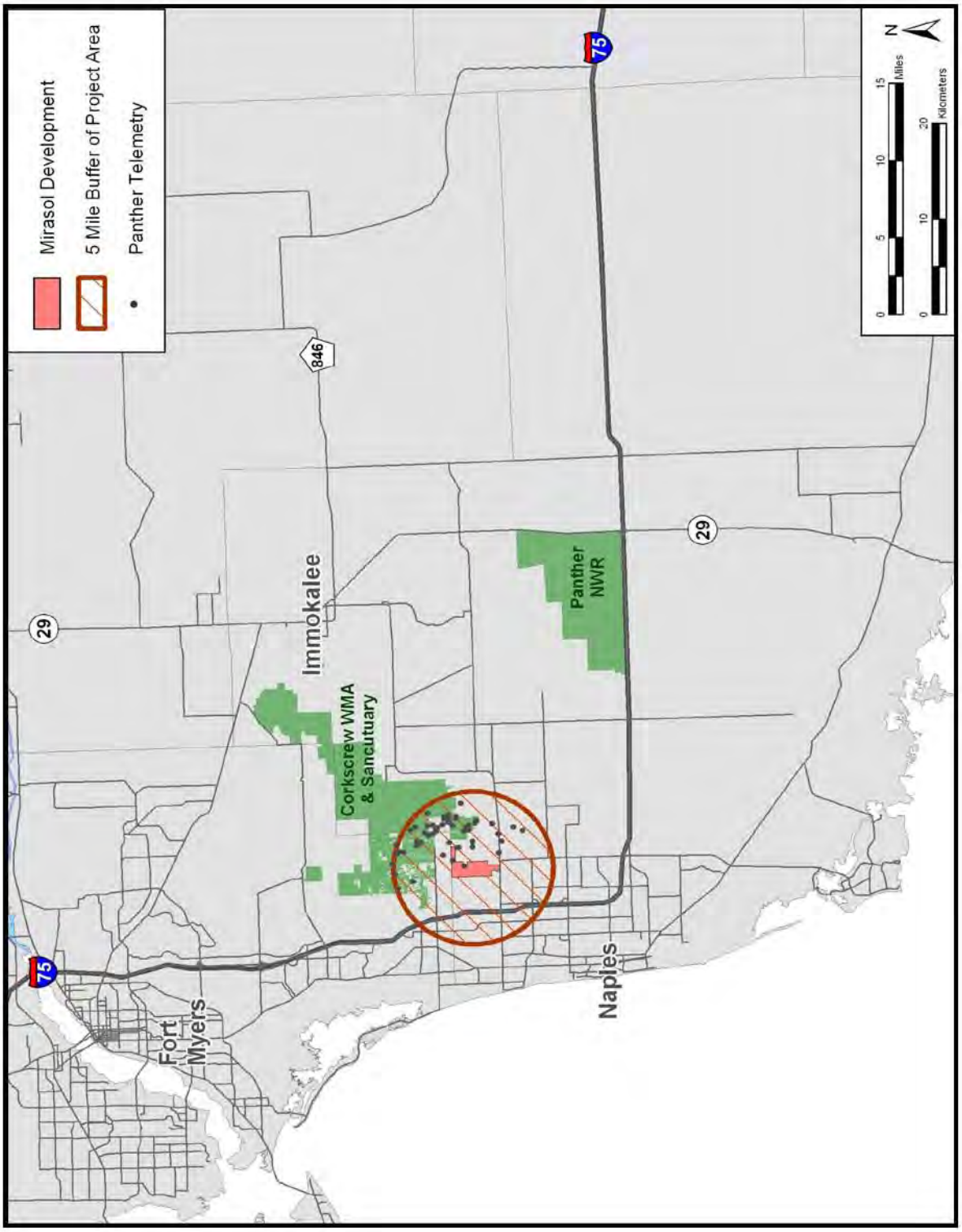

Figure 12. Panther telemetry within a 5-mile radius of the project site.

Appendix 1

Fish Biomass Composite

Appendix 1																
		Kushlan et al. (1986)					Ogden et al. (1976)		Everglades - Trexler et al. (2002)				Sample Size Values			
Species	Common name	Mean Mass (g)	Percent of total mass	Proportion of fish < 15mm	Proportion of fish > 90mm	Proportion within 15-90 mm wood stork preference range	% items consumed by stork	% biomass consumed by stork	Total collected	% of total collected	Mean mass based on % collected	% of estimated biomass collected	Mass within 6 g/m2	Mass within 6.5 g/m2	Mass within stork prey size 6.0 sample	Mass within stork prey size 6.5 sample
Osteichtheyes																
Amia calva	Bowfin	1307.3	48.41%	0.000	0.997	0.002	0.1	0.1		0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Lepisosterus platyrhincus	gar	182.5	6.76%	0.012	0.948	0.039	0.2	2.8	1	0.003	0.484	1.40%	0.084	0.091	0.003	0.004
Elops saurus	lady fish	346.7	12.84%	0.000	1.000	0.000				0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Notemigonus crysoleucas	golden shiner	2.5	0.09%	0.086	0.028	0.885	0.1	0.2		0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Notropis petersoni	coastal shiner	0.3	0.01%	0.029	0.000	0.971			60	0.159	0.046	0.13%	0.008	0.009	0.008	0.008
Notropis maculatus	taillight shiner		0.00%				0.2	0.1	1	0.003	0.000	0.00%	0.000	0.000	0.000	0.000
Erimuzon sucetta	Lake cubsucker	20.5	0.76%	0.300	0.211	0.489			145	0.384	7.864	22.74%	1.365	1.478	0.667	0.723
Ictalurus natalis	yellow bullhead catfish	29.0	1.07%	0.063	0.438	0.499	1.7	11.8	29	0.077	2.228	6.44%	0.387	0.419	0.193	0.209
Ameiurus nebulosus	brown bullhead catfish		0.00%							0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Noturus gyrinus	tadpole madtom	1.4	0.05%	0.052	0.000	0.948	0.2	0.1	8	0.021	0.029	0.09%	0.005	0.006	0.005	0.005
Clarias batrachus	walking catfish	40.5	1.50%	0.016	0.796	0.188			4	0.011	0.429	1.24%	0.074	0.081	0.014	0.015
Bagre marinus	gafftopsail catfish	464.4	17.20%	0.000	0.997	0.003				0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Opsanus beta	gulf toadfish	14.9	0.55%	0.001	0.339	0.660				0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Strongylura notata	redfin needlefish	3.9	0.14%	0.034	0.669	0.297				0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Adinia xenica	diamond killfish	0.7	0.03%	0.002	0.000	0.998				0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Cyprinidon variegatus	sheepshead minnow	0.3	0.01%	0.278	0.000	0.722	4.1	2.7	41	0.109	0.035	0.10%	0.006	0.007	0.004	0.005
Floridichthylys carpio	goldspotted killfish	1.1	0.04%	0.033	0.000	0.967				0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Fundulus chrysotus	golden topminnow	0.4	0.01%	0.273	0.000	0.727	1.3	0.8	1844	4.889	1.750	5.06%	0.304	0.329	0.221	0.239

Appendix 1																
		Kushlan et al. (1986)					Ogden et al. (1976)		Everglades - Trexler et al. (2002)				Sample Size Values			
Species	Common name	Mean Mass (g)	Percent of total mass	Proportion of fish < 15mm	Proportion of fish > 90mm	Proportion within 15-90 mm wood stork preference range	% items consumed by stork	% biomass consumed by stork	Total collected	% of total collected	Mean mass based on % collected	% of estimated biomass collected	Mass within 6 g/m2	Mass within 6.5 g/m2	Mass within stork prey size 6.0 sample	Mass within stork prey size 6.5 sample
Fundulus confluentus	marsh killifish	0.5	0.02%	0.188	0.000	0.812	18.0	10.7	87	0.231	0.120	0.35%	0.021	0.023	0.017	0.018
Fundulus grandis	gulf killfish	9.9	0.37%	0.001	0.118	0.881				0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Fundulus seminolis	seminole killifish	5.8	0.22%	0.000	0.110	0.890	0.7	3.1	1	0.003	0.016	0.04%	0.003	0.003	0.002	0.003
Jordanella floridae	flagfish	0.3	0.01%	0.260	0.000	0.740	32.0	7.0	1783	4.728	1.480	4.28%	0.257	0.278	0.190	0.206
Lucania goodei	bluefin killifish	0.1	0.00%	0.280	0.000	0.720	0.1	0.1	8391	22.248	2.759	7.98%	0.479	0.519	0.344	0.373
Lucania parva	rainwater killifish	0.2	0.01%	0.150	0.000	0.850	0.3	0.1	1	0.003	0.001	0.00%	0.000	0.000	0.000	0.000
Gambusia affinus	mosquitofish	0.1	0.00%	0.464	0.000	0.536	6.3	0.5	9825	26.051	2.214	6.40%	0.384	0.416	0.206	0.223
Heterandria formosa	least killifish	0.0	0.00%	0.917	0.000	0.083	0.5	0.1	12713	33.708	1.315	3.80%	0.228	0.247	0.019	0.021
Poecilia latipinna	sailfin molly	0.2	0.01%	0.292	0.000	0.708	19.8	10.6	1699	4.505	1.081	3.13%	0.188	0.203	0.133	0.144
Labidesthes sicculus	brook silverside	0.5	0.02%	0.002	0.000	0.998	0.1	0.1	5	0.013	0.007	0.02%	0.001	0.001	0.001	0.001
Menidia beryllina	tidewater silverside	0.8	0.03%	0.000	0.000	1.000	0.1	0.1		0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Elassoma evergladei	everglades pygmy sunfish	0.2	0.01%	0.250	0.000	0.750			487	1.291	0.200	0.58%	0.035	0.038	0.026	0.028
Enneacanthus gloriosus	bluespotted sunfish	0.5	0.02%	0.155	0.000	0.845	0.8	0.9	238	0.631	0.321	0.93%	0.056	0.060	0.047	0.051
Lepomis gulosus	warmouth	36.8	1.36%	0.006	0.484	0.510	4.8	27.2	18	0.048	1.754	5.07%	0.304	0.330	0.155	0.168
Lepomis macrochirus	bluegill	21.2	0.79%	0.047	0.283	0.670	0.3	0.7	6	0.016	0.337	0.98%	0.059	0.063	0.039	0.043
Lepomis marginatus	dollar sunfish	2.1	0.08%	0.046	0.000	0.954			14	0.037	0.077	0.22%	0.013	0.014	0.013	0.014
Lepomis microlophus	redear sunfish	30.8	1.14%	0.052	0.362	0.586	2.3	5.4	55	0.146	4.490	12.99%	0.779	0.844	0.457	0.495
Lepomis punctatus	spotted sunfish	7.0	0.26%	0.182	0.030	0.787	2.8	8.7	197	0.522	3.661	10.59%	0.635	0.688	0.500	0.542
Lepomis	unidentified sunfish	12.6	0.47%	0.137	0.134	0.729	2.5	1.0	16	0.042	0.534	1.54%	0.093	0.100	0.067	0.073

Appendix 1																
		Kushlan et al. (1986)					Ogden et al. (1976)		Everglades - Trexler et al. (2002)				Sample Size Values			
Species	Common name	Mean Mass (g)	Percent of total mass	Proportion of fish < 15mm	Proportion of fish > 90mm	Proportion within 15-90 mm wood stork preference range	% items consumed by stork	% biomass consumed by stork	Total collected	% of total collected	Mean mass based on % collected	% of estimated biomass collected	Mass within 6 g/m2	Mass within 6.5 g/m2	Mass within stork prey size 6.0 sample	Mass within stork prey size 6.5 sample
Sunfish	unidentified sunfish	9.8	0.36%	0.175	0.070	0.754	2.5	1.0		0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Micropterus salmoides	largemouth bass	104.0	3.85%	0.007	0.855	0.138	0.3	4.4	4	0.011	1.103	3.19%	0.191	0.207	0.026	0.029
Etheostoma fusiforme	swamp darter	0.4	0.02%	0.002	0.000	0.998			2	0.005	0.002	0.01%	0.000	0.000	0.000	0.000
Astronotus ocellatus	oscar		0.00%							0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Hemichromis bimaculatus	jewelfish	4.2	0.15%	0.092	0.000	0.908				0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Spilotum nicaraguense	Nicaraguan cichlid		0.00%							0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Eucinostomus gula	jenny mojarra	2.9	0.11%	0.000	0.000	1.000				0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Haemulon plumieri	white grunt	6.2	0.23%	0.000	0.011	0.988				0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Lagodon rhomboides	pinfish	7.1	0.26%	0.001	0.039	0.960				0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Bairdiella chrysoura	silver perch	7.1	0.26%	0.000	0.047	0.953				0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Cichlasoma bimaculatum	black acara	13.0	0.48%	0.000	0.005	0.995			7	0.019	0.242	0.70%	0.042	0.045	0.042	0.045
Cichlasoma urophthalmus	mayan cichlid		0.00%						21	0.056	0.000	0.00%	0.000	0.000	0.000	0.000
Mugil curema	white mullet		0.00%				0.1	0.8		0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Rivulus marmoratus	rivulus		0.00%				0.1	0.1		0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Esox niger	chain pickerel		0.00%				0.1	0.1	5	0.013	0.000	0.00%	0.000	0.000	0.000	0.000
Erimyzon sucetta	lake chubsucker		0.00%							0.000	0.000	0.00%	0.000	0.000	0.000	0.000
Belonesox belizanus	pike killifish		0.00%						3	0.008	0.000	0.00%	0.000	0.000	0.000	0.000
Tilapia mariae	spotted tilapia		0.00%						4	0.011	0.000	0.00%	0.000	0.000	0.000	0.000
Total		2700.6	1.0			30.1			**37,715**	**100.000**	**34.579**	**100.00%**	**6.000**	**6.500**	**3.401**	**3.685**

Appendix 1																
Species	Common name	Kushlan et al. (1986)					Ogden et al. (1976)		Everglades - Trexler et al. (2002)				Sample Size Values			
		Mean Mass (g)	Percent of total mass	Proportion of fish < 15mm	Proportion of fish > 90mm	Proportion within 15-90 mm wood stork preference range	% items consumed by stork	% biomass consumed by stork	Total collected	% of total collected	Mean mass based on % collected	% of estimated biomass collected	Mass within 6 g/m2	Mass within 6.5 g/m2	Mass within stork prey size 6.0 sample	Mass within stork prey size 6.5 sample

Appendix 2

Base Data

Appendix 2A. Acres of habitats within the development footprint (includes internal and golf course preserves).

	Pre-Development Acreage Total	< 25% Melaleuca Coverage	25% - 50% Melaleuca Coverage	50% - 75% Melaleuca Coverage	Greater than 75% Melaleuca Coverage	Post-Development Acreage Total
UPLANDS						
411 – Pine Flatwoods	124.94	18.51	74.82		31.61	2.24
ROW – Road Right-of-way	4.92					
Developed						127.1
Sub-total	129.86	18.51	74.82		31.61	129.86
WETLANDS						
424 – Melaleuca	156.68				156.68	
617 – Mixed Wetland Hardwoods	1.39		1.39			
621 – Cypress	39.48	16.09	11.36	12.03		28.26
624 – Pine / Cypress Flatwood	36.21	2.67	5.76	17.22	10.56	
625 – Hydric Pine Flatwood	461.82	0.62	86.35	120.16	254.69	
643 – Disturbed Prairie	4.29	4.29				
Developed						673.03
Sub-total	699.87	23.67	104.86	149.41	421.93	699.87
TOTAL	829.73	42.18	179.68	149.41	453.54	829.73

Appendix 2B. Acreages of habitats within the preserve footprint.

	Pre-Development Acreage Total	< 25% Melaleuca Coverage	25% - 50% Melaleuca Coverage	50% - 75% Melaleuca Coverage	Greater than 75% Melaleuca Coverage
UPLANDS					
411 – Pine Flatwoods	106.88	83.49	11.49		11.90
Sub-total	106.88	83.49	11.49		11.90
WETLANDS					
422 Brazilian Pepper	3.59				3.59
424 – Melaleuca	226.96				226.96
540– Cattle Pond-	0.27	0.27			
621 – Cypress	93.98	71.47	22.51		
624 – Pine / Cypress Flatwood	54.48		27.10	27.38	
625 – Hydric Pine Flatwood	396.12	14.50	36.44	143.92	201.29
640 – Flag Pond	1.43	1.43			
Sub-total	776.83	87.67	86.05	171.30	431.81
TOTAL	883.71	171.16	97.54	171.3	443.71

Appendix 2C. Data - Service Consultations - Mirasol Action Area Project List – Panthers.

Date	Log Number	Project Number	Applicant (project description)	Direct Effects (acres)	Anticipated Take (acres)	Preservation Onsite (acres)	Compensation Offsite (acres)	Total Compensation (acres)
9/8/2005 02/28/08	4-1-04-F-5260 41420-2008-F-0112	200106580	Parklands Collier	487	487	157	434	591
09/26/05 10/26/05	4-1-04-F-9348	2004-1122 (IP-RMT)	Super Target/Brentwood Land Partners	34	34	0	20	20
02/25/05 03/16/05 06/29/05 04/04/06	4-1-04-F-6866	200309416 (NW-MAE)	Ava Maria University	5,027	5,027	0	6,114	6,114
3/9/2007 7/23/08	4-1-04-F-6112	20021683	Alico Airpark (Haul Ventures)	166	166		315	315
06/14/04 03/21/05 08/24/07	4-1-04-F-5744	199603501 (IP-TWM)	Terafina	362	437	210	261	471
06/26/08	41420-2007-FA-1150 41420-2007-F-1144	2007-2175	Immokalee Master Plan	506	506	0	1,015	1,015
09/25/08	41420-2008-FA-0702 41420-2008-I-0806	1988-1061	Alligator Alley Commercial Center	41	41	0	18	18
12/17/2008	41420-2007-F-0018	1999-4926	Sembler Partnership McMullen Parcel	40	40	0	49	49
07/02/08	41420-2007-FA-0592 41420-2007-F-0491	2005-7439	Kaicasa	72	72		183	183
07/23/08	41420-2006-FA-0165 41420-2006-F-0846	2004-182	Premier Airport Park	180	180		211	211
02/26/09	41420-2006-FA-0548 41420-2006-F-1011	2006-7018	Oil Well Road Widening	329	329	0	356	356
04/28/08	41420-2008-FA-0442 41420-2008-I-0313	2007-6414	LCEC, Immokalee Rd Substn	1	1	0	1	1
07/14/08	41420-2008-FA-0294 41420-2008-I-0508	2005-6488	Amerisite LLC, Amerimed Medical Center	18	19	0	14	14

Appendix 2C. Data - Service Consultations - Mirasol Action Area Project List – Panthers.

Date	Log Number	Project Number	Applicant (project description)	Direct Effects (acres)	Anticipated Take (acres)	Preservation Onsite (acres)	Compensation Offsite (acres)	Total Compensation (acres)
09/04/08	41420-2008-FA-0415 41420-2008-I-0211	1984-4913	Colonial Boulevard Widening	35	35	0	39	39
12/14/01	4-1-00-F-585	199301156 (IP-MN)	SWFIA, Mid-field Terminal Expansion	2,354	8,058	0	6,986	6,986
1/30/02 02/12/09	4-1-98-F-372 41420-2007-FA-0189 41420-2007-F-0247	199402492 (IP-ML)	Florida Rock Industries, Inc. (Fort Myers Mine #2)	2,913	2,913	1,960	0	1,960
06/10/03	4-1-01-F-1955	200003795 (IP-DY)	Walnut Lakes	157	157	21	145	166
06/18/03	4-1-01-F-136	199701947 (IP-SR)	Twin Eagles Phase II	491	593	57	98	155
06/23/03	4-1-01-F-143	199905571 (IP-SR)	Airport Technology Center	116	116	55	175	230
07/02/03	4-1-98-F-428	1995-07483	Miromar Lakes Additions	342	342	158	340	498
10/06/03	4-1-02-F-0027	200102043 (IP-MN)	Bonita Beach Road Development	1,117	1,117	145	640	785
12/29/03	4-1-02-F-1743	200202926 (IP-MGH)	The Forum - Saratoga Investments	650	650	0	310	310
01/18/05	4-1-04-F-4259	199702228 (TWM)	Bonita Springs Utilities	79	79	0	108	108
03/31/05	4-1-04-F-5656	200306759 (NW-MAE)	Gateway Shoppes II	82	82	0	122	122
04/29/05	4-1-04-F-5780 4-1-04-F-5982	2003-5331 (IP-TWM) 2003-6965 (IP-TWM)	Worthington Holdings - Arborwood Worthington Holdings - Treeline Avenue Extension	2,330	2,330	0	1,700	1,700

Appendix 2C. Data - Service Consultations - Mirasol Action Area Project List – Panthers.

Date	Log Number	Project Number	Applicant (project description)	Direct Effects (acres)	Anticipated Take (acres)	Preservation Onsite (acres)	Compensation Offsite (acres)	Total Compensation (acres)
06/06/05	4-1-03-F-7855	2003-11156 (IP-RMT)	Collier Regional Medical Center	44	44	0	64	64
06/29/05	4-1-03-F-3915	199806220 (IP-MAE)	Wenthworth Estates - V.K. Development	917	917	0	458	458
07/15/05	4-1-04-F-5786	199405829 (IP-CDC)	Land's End Preserve	231	231	0	61	61
11/23/05	4-1-04-F-6043	20039414	Waterways Join Venture IV (Summit Place)	108	108	0	61	61
11/29/05	4-1-04-F-8847	20048995	Seminole Tribe of FL Administrative Complex	6	6	0	8	8
12/6/05	4-1-04-F-6691	200310689	Rattlesnake Hammock Road	23	23	0	23	23
12/06/05	4-1-03-F-3483	200302409	Southwest Florida Investment Property, LLC	207	207	0	305	305
01/04/06	4-1-04-F-8388	2004554	Immokalee Regional Airport - Phase I	67	67	0	43	43
01/04/06	4-1-04-F-9777	20048577	Logan Boulevard Extension	40	40	0	10	10
01/13/06	4-1-04-F-6707	20042404	Journey's End	66	66	0	34	34
01/26/06	4-1-04-F-8940	20047053	The Orchard	93	93	0	81	81
02/09/06	4-1-05-11724	2005384	Firano at Naples	24	24	0	19	19
02/22/06	4-1-04-F-6505	2004-91 (IP-JWS)	Corkscrew Road	20	20	0	47	47

Appendix 2C. Data - Service Consultations - Mirasol Action Area Project List – Panthers.

Date	Log Number	Project Number	Applicant (project description)	Direct Effects (acres)	Anticipated Take (acres)	Preservation Onsite (acres)	Compensation Offsite (acres)	Total Compensation (acres)
02/23/06	4-1-04-F-5244	2003-12276	Summit Church	10	10	0	13	13
05/05/06	41420-2006-I-0274	2005-6176	Santa Barbera , Davis to Radio Road, Widening	6	6	0	3	3
05/09/06	41420-2006-F-0089	200403248	Collier Boulevard, Immokalee Rd. to Goldengate Blvd.	14	14	0	16	16
05/09/06	41420-2006-I-0263	2005-6298	Santa Barbara and Radio Road Widening	29	29	0	20	20
05/16/06	4-1-05-F-10309	19971924	Sabal Bay	1,017	1,017	1,313	223	1,536
06/05/06	4-1-05-PL-8486	20041688	Seacrest School	31	31	0	16	16
06/15/06	41420-2006-I-0362	20056176	Collier County Wellfield	29	29	0	36	36
07/12/06	41420-2006-F-0282	200311150	Cypress Shadows	244	244	0	326	326
07/28/06	4-1-04-F-7279	20041695	Raffia Preserve	131	131	0	119	119
08/15/06	41420-2006-I-0151	20031963	Naples Custom Homes	10	10	0	9	9
08/21/06	41420-2006-I-0540	20041813	ASGM Business Park	41	41	0	25	25
09/22/06	41420-2006-I-0355	20040047	Immokalee Seminole Reservation Road Improvements	17	17	0	35	35
10/05/06	41420-2006-I-0616	20065295	New Curve on Corkscrew Road	12	12	0	18	18

Appendix 2C. Data - Service Consultations - Mirasol Action Area Project List – Panthers.

Date	Log Number	Project Number	Applicant (project description)	Direct Effects (acres)	Anticipated Take (acres)	Preservation Onsite (acres)	Compensation Offsite (acres)	Total Compensation (acres)
7/2/2003 10/16/2006	4-1-98-F-428 41420-2006-F-0667	199507483	Miromar Addition	366	366	0	390	390
10/18/06	41420-2007-F-0026	2004777	Treeline Preserve	97	97	0	95	95
10/25/06	41420-2006-F-0442	20047046	Koreshan Boulevard Extension	14	14	0	30	30
10/26/06	41420-2006-F-0787	200306755	Jetway Tradeport	38	38	0	52	52
10/27/06	41420-2006-I-0203	20057180	Living Word Family Church	18	18	0	35	35
11/15/06	41420-2006-TA-0727	N/A	Liberty Landing	27	27	0	19	19
11/16/06	41420-2006-TA-0060	N/A	Collier County Elementary School K	26	26	0	17	17
12/05/06	41420-2006-FA-1179	20057179	The Roberts Group CPD	58	58	0	29	29
12/07/06	41420-2006-FA-0781	20041689	Cypress Landing	46	46	0	18	18
03/09/07	41420-2006-F-0850	200312445	Airport Interstate Commerce Park	323	323	0	371	371
03/09/07	41420-2007-I-0581	1999-4313	Savanna Lakes	124	124		140	140
03/09/07	41420-2007-TA-0623	NA	Abercia North	25	25		31	31
04/13/07	41420-2007-TA-0618	NA	Collier County School Site J - Everglades Blvd.	39	39		56	56

Appendix 2C. Data - Service Consultations - Mirasol Action Area Project List – Panthers.

Date	Log Number	Project Number	Applicant (project description)	Direct Effects (acres)	Anticipated Take (acres)	Preservation Onsite (acres)	Compensation Offsite (acres)	Total Compensation (acres)
06/19/07	41420-2007-I-0997	2006-2583	Caloosa Reserve	111	111		139	139
07/03/07	41420-2007-TA-0818	NA	Woodcrest Development	11	11	0	15	15
07/17/07	41420-2007-I-0330	2006-6377	Faith Landing	35	35	0	18	18
07/30/07	41420-2007-I-0866	2006-7022	Collier County School Site L	32	32	0	21	21
09/05/07	41420-2006-FA-0051 41420-2006-I-0948	2005-4186	Gulf Coast Landfill Expansion	123	123	0	65	65
11/13/07	41420-2006-FA-1430	2005-782	Summit Lakes	138	138	0	134	134
01/22/08	41420-2008-FA-0021 41420-2008-I-005	2007-4503 (IP-JPF)	I-75 from Collier County Line to South of Daniels Parkway	7	7	0	44	44
01/30/08	41420-2008-FA-0009 41420-2008-I-003	2007-4884 (IP-JPF)	I-75 from Corkscrew Road to Daniels Parkway	7	7	0	12	12
02/21/03 03/9/05 03/02/07 05/03/07 04/21/11	4-1-01-F-607	200001926 (IP-SB)	Mirasol	810	810	904	373	1,277
Total				23,842	29,724	4,979	23,828	28,808

Appendix 2D. Data - Service Consultations - Mirasol Action Area Project List – Wood Storks.

Date	Log Number	Project Number	Applicant (project description)	Project Site Total Acres	Preservation Onsite (acres)	Compensation Offsite (acres)	Total Compensation (acres)	Wetlands Impacted	Wetlands Preserved
9/8/2005 02/28/08	4-1-04-F-5260 and 41420-2008-F-0112	200106580	Parklands Collier	646	157	434	591	209	546
09/26/05 10/26/05	4-1-04-F-9348	2004-1122 (IP-RMT)	Super Target/Brentwood Land Partners	34	0	20	20	16	20
02/25/05 03/16/05 06/29/05 04/04/06	4-1-04-F-6866	200309416 (NW-MAE)	Ava Maria University	5,027	0	6,114	6,114	30	4,463
3/9/2007 7/23/08	4-1-04-F-6112	20021683	Alico Airpark (Haul Ventures)	241		315	315	46	475
06/14/04 03/21/05 08/24/07	4-1-04-F-5744	199603501 (IP-TWM)	Terafina	647	210	261	471	296	475
06/26/08	41420-2007-FA-1150 41420-2007-F-1144	2007-2175	Immokalee Master Plan	615	0	1,015	1,015	1	1,014
09/25/08	41420-2008-FA-0702 41420-2008-I-0806	1988-1061	Alligator Alley Commercial Center	41	0	18	18	13	5
12/17/2008	41420-2007-F-0018	1999-4926	Sembler Partnership McMullen Parcel	40	0	49	49	1	6
07/02/08	41420-2007-FA-0592 41420-2007-F-0491	2005-7439	Kaicasa	100		183	183	2	264
07/23/08	41420-2006-FA-0165 41420-2006-F-0846	2004-182	Premier Airport Park	241		211	211	49	202
02/26/09	41420-2006-FA-0548 41420-2006-F-1011	2006-7018	Oil Well Road Widening	523	0	356	356	50	525
04/28/08	41420-2008-FA-0442 41420-2008-I-0313	2007-6414	LCEC, Immokalee Rd Substn	6	0	1	1	1	1
07/14/08	41420-2008-FA-0294 41420-2008-I-0508	2005-6488	Amerisite LLC, Amerimed Medical Center	19	0	14	14	9	14
09/04/08	41420-2008-FA-0415 41420-2008-I-0211	1984-4913	Colonial Boulevard Widening	90	0	39	39	32	439
12/14/01	4-1-00-F-585	199301156 (IP-MN)	SWFIA, Mid-field Terminal Expansion	3,258	0	6,986	6,986	709	4,293

Appendix 2D. Data - Service Consultations - Mirasol Action Area Project List – Wood Storks.

Date	Log Number	Project Number	Applicant (project description)	Project Site Total Acres	Preservation Onsite (acres)	Compensation Offsite (acres)	Total Compensation (acres)	Wetlands Impacted	Wetlands Preserved
1/30/02 02/12/09	4-1-98-F-372 41420-2007-FA-0189 41420-2007-F-0247	199402492 (IP-ML)	Florida Rock Industries, Inc. (Fort Myers Mine #2)	4,867	1,960	0	1,960	334	1,693
06/18/03	4-1-01-F-136	199701947 (IP-SR)	Twin Eagles Phase II	650	57	98	155	133	175
06/23/03	4-1-01-F-143	199905571 (IP-SR)	Airport Technology Center	171	55	175	230	37	159
07/02/03	4-1-98-F-428	1995-07483	Miromar Lakes Additions	342	158	340	498	87	309
10/06/03	4-1-02-F-0027	200102043 (IP-MN)	Bonita Beach Road Development	1,298	145	640	785	99	531
01/18/05	4-1-04-F-4259	199702228 (TWM)	Bonita Springs Utilities	79	0	108	108	69	118
04/29/05	4-1-04-F-5780 4-1-04-F-5982	2003-5331 (IP-TWM) 2003-6965 (IP-TWM)	Worthington Holdings - Arborwood Worthington Holdings - Treeline Avenue Extension	2,330	0	1,700	1,700	248	1,492
06/06/05	4-1-03-F-7855	2003-11156 (IP-RMT)	Collier Regional Medical Center	60	0	64	64	35	78
11/23/05	4-1-04-F-6043	20039414	Waterways Join Venture IV (Summit Place)	108	0	61	61	35	73
11/29/05	4-1-04-F-8847	20048995	Seminole Tribe of FL Administrative Complex	6	0	8	8	1	1
12/6/05	4-1-04-F-6691	200310689	Rattlesnake Hammock Road	47	0	23	23	10	23
12/06/05	4-1-03-F-3483	200302409	Southwest Florida Investment Property, LLC	207	0	305	305	47	351
01/04/06	4-1-04-F-8388	2004554	Immokalee Regional Airport - Phase I	163	0	43	43	7	7
01/04/06	4-1-04-F-9777	20048577	Logan Boulevard Extension	40	0	10	10	2	10
02/09/06	4-1-05-11724	2005384	Firano at Naples	48	0	19	19	7	22
02/22/06	4-1-04-F-6505	2004-91 (IP-JWS)	Corkscrew Road	63	0	47	47	5	26
02/23/06	4-1-04-F-5244	2003-12276	Summit Church	10	0	13	13	9	13
05/05/06	41420-2006-I-0274	2005-6176	Santa Barbera , Davis to Radio Road, Widening	45	0	3	3	1	1
05/09/06	41420-2006-F-0089	200403248	Collier Boulevard, Immokalee Rd. to Goldengate Blvd.	62	0	16	16	17	16

Appendix 2D. Data - Service Consultations - Mirasol Action Area Project List – Wood Storks.

Date	Log Number	Project Number	Applicant (project description)	Project Site Total Acres	Preservation Onsite (acres)	Compensation Offsite (acres)	Total Compensation (acres)	Wetlands Impacted	Wetlands Preserved
05/09/06	41420-2006-I-0263	2005-6298	Santa Barbara and Radio Road Widening	157	0	20	20	1	1
06/05/06	4-1-05-PL-8486	20041688	Seacrest School	31	0	16	16	13	18
06/15/06	41420-2006-I-0362	20056176	Collier County Wellfield	29	0	36	36	21	36
07/12/06	41420-2006-F-0282	200311150	Cypress Shadows	353	0	326	326	126	262
07/28/06	4-1-04-F-7279	20041695	Raffia Preserve	131	0	119	119	56	119
08/15/06	41420-2006-I-0151	20031963	Naples Custom Homes	10	0	9	9	8	13
09/22/06	41420-2006-I-0355	20040047	Immokalee Seminole Reservation Road Improvements	20	0	35	35	1	1
10/05/06	41420-2006-I-0616	20065295	New Curve on Corkscrew Road	14	0	18	18	1	4
7/2/2003 10/16/2006	4-1-98-F-428 41420-2006-F-0667	199507483	Miromar Addition	535	0	390	390	87	158
10/25/06	41420-2006-F-0442	20047046	Koreshan Boulevard Extension	14	0	30	30	14	30
10/26/06	41420-2006-F-0787	200306755	Jetway Tradeport	38	0	52	52	18	51
10/27/06	41420-2006-I-0203	20057180	Living Word Family Church	18	0	35	35	11	39
11/15/06	41420-2006-TA-0727	N/A	Liberty Landing	27	0	19	19	1	2
11/16/06	41420-2006-TA-0060	N/A	Collier County Elementary School K	26	0	17	17	0	17
12/05/06	41420-2006-FA-1179	20057179	The Roberts Group CPD	68	0	29	29	4	13
12/07/06	41420-2006-FA-0781	20041689	Cypress Landing	78	0	18	18		
03/09/07	41420-2006-F-0850	200312445	Airport Interstate Commerce Park	323	0	371	371	86	401
03/09/07	41420-2007-I-0581	1999-4313	Savanna Lakes	124		140	140	9	60
03/09/07	41420-2007-TA-0623	NA	Abercia North	25		31	31	0	31
04/13/07	41420-2007-TA-0618	NA	Collier County School Site J - Everglades Blvd.	39		56	56	0	56
06/19/07	41420-2007-I-0997	2006-2583	Caloosa Reserve	111		139	139	4	5
07/03/07	41420-2007-TA-0818	NA	Woodcrest Development	11	0	15	15	1	1
07/17/07	41420-2007-I-0330	2006-6377	Faith Landing	35	0	18	18	2	5

Appendix 2D. Data - Service Consultations - Mirasol Action Area Project List – Wood Storks.

Date	Log Number	Project Number	Applicant (project description)	Project Site Total Acres	Preservation Onsite (acres)	Compensation Offsite (acres)	Total Compensation (acres)	Wetlands Impacted	Wetlands Preserved
07/30/07	41420-2007-I-0866	2006-7022	Collier County School Site L	32	0	21	21	14	14
09/05/07	41420-2006-FA-0051 41420-2006-I-0948	2005-4186	Gulf Coast Landfill Expansion	588	0	65	65	14	26
11/13/07	41420-2006-FA-1430	2005-782	Summit Lakes	138	0	134	134	27	16
01/22/08	41420-2008-FA-0021 41420-2008-I-005	2007-4503 (IP-JPF)	I-75 from Collier County Line to South of Daniels Parkway	28	0	44	44	80	44
01/30/08	41420-2008-FA-0009 41420-2008-I-003	2007-4884 (IP-JPF)	I-75 from Corkscrew Road to Daniels Parkway	17	0	12	12	15	10
02/21/03 03/9/05 03/02/07 05/03/07 04/21/11	4-1-01-F-607	200001926 (IP-SB)	Mirasol	1,713	941	373	1,314	645	831
Total				26,857	3,682	22,274	25,957	3,906	20,104

Appendix 2E. Data - District ERP 2004 to 2010 - Mirasol Action Area Project List – Panthers.

PERMIT #	APPROVED	PROJECT NAME	PROJECT ACREAGE	WETLAND ACREAGE	WETLAND IMPACTS	WETLAND PRESERVE	UPLAND PRESERVE
11-02352-P	11/10/2004	Sr 29 Road Improvements	37.76	14.72	2.24	12.48	0
11-02412-P	6/8/2005	Collier Regional Medical	60	42.03	28.36	13.67	1.6
11-02478-P	12/14/2005	Cook Property aka Firaro at Naples	40.48	10.25	6.92	3.33	0.96
11-02492-P	1/11/2006	Palermo Cove	131.01	106.09	71.94	34.15	0.86
11-02506-P	6/14/2006	Asgm Business Park	40.88	20.21	13.54	6.67	0
11-02513-P	3/8/2006	Collier Blvd (CR 951) Widening Immokalee Rd to Golden Gate Blvd	54.16	6.83	6.83	0	0
11-02582-P	8/9/2006	County Barn Road Widening	45.71	6.48	6.48	0	0
11-02603-P	4/12/2007	Mockingbird Crossing fka Caloosa Reserve	110.95	8.06	0.72	7.34	20.37
11-02649-P	3/15/2007	Yahl Mulching	28.76	18.1	6.37	11.73	0
11-02654-P	4/12/2007	Hamilton Greens fka Livingston Greens	29.68	14.45	0.4	14.05	0.11
11-02743-P	10/11/2007	Diamonte Estates	8.85	2.72	2.72	0	0.15
11-02748-P	1/8/2008	Amerimed Center	18.95	8.97	8.97	0	0.4
11-02785-P	1/8/2008	Faith Landing	35.11	6.31	1.43	4.88	1.22
11-02802-P	1/8/2008	Gridley Medical Building	3.56	1.6	1.6	0	0
11-02836-P	3/13/2008	North Naples Fire District 48	3.4	3.4	2.85	0.55	0.54
11-02856-P	5/15/2008	Santa Babara Blvd Ext	90.27	69.82	33.82	36	0
11-02874-P	7/10/2008	Elementary School Site L	34.03	20.92	11.95	8.97	2.69
11-02893-P	8/14/2008	Living Word Family Church	18.35	16.35	10.96	5.39	1.92
11-02908-P	9/11/2008	Ten Thousand Islands Nwr	26.5	26.06	1.56	24.5	0
11-03005-P	6/11/2009	Hole In The Wall Golf Club	204.2	44.7	2.21	42.49	5
11-03026-P	7/20/2009	Gordon River CRCC	22.1	4.85	3.05	1.8	0.06
11-03043-P	8/10/2009	Sr 84 (Davis Blvd) from Radio Rd to Collier Blvd	33.37	9.24	8.33	0.91	0
11-03044-P	9/9/2009	Tamiami Crossing	25.45	14.08	14.08	0	1.81
11-03058-P	9/21/2009	Groverman Farm	313	25.68	0	25.68	0
11-03097-P	1/11/2010	Kaicasa	100	28.22	8.63	19.59	8.52
11-03124-P	4/12/2010	Imperial Golf Estates Livingston Rd Access	4.75	4.15	4.15	0	0
26-00820-P	11/9/2006	Section 33 Farm	738.66	162.66	0	162.66	0
26-00844-P	4/12/2007	Corbitt Farms	797	230.13	0	230.13	75.95
26-00857-	8/9/2007	Stallings Claim	281.2	25.46	0	25.46	4.79

Appendix 2E. Data - District ERP 2004 to 2010 - Mirasol Action Area Project List – Panthers.

PERMIT #	APPROVED	PROJECT NAME	PROJECT ACREAGE	WETLAND ACREAGE	WETLAND IMPACTS	WETLAND PRESERVE	UPLAND PRESERVE
P							
36-05139-P	2/9/2005	Ultimate Ski Lake	166.7	79.9	0	79.9	7.5
36-05290-P	6/8/2005	Banyan Bay	88.81	72.69	29.91	42.98	1.24
36-05344-P	8/10/2005	Thirty Nine Preserve	76.8	21.25	6.01	15.24	5.86
36-05343-P	8/10/2005	Rockfill Industrial Park	28.59	3.86	3.86	0	0
36-05388-P	9/14/2005	Portico	589.1	29.91	5.98	23.93	8.56
36-05393-P	10/12/2005	Cypress Shadows	352.83	253.71	125.61	127.78	10.31
36-05412-P	10/12/2005	Chicos Plantation Rd	6.67	3.51	3.51	0.31	0.61
36-05430-P	10/12/2005	Island Park Regional Mitigation Area	84.16	56.96	0	56.96	23.74
36-05413-P	11/9/2005	Colonial Plantation	72.15	43.66	43.66	0	0
36-05321-P	12/14/2005	Bonita 120 Rpd	122	39.9	39.9	0	0
36-05251-P	1/11/2006	Colonial Plaza	96.93	19.84	9.22	10.62	0.4
36-05519-P	1/11/2006	Three Corners Project	2.4	1.06	1.06	0	0
36-05619-P	3/8/2006	Frp Llc	4.95	4.1	4.1	0	0
36-05238-P	4/12/2006	Florida Gulf Coast Technology and Research Park	1048	407.5	228.4	179.1	92.46
36-05630-P	8/9/2006	Main Street	37.13	8.68	8.68	0	0
36-05651-P	5/10/2006	Orchid Isles (fka The Orchard)	105.64	43.6	35.73	7.87	10.91
36-05670-P	4/12/2006	Griffith/Greenway Landscaping	14.4	4.4	3.46	0.94	0
36-05705-P	5/10/2006	Orchid Isles Offsite Mitigation	122.62	121.46	0	121.46	0.72
36-05709-P	6/14/2006	Community Palm Cove	19.42	17.15	11.12	6.03	0
36-05751-P	6/14/2006	Sunset Falls (fka-Waterstone)	109.03	48.57	23.98	24.59	2.76
36-05753-P	7/12/2006	Challenger - 32	31.69	7.68	7.68	0	0
36-05869-P	8/9/2006	Summerlin Place	16.62	3.9	2.1	1.8	0.5
36-05874-P	8/9/2006	Cypress Hammock	25.63	21.01	13.51	7.5	0
36-05881-P	8/9/2006	Colonial Winkler aka Royal Public Fort Myers	40.03	4.3	4.3	0	0
36-05710-P	9/1/2006	Koreshan Boulevard Ext. fka Estero Parkway	41.75	20.23	20.23	0	0
36-05939-P	9/13/2006	Buckingham 345	345	17.51	0	17.51	4.64
36-05941-P	9/13/2006	Trieste Preserve	18.5	11.68	9.35	2.33	0.27
36-04871-P	10/12/2006	Heritage Lakes	1576	531.5	172.7	358.8	65.2

Appendix 2E. Data - District ERP 2004 to 2010 - Mirasol Action Area Project List – Panthers.

PERMIT #	APPROVED	PROJECT NAME	PROJECT ACREAGE	WETLAND ACREAGE	WETLAND IMPACTS	WETLAND PRESERVE	UPLAND PRESERVE
36-06026-P	11/9/2006	Corkscrew Ranch	61.78	11.48	6.9	4.58	3.36
36-05372-P	11/9/2006	Carissa Commercial Park	27.42	10.96	10.96	0	0
36-05980-P	12/14/2006	Stratford Downs	14.8	2.62	2.62	0	0
36-06211-P	1/11/2007	Cleveland Clinic	39.97	20.26	14.59	5.67	0
36-06053-P	2/15/2007	Colonial - Ortiz	70.09	46.09	19.14	26.95	1.23
36-06275-P	4/12/2007	Target 22	22.4	8.8	5.8	3	0.4
36-06302-P	4/12/2007	Hibiscus Isle	14.27	9.89	6.89	3	0
36-06310-P	4/12/2007	Kelly Road Industrail	3.92	3.92	3.92	0	0
36-06347-P	5/10/2007	Winkler 8.58 Acres	8.58	7.98	7.05	0.93	0
36-06202-P	6/14/2007	Formosa Industrial Park	128.77	1.03	0.55	0.48	2.21
36-06404-P	8/9/2007	Chapel Creek	143.03	16.52	0.68	15.84	21.1
36-06513-P	9/13/2007	Shirelane	4.94	4.3	3.9	0.4	0
36-06395-P	10/11/2007	Gora 6 Mile Friends Trust	8.26	8.25	4.74	3.51	0
36-06551-P	10/11/2007	Marni Fields	16.45	2.05	2.05	0	0
36-06587-P	11/15/2007	Tello Farms	437	123.24	0	123.24	0
36-06586-P	1/8/2008	Arlington Commerce Park	80.57	49.1	36.79	12.31	3.16
36-06693-P	2/14/2008	Pinnacle Center	12.18	5.26	2.8	2.46	0.37
36-06714-P	3/13/2008	Crystal - Plantation	39.97	32.1	24.6	7.5	0.03
36-06768-P	4/10/2008	Pine Ridge Road Gov.	9.1	6.96	6.96	0	0
36-06750-P	4/10/2008	Marina Del Lago	49.54	12.56	4.16	8.4	4.49
36-06871-P	7/10/2008	Colonial 70	69.39	11.19	6.28	4.91	1.72
36-06899-P	8/14/2008	Stoneybrook North	741.23	66	5	65.9	59.98
36-06523-P	10/6/2008	State road 80 / State Road 31 Cdp	16.07	5.69	3.19	2.5	0.26
36-06705-P	11/13/2008	Southland Lakes	153.87	60.09	30.76	29.33	8.49
36-07038-P	2/12/2009	River Run Estates Subdivision	176.61	13.64	0	13.64	4.46
36-05908-P	4/9/2009	Enclaves of Eagle Landing	78.03	9.82	3.28	6.54	8.75
36-07096-P	5/14/2009	Daniels Market Place	65.52	19.6	13.97	5.63	3.25
36-07151-P	8/17/2009	Sr 82 Improvements	125.06	16.31	16.31	0	0
36-07168-P	8/31/2009	Wa Ke Hatchee Park	48.9	24.35	7.84	16.51	1.42

Appendix 2E. Data - District ERP 2004 to 2010 - Mirasol Action Area Project List – Panthers.

PERMIT #	APPROVED	PROJECT NAME	PROJECT ACREAGE	WETLAND ACREAGE	WETLAND IMPACTS	WETLAND PRESERVE	UPLAND PRESERVE
36-07199-P	10/28/2009	Orange River Landing	34.9	19.5	7.8	12.5	0
36-07251-P	2/8/2010	Section 33 Regional Mitigation Site	632.24	439.2	0	439.2	180.42
36-07267-P	2/16/2010	Popash creek Preserve	307.45	144.93	1.28	146.8	0
36-06983-P	3/8/2010	Freedom Subdivision	9.66	5.8	4.99	0.81	0.66
36-07296-P	4/26/2010	Colonial Parkway Center	12.27	10.39	10.39	0	0
			12245.93	4081.94	1350.36	2740.62	668.39
PROJECTS WITH LESS THAN 5% WETLANDS							
11-02432-P	9/14/2005	Orange Blossom Ranch	623.59	0	0	0	0
11-02891-P	10/9/2008	Immokalee Road S	551.02	23.61	0	23.61	0
11-02965-P	1/13/2009	Collier Blvd Mixed Use Commerce Center	70.18	1.4	1.4	0	0
11-03086-P	1/4/2010	Riverbend Docks	5.25	0	0	0	0
11-03094-P	1/20/2010	Sr 951 Marco Island Bridge	43.43	2.14	0.03	2.11	0
26-00841-P	2/15/2007	Oakbrooke Lakes aka Old Grove	332.4	7.74	0	7.74	3.36
26-00877-P	10/11/2007	Mims Sand Mine	140.1	0	0	0	0
36-05461-P	12/14/2005	Caloosa Oaks	110.02	0	0	0	0
36-05513-P	1/11/2006	Colonial Lakes fka Cypress Palm 1 & 2	106.45	0	0	0	0
36-05988-P	10/12/2006	Laredo Lakes	130.8	0	0	0	0
36-06930-P	10/9/2008	Treeco fka Somerset	141.88	0	0	0	0
36-07122-P	6/11/2009	The Broadlands	367.7	3.99	0	3.99	7.48
36-07176-P	9/14/2009	Shops at Village Walk Outparcels	5.7	3.84	3.84	0	0
36-07191-P	10/12/2009	Ortiz Avenue Widening from SR 82 to SR 80	83.48	3.6	3.6	0	0
			2,712.00	46.32	8.87	37.45	10.84

Appendix 2F. Data - District ERP 2004 to 2010 - Mirasol Action Area Project List – Wood Storks.

PERMIT #	APPROVED	PROJECT NAME	PROJECT ACREAGE	WETLAND ACREAGE	WETLAND IMPACTS	WETLAND PRESERVE	UPLAND PRESERVE
11-02387-P	3/14/2005	Cr 846 & Cr 858	0.05	0	0	0	0
11-02407-P	4/29/2005	Marco Island Bridge Scour	1	0	0	0	0
11-02441-P	8/18/2005	Collier County Fleet Facility	9.96	0	0	0	0
11-02442-P	8/19/2005	Tract N Lake Culvert Improvement	0.18	0	0	0	0
11-02445-P	9/9/2005	Bosley PUD (Summer Lakes Phase 2)	20.23	0.9	0	0.9	1.91
11-02447-P	9/26/2005	Ibis Way Road Crossing Improvement	0.14	0	0	0	0
11-02461-P	10/10/2005	Avalon School Drainage	1.32	0.27	0.27	0	0
11-02462-P	10/11/2005	East Winterberry Bridge Replacement	1.54	0	0	0	0
11-02480-P	12/1/2005	C-1 Canal at 10th St SE	0.08	0	0	0	0
11-02482-P	12/6/2005	Sarecino	10.75	0.21	0.21	0	0
11-02512-P	2/2/2006	Bristol Pines	42.61	0	0	0	0
11-02520-P	2/28/2006	Big Cypress Elementary School	20.3	0	0	0	0
11-02525-P	3/6/2006	Orchid Run	21.91	0	0	0	1.06
11-02514-P	3/8/2006	Journeys End fka Tierra Bay	65.87	15.45	0	12.09	0
11-02519-P	3/16/2006	Naples New Haitian Church of the Nazarene	10.3	5.32	0.2	5.11	0
11-02531-P	4/6/2006	Eden Gardens	20.17	4.06	0	4.06	0
11-02563-P	6/21/2006	Gateway Triangle Stormwater Project	135	0	0	0	0
11-02597-P	8/11/2006	Collier County Riviera Golf Estates-Lake Interconnect	0.09	0	0	0	0
11-02599-	8/22/2006	Elementary School J	22.13	0	0	0	0
11-02613-P	9/18/2006	Northside Medical Plaza Building	3.79	0.06	0	0.37	0.31
11-02637-P	10/20/2006	Flamingo Bend Nursery	16.46	0	0	0	
11-02627-P	10/27/2006	Elementary School K	26.03	0	0	0	6.52
11-02653-P	12/12/2006	Golden Gate Middle School Additions and Renovations	20.63	0	0	0	0
11-02659-P	1/3/2007	Sr 90 over Ok-Dutchess-Sandy Canals	1	0	0	0	0
11-02663-P	1/18/2007	Golden Gate Intermediate Center North 400 Parking	3.7	0	0	0	0
11-02664-P	1/30/2007	Village Oaks Elementary School	20	0.08	0.08	0	0
11-02665-P	2/8/2007	Buttonwood Preserve (fka Tree Farm Road PUD)	54.2	10.12	0.29	9.83	4.19
11-02670-P	2/16/2007	Interstate 75 (Sr93) Contraflow at Collier Blvd	2.74	0	0	0	0
11-02694-P	4/20/2007	Naples Nissan	15.17	1.51	0.62	0.89	0.31
11-02705-P	6/12/2007	Vista Royale	1.42	0	0	0	0
11-00218-S-02	6/28/2007	Collier Athletic Club Dock	1	0	0	0	0
11-02716-P	7/5/2007	Wet Woods Preserve Fence	25.5	0	0	0	0
11-02725-P	8/1/2007	Golden Gate Community Park Picnic Pavilion	1	0	0	0	0
11-02734-P	8/10/2007	Rookery Bay Pedestrian Bridge	0.09	0	0	0	0

Appendix 2F. Data - District ERP 2004 to 2010 - Mirasol Action Area Project List – Wood Storks.

PERMIT #	APPROVED	PROJECT NAME	PROJECT ACREAGE	WETLAND ACREAGE	WETLAND IMPACTS	WETLAND PRESERVE	UPLAND PRESERVE
11-02737-P	8/15/2007	Oakes Park	4.79	2.76	0	2.76	0.44
11-02735-P	9/5/2007	Immokalee Career Center	6.56	0	0	0	0
11-02744-P	9/20/2007	Two Lakes Plaza	20.24	7.63	0	8.04	1.55
11-02719-P	9/24/2007	Cirrus Pointe	9.72	0.16	0	0.16	0
11-02754-P	9/27/2007	Marriotts Crystal Shores on Marco Island	5.73	0	0	0	0
11-02756-P	9/27/2007	Henderson Creek Canal Directional Bore Crossing	1	0	0	0	0
11-02704-P	10/3/2007	Pristine Estates	48.84	4.57	0.72	3.85	6.09
11-02771-P	10/17/2007	Logan Woods Preserve Fence Installation	5.69	0	0	0	0
11-03081-P	11/4/2009	Imperial golf-Palm River Driveway	0.12	0	0	0	0
11-02779-P	11/21/2007	Collier County EMS site	2.22	0.99	0.07	1	0.11
11-02801-P	12/21/2007	Brooks Village	20.31	0.2	0.2	0	3.05
11-02831-P	1/11/2008	Triple G Lop (Picayune Strand State Forest)	4	0	0	0	0
11-02813-P	1/29/2008	Big Corkscrew Island Fire Control Station 14	6.47	2.54	0.72	1.82	0
11-02867-P	5/9/2008	Standing Oaks	41.11	0	0	0	8.57
11-02878-P	6/6/2008	Cr 901 Vanderbilt Drive over Cocohatchee Canal	2.02	0	0	0	0
11-02912-P	8/27/2008	Napoli Village	8.97	0.16	0	1.7	0
11-02928-P	10/7/2008	Captiva Pond	46.87	0	0	0	0
11-02931-P	10/14/2008	Gaspar Station	17.7	0.4	0.36	0.04	2.36
11-02936-P	10/15/2008	Conner Park	3.34	0	0	0	0
11-02947-P	11/7/2008	Naples Church of Christ	19.11	0	0	0	0.93
11-02911-P	11/3/2008	Esperanza Place PUD	29.6	1.8	1.8	0	0
11-02953-P	11/13/2008	Collier County Bridge Repairs-Bridge No 030153/030154	0.48	0	0	0	0
11-02952-P	11/13/2008	Collier County Bridge Repairs-Bridge No 034014	0.1	0	0	0	0
11-02960-P	12/22/2008	Conservancy of Southwest Florida	19.96	0.79	0	0.79	0
11-02971-P	2/2/2009	20th Pl SW Pedestrian Bridge	0.24	0	0	0	0
11-02990-P	3/5/2009	St Andrews Blvd Phase 2 Stormwater Improvements	0.2	0	0	0	0
11-02993-P	3/9/2009	Shell Island Restoration	10.8	3.9	0.36	3.54	0
11-02998-P	4/1/2009	Rookery Bay National Estuarine Reserve Nature Trail	47.34	9.04	0.01	9.03	0
11-03000-P	4/17/2009	Unity Faith Missionary Baptist Church	5.23	1.15	0.21	0.94	0
11-03024-P	6/29/2009	Manatee Road 6 MGD & ASR Wells 2-5	4.47	0	4.47		0
11-03028-P	7/15/2009	Immokalee Meeting House	16.75	0.85	0	0.85	0
11-03048-P	8/11/2009	Greenway Road Swale	6.99	0	0	0	0
11-03032-P	8/14/2009	Fishermans Village	20.51	4.99	0.79	4.2	0
11-03051-P	8/24/2009	Regal Acres	36.8	0	0	0	0
11-03063-P	9/18/2009	Roadway Improvements of Immokalee Rd	3.45	0	0	0	0

Appendix 2F. Data - District ERP 2004 to 2010 - Mirasol Action Area Project List – Wood Storks.

PERMIT #	APPROVED	PROJECT NAME	PROJECT ACREAGE	WETLAND ACREAGE	WETLAND IMPACTS	WETLAND PRESERVE	UPLAND PRESERVE
11-03061-P	9/18/2009	Roadway Improvements of Northbrooke Rd	4.33	0	0	0	0
11-03068-P	10/5/2009	Drainage Improvements Basin 5	21.81	0	0	0	0
11-03075-P	11/2/2009	Sr 29 resurfacing	5	0.01	0.01	0	0
11-03085-P	11/23/2009	New Fire Station on US 41-Lake Park Blvd	3.67	2.28	0.27	2.01	0
11-03079-P	12/2/2009	Ngala	20.8	2.73	0.31	2.7	1.69
11-03091-P	12/16/2009	Goodland Dock Extension	66.76	0	0	0	0
11-03098-P	12/17/2009	Vanderbilt Beach Rd & Airport Rd Canal	1	0	0	0	0
11-03102-P	12/18/2009	North Collier Blvd Fairlawn Court to Jolley Bridge	1	0	0	0	0
11-03100-P	12/18/2009	Shady Hollow Blvd at Corkscrew	1	0	0	0	0
11-03093-P	12/18/2009	Palm River Estates Unit 5	5.2	0	0	0	0
11-03107-P	1/11/2010	Covenant Presbyterian Church of Naples	15.96	0	0	0	0
11-03111-P	1/26/2010	Krehling PUD	15.25	2.86	0.87	1.99	0.07
11-03099-P	2/8/2010	Golden Gate Canal at Oil Well Rd Cable	1	0	0	0	0
11-03118-P	2/22/2010	Immokalee Rd/Everglades Intersection Improvements	6.328	0	0	0	0
11-03121-P	2/23/2010	Greenway	37.5	0	0	0	0
11-03117-P	3/12/2010	Signature Beach Club Docks	0.99	0	0	0	0
11-03123-P	3/19/2010	Royal Poinciana Golf Club-Pines Course Front 9	88.97	8.41	0	8.41	0
11-03129-P	4/5/2010	Oil Well Road at Faka Union Aerial Cable crossing	1	0	0	0	0
11-03134-P	5/5/2010	Peace Lutheran Church	9.34	0	0	0	2.07
22-00347-P	2/4/2005	Mizell Pines	32.2	0	0	0	0
22-00276-P	1/10/2007	Hull Shell Pit	55.48	3.33	0	3.33	0
22-00391-P	8/1/2007	Cr 720/731 Road Improvements	78	0	0	0	0
22-00766-P	4/1/2005	Ortiz Borrow Pit	24.44	0	0	0	0
22-00775-P	7/1/2005	Seminole Tracks	55.44	0	0	0	0
26-00793-P	1/5/2006	Hendry/Labelle Community Civic Park	23.42	0	0	0	0
26-00795-P	2/3/2006	Patterson - Wild Cow Project	1	0	0	0	0
26-00835-P	10/25/2006	Cowboy Way Commerce Center Two	9.53	0	0	0	0
26-00843-P	2/2/2007	Everglades Plantation Farm	284	0	0	0	0
26-00846-P	3/8/2007	Shady Oak Villas	8.5	0.93	0	0.93	0
26-00850-P	5/4/2007	Labelle Townhomes	18.27	0	0	0	0
26-00872-P	8/28/2007	J & B Borrow Pit	40.6	0	0	0	0
26-00875-P	9/21/2007	Murphys Landing Sales Facility	50.15	0	0	0	0
26-00901-P	1/10/2008	Fort Denaud Cemetery Expansion	20.65	0	0	0	0
26-00907-P	1/18/2008	Fence County Line Canal ROW	119.86	0	0	0	0
26-00911-P	2/15/2008	Walmart (Labelle FL)	42.76	0.25	0	0.25	0
26-00913-P	2/22/2008	Okaloacoochee Slough State Forest	1	0	0	0	0

Appendix 2F. Data - District ERP 2004 to 2010 - Mirasol Action Area Project List – Wood Storks.

PERMIT #	APPROVED	PROJECT NAME	PROJECT ACREAGE	WETLAND ACREAGE	WETLAND IMPACTS	WETLAND PRESERVE	UPLAND PRESERVE
26-00922-P	5/1/2008	HCGM LLC Borrow Pit	98.36	1.4	1.4	0	0
26-00930-P	6/9/2008	Charltons Pond	28	0	0	0	0
26-00940-P	10/29/2008	Hendry County Emergency Operations Center	9.96	0	0	0	0
26-00831-P	11/10/2008	Grovewood Estates	80.55	0	0	0	0
26-00942-P	11/14/2008	Bill Hicks Rock Lake Culvert Crossing	0.1	0	0	0	0
26-00951-P	1/16/2009	Sr 80 over Goodno Drainage Canal	0.08	0	0	0	0
26-00955-P	4/9/2009	Seminis Office Building & Drainage Improvement	20	0.93	0	0.93	0
26-00961-P	4/16/2009	Hendry-Labelle Sports Complex	55.71	0	0	0	0
26-00966-P	5/29/2009	Double Down Express	33.81	0	0	0	0
26-00972-P	8/5/2009	City of Labelle Basin C-5 stormwater improvements	36.56	0	0	0	0
26-00969-P	9/8/2009	Sr 29 Labelle draw bridge repairs	2.3	0	0	0	0
26-00984-P	11/16/2009	Eagle Farm Mine	98.88	1.92	0	1.92	0
26-00983-P	11/24/2009	Pollywog Creek commons	6.29	0	0	0	0
26-01004-P	2/3/2010	County Road 835 at L2W Canal Cable Crossing	1	0	0	0	0
26-01011-P	3/4/2010	River Landings	30.1	0	0	0	0
26-01015-P	4/15/2010	River Estates	15.14	0	0	0	0
26-01018-P	6/1/2010	State Road 80 at C-3 Canal Cable Installation	1	0	0	0	0
36-05106-P	1/11/2005	Hickey's Creekside	48.3	0.63	0.29	0.34	2.69
36-05196-P	2/11/2005	Corkscrew Road Curves Improvements	14.07	0	0	0	0
36-04894-P	3/1/2005	Sanibel Island Causeway Improvements	54.4	0	0	0	0
36-05334-P	6/21/2005	Davis Road Lakes	4.76	0	0	0	0
36-05332-P	6/30/2005	Mercedes Plaza	22.69	0	0	0	0
36-05189-P	7/21/2005	Terraces at Savona Lakes Condo	19.96	0	0	0	0
36-05353-P	7/18/2005	Bonita Village Residential Development	15.73	0	0	0	1.12
36-05360-P	7/29/2005	Majorca Palms Estates Pud	25.35	0.71	0.4	0.31	0
36-05385-P	8/12/2005	Sr 739 (Metro Parkway) from Winkler Ave to Hanson St	78.57	0	0	0	0
36-04314-P	8/17/2005	First Bank of Clewiston-Riverside Site	1	0	0	0	0
36-05403-P	8/29/2005	Gulf Coast Church of Christ	13.51	0.1	0.1	0	0
36-05440-P	10/3/2005	The Cove At Cypress Reserve	20.13	5.14	0.32	4.82	0.25
36-05428-P	10/10/2005	Town and River Place	10.85	0	0	0	0
36-05426-P	10/11/2005	Oaks at Riverwalk	8	0.42	0	0.42	0.55
36-05364-P	10/20/2005	Gulfview Pines fka park Road Residential Sub	17.47	0.94	0	1.46	0.52
36-05483-P	11/18/2005	Metro Medical Park	18.36	0	0	0	0
36-05750-P	12/5/2005	United Plumbing Storage	3.28	0	0	0	0
36-05512-P	12/6/2005	Colonial Plaza	7.02	0	0	0	0
36-05522-P	12/19/2005	Gator Lanes	7.1	0	0	0	0

Appendix 2F. Data - District ERP 2004 to 2010 - Mirasol Action Area Project List – Wood Storks.

PERMIT #	APPROVED	PROJECT NAME	PROJECT ACREAGE	WETLAND ACREAGE	WETLAND IMPACTS	WETLAND PRESERVE	UPLAND PRESERVE
36-05518-P	12/28/2005	Alico Lakes Village	30.96	0.61	0.61	0	0
36-05736-P	1/6/2006	Volvo of Fort Myers	6.15	0	0	0	0
36-05560-P	1/12/2006	River Pointe	39.91	0.93	0.3	1.62	0.56
36-05587-P	1/25/2006	Lee Boulevard Complex	3.71	0	0	0	0
36-05590-P	1/31/2006	Lake McGregor Dr	28.65	0.61	0	0.61	3.4
36-05600-P	2/2/2006	Rosarno Condominiums	32.32	5.63	0	9.03	3.14
36-05592-P	2/3/2006	Daniels Parkway Business Center	10.35	0	0	0	0
36-05626-p	2/13/2006	Dewey Vehicle Storage	3.65	0	0	0	0
36-05621-P	2/13/2006	Cedar Ridge Subdivision	14.8	0	0	0	0
36-05657-P	3/1/2006	Westenbarger Pond	1	0	0	0	0
36-05656-P	3/7/2006	Imperial St 4 Laning-Bonita Beach Rd to E Terry St	21.73	0.44	0.22	0.22	0
36-05669-P	3/22/2006	Metro Marketplace	5.05	0.26	0.26	0	0
36-05672-P	3/24/2006	The Venetian	24.12	0	0	0	0
36-05690-P	3/31/2006	Ten Mile Canal Linear Park North	10.9	0	0	0	0
36-05693-P	4/5/2006	Oasis at Fort Myers	17.66	0.92	0	1.39	0.47
36-05695-P	4/6/2006	8930 Laredo Ave - Industrial Development	5.09	0	0	0	0
36-05737-P	5/3/2006	Sr 80 - Fowler Street to Seaboard Street	6.79	0	0	0	0
36-05758-P	5/19/2006	10900 Leeco Court	2.7	0	0	0	0
36-05812-P	6/8/2006	Westgate Warehouses	3.24	0	0	0	0
36-05720-P	6/16/2006	Orange River Middle School & Elementary School U	38.2	0	0	0	0
36-05839-P	6/19/2006	Bainbridge Colonial and Winkler	38.89	0.67	0.67	0	0
36-05845-P	6/22/2006	Pennington Park	4.89	0	0	0	0
36-05847-P	6/23/2006	Cypress Garden Preserve	9.04	0	0	0	0
36-05853-P	6/30/2006	Pine Forest Subdivision	9.69	1.5	1.5	0	0
36-05867-P	7/3/2006	B and I Office/Manufacturing - Additions & Renovations	7.22	0	0	0	0
36-05858-P	7/11/2006	Center Town Commons	4.95	0	0	0	0
36-05877-P	7/14/2006	Old 41 Widening Project-Rosemary Dr to US 41	35.01	0	0	0	0
36-05862-P	7/14/2006	Cornerstone - Merrick Park	18.01	0	0	0	0
36-05889-P	7/28/2006	Richview Court Drainage Improvements	0.16	0	0	0	0
36-05787-P	8/9/2006	Oasis Cove fka Reflection	32.54	0.1	0.1	0	0
36-05922-P	8/14/2006	Heritage Gulf Lakes	28.74	0	0	0	0
36-05955-P	8/23/2006	Estero ridge	5.84	0	0	0	0
36-05957-P	8/24/2006	Smi Steel Fabricators Industrial Building	5.53	0	0	0	0
36-05967-P	8/29/2006	Crystal Flex Park	3.21	0	0	0	0
36-05964-P	8/29/2006	Suncoast Commerce Park	8.34	0	0	0	0
36-05968-P	8/29/2006	Alley Design - Del Prado Blvd	6.04	0	0	0	0

Appendix 2F. Data - District ERP 2004 to 2010 - Mirasol Action Area Project List – Wood Storks.

PERMIT #	APPROVED	PROJECT NAME	PROJECT ACREAGE	WETLAND ACREAGE	WETLAND IMPACTS	WETLAND PRESERVE	UPLAND PRESERVE
36-06048-P	10/11/2006	Hancock Professional Center	1.22	0	0	0	0
36-06044-P	10/12/2006	Crown Pointe	14.29	0	0	0	0
36-06066-P	10/19/2006	Scalon Lexus	7.37	0	0	0	0
36-06046-P	10/20/2006	Metro Workman Commerce Center	5.17	0.78	0.78	0	0
36-06071-P	10/23/2006	Halvorsen Corners Bayshore Park	5.71	0	0	0	0
36-06049-P	10/24/2006	Parker Business Center Fka Pinto Lane CPD	4.95	0	0	0	0
36-06111-P	11/13/2006	Cape Villagio	5.88	0	0	0	0
36-06155-P	11/16/2006	Captiva Villas	2.43	0	0	0	0
36-06103-P	11/16/2006	Rose Eagle Ridge	9.35	0	0	0	0
36-04502-P	12/7/2006	Rails End Rip Rap Lot 5	0.99	0	0	0	0
36-06222-P	1/3/2007	Bayshore 40 Residential Subdivision	40.52	0	0	0	0
36-06229-P	1/9/2007	Fire Station Number 9 and 4 Soccer Fields	11.55	0	0	0	0
36-06231-P	1/16/2007	Harbor Plaza	11.89	0	0	0	0
36-06233-P	1/26/2007	Mirada fka Ascot Preserve	60	15.27	0.25	15.02	1.5
36-06255-P	1/31/2007	Coffey Discount Furniture	5	0	0	0	0
36-05904-P	1/31/2007	McLean - 37 acre parcel	37.68	15.16	0	15.16	0
36-06163-P	2/9/2007	Caloosahatchee Creeks Preserve	3.48	3.49	0.3	3.19	0
36-06271-P	2/14/2007	Garden Street Shredding	11	0	0	0	0
36-06268-P	2/14/2007	Bonita Springs Utilities Operations Center	11.67	0	0	0	0
36-06150-P	2/16/2007	Farmington (aka Tice 60)	60.33	18.4	0	18.4	0.57
36-06276-P	2/28/2007	Ortiz Corners	6.15	0	0	0	0
36-06288-P	3/7/2007	G-5 Properties Residential Development	5.35	0.11	0	0.11	0
36-06266-P	3/9/2007	Metro Commons	7.88	0.55	0.55	0	0
36-06303-P	3/12/2007	Alico Farm Field	150	0	0	0	0
36-06318-P	3/30/2007	Homestead Lane Road Paving	9.1	0	0	0	0
36-06326-P	3/30/2007	Midtown Estero Village	34.02	7.4	0	12.82	2.3
36-06342-P	4/26/2007	West Cypress View	5.03	0	0	0	0
36-06341-P	4/26/2007	East Cypress View	4.95	0	0	0	0
36-06340-P	4/27/2007	Montego Square	18.66	0	0	0	0
36-06362-P	5/7/2007	Infinity of Fort Myers	3.97	0	0	0	0
36-06361-P	5/8/2007	Country Lakes Business Center	6.88	0	0	0	0
36-06396-P	6/5/2007	Broadway Grande Shoppes	5.32	0.38	0.38	0	0
36-06394-P	6/6/2007	Florida community Bank on Sr 80	7.51	1.2	0	1.2	0
36-06399-P	6/11/2007	Pine Ridge Business Center	4.78	0	0	0	0
36-06403-P	6/14/2007	Truck Outfitters Inc	3.21	0.68	0	0.68	0.08
36-06358-P	6/15/2007	San Carlos Center - Phase I	32.63	0	0	0	0

Appendix 2F. Data - District ERP 2004 to 2010 - Mirasol Action Area Project List – Wood Storks.

PERMIT #	APPROVED	PROJECT NAME	PROJECT ACREAGE	WETLAND ACREAGE	WETLAND IMPACTS	WETLAND PRESERVE	UPLAND PRESERVE
36-06202-P	6/28/2007	Formosa Industrial Park Tract 67	12.81	0	0	0	0
36-06400-P	6/29/2007	Hydro Rock Maintenance Facility	28.27	0.96	0	0.96	0
36-06431-P	7/2/2007	Emerson Condominiums	26.12	0	0	0	0
36-06425-P	7/9/2007	Trusted Medical Park	3.96	0	0	0	0
36-06475-P	7/20/2007	RO Raw Water Transmission Main Phase 2	1	0	0	0	0
36-06470-P	7/23/2007	Popash Creek-Lee County Natural Resources	0.22	0	0	0	0
36-06487-P	7/27/2007	Harlem Heights Community Center	4.89	0	0	0	0
36-06446-P	8/3/2007	Daniels Road Business Park	4.35	0.46	0.01	0.45	0.06
36-06504-P	8/9/2007	Hindu Temple of Southwest Florida	7.39	0.48	0.4	0.08	0
36-06488-P	8/15/2007	Whitney Interstate Industrial Park	30.12	0	0	0	0
36-06518-P	8/16/2007	Midtown Estero	48.22	2.1	0	2.1	3.89
36-06502-P	8/23/2007	Hickey Creek Parcel	39.39	0.68	0.07	0.61	0.28
36-06520-P	8/27/2007	Mccables Fleet Maintenance Site	4.54	0	0	0	0
36-06526-P	8/29/2007	Villas of Paradise	11.17	0.36	0.36	0	0
36-06533-P	9/7/2007	Value Place Hotel (aka Colonial Pointe Sub)	5.25	0.47	0.47	0	0
36-06549-P	9/19/2007	Mlk Industrial Site	20.71	0.15	0.15	0	0
36-06563-P	10/2/2007	Valuguard Self Storage	3.02	0	0	0	0
36-06562-P	10/3/2007	San Carlos Drive road Paving	5.7	0	0	0	0
36-06573-P	10/16/2007	Chapel Branch	0	0	0	0	0
36-06601-P	10/25/2007	Canal Crossing I-75 & Three Oaks Blvd	0.08	0	0	0	0
36-06537-P	10/26/2007	Alico Road Business Park Tracts A & B	23.3	0.74	0	0.74	1.57
36-06455-P	10/29/2007	Treeline Office Complex	59.56	12.97	0	12.97	0
36-06550-P	11/15/2007	Pine Lake Preserve	29.52	0	0	0	0
36-06378-P	11/21/2007	Colonial Square Improvements	59.1	0	0	0	0
36-06648-P	11/28/2007	Brantley Road guardrail and Culver Replacements	1	0	0	0	0
36-06664-P	12/14/2007	Palm Pointe Shoppes	20.34	0	0	0	0
36-06651-P	12/17/2007	Fort Myers Broadcasting Expansion	4.75	0.83	0	0.83	0
36-06669-P	12/21/2007	Caloosa Estates fka Riverbend	91.85	0	0	0	6.72
36-06674-P	12/21/2007	Buckingham Chase	18.9	2.92	0	3.42	0
36-06676-P	1/7/2008	Londonderry Plaza	3.83	0	0	0	0
36-06691-P	1/10/2008	Waterside Medical Complex at Shell Point	3.07	0	0	0	0
36-06694-P	1/15/2008	Alico Lake Villages	58.95	0	0	0	0
36-06696-P	1/16/2008	Colonial Crossroads	69.94	0	0	0	0
36-06687-P	1/16/2008	Faith P{Presbyterian Church	8.73	0	0	0	0
36-06703-P	1/24/2008	Nine Mile Run Culvert Extension	0.55	0	0	0	0
36-06690-P	1/30/2008	Page Field Center	3.31	0	0	0	0

Appendix 2F. Data - District ERP 2004 to 2010 - Mirasol Action Area Project List – Wood Storks.

PERMIT #	APPROVED	PROJECT NAME	PROJECT ACREAGE	WETLAND ACREAGE	WETLAND IMPACTS	WETLAND PRESERVE	UPLAND PRESERVE
36-06722-P	2/8/2008	Rosen Building Supplies	3.96	0	0	0	0
36-06723-P	2/15/2008	Belanger Ranch	14.06	0.7	0	0.7	0
36-06728-P	2/15/2008	IDD Canal G Maintenance Crossing	1	0	0	0	0
36-06718-P	2/20/2008	Thyssenkrupp Safeway Work Dr	3.08	0	0	0	0
36-06747-P	3/6/2008	Mulloch Creek Weir Replacement	1	0	0	0	0
36-06707-P	3/13/2008	Wyandotte Way Extension	11.74	0.4	0.4	0	0
36-06538-P	3/13/2008	Plumosa Pit	36.82	0	0	0	0
36-06749-P	3/14/2008	Suncoast Commerce Park Phase 3	18.26	0	0	0	0
36-06785-P	4/10/2008	Renaissance Preserve	54.4	0	0	0	0
36-06786-P	4/10/2008	Vila and Son Tree Farm	17.6	0.37	0.31	0.8	0
36-06673-P	4/14/2008	Billy Creek Filter Marsh	55.7	5.54	0.39	6.87	0
36-06810-P	5/5/2008	Preliminary Geotech Inestigations Caloosahatchee	4.25	0	0	0	0
36-06824-P	5/16/2008	Michigan Elementary	18	0	0	0	0
36-06825-p	5/19/2008	G Weaver Hipps Elementary School - School V	16.26	0	0	0	0
36-06851-P	6/6/2008	South Trail Fire Protection & Rescue Service District	1.88	0.85	0.85	0	0
36-06859-P	6/18/2008	Harry Chapin Food Bank	8.86	0.18	0.18	0	0
36-06559-P	9/12/2008	North River Ranch	77.3	8.38	0	8.38	2.77
36-06940-P	9/17/2008	James Mann Properties	44.88	0	0	0	0
36-06944-P	10/10/2008	Bunche Beach Park Improvement Project	1.14	0	0	0	0
36-06955-P	10/14/2008	Nortrax Building	9.83	0	0	0	0
36-06952-P	10/17/2008	Cypress Lake Presbyterian Phase 1	4.68	0	0	0	0
36-06977-P	11/6/2008	Pepsi Distribution Center	6.6	0	0	0	0
36-06960-P	11/6/2008	Coral Self-Storage	5	0	0	0	0
36-06979-P	11/10/2008	Brookhill Sub Utility and Roadway Improvements	40.1	0	0	0	0
36-06963-P	11/13/2008	Shops at Village Walk	34	0.95	0.49	0.46	0
36-06972-P	11/13/2008	Nalle Road Estates	33.18	0.47	0.47	0	0
36-06992-P	11/19/2008	Whitehead 70Ac	70.71	0	0	0	0
36-06995-P	11/20/2008	200 Joel blvd	9.24	0	0	0	0
36-06989-P	11/21/2008	Bucks Lane Storage	9.98	0	0	0	0
36-06994-P	11/26/2008	Halfway Creek Lock Up	10.55	5.88	0.16	5.72	1.58
36-07004-P	12/4/2008	Davis Preserve	4.77	0	0	0	0
36-07003-P	12/5/2008	Preserve at San Carlos Park	9.29	0	0	0	0.61
36-07009-P	12/11/2008	Ortiz Plaza	5.76	0	0	0	0
36-07021-P	12/23/2008	Palmetto Corporate Park	9.45	0	0	0	0
36-07042-P	1/14/2009	Pawlet Plaza	10.02	0	0	0	0
36-07045-P	1/22/2009	Harp Center	7	0	0	0	0

Appendix 2F. Data - District ERP 2004 to 2010 - Mirasol Action Area Project List – Wood Storks.

PERMIT #	APPROVED	PROJECT NAME	PROJECT ACREAGE	WETLAND ACREAGE	WETLAND IMPACTS	WETLAND PRESERVE	UPLAND PRESERVE
36-07051-P	1/22/2009	Crystal Drive Transmission Line Improvements	4.59	0	0	0	0
36-07059-P	2/2/2009	Gulf Coast Medical Park	4.8	0	0	0	0
36-07058-P	2/2/2009	Bonita Springs Retirement Village	20	0	0	0	0
36-07071-P	3/7/2009	Devonwood Auto Dealership	5.58	0	0	0	1.14
36-07074-P	3/13/2009	Gorovoy Cornea Laser Center	3.41	0	0	0	0
36-07102-P	4/24/2009	Jesus The Worker	6.6	0	0	0	0
36-07105-P	4/24/2009	Mobile Mini Expansion	7.02	0	0	0	0
36-07113-P	5/1/2009	Miles Way	1.27	0	0	0	0
36-07119-P	5/15/2009	Greenwell Access Way Construction	37.45	2.77	0	2.77	0.51
36-07144-P	7/9/2009	Marsh Point	46.7	0.02	0	0.02	0
36-07147-P	7/17/2009	Estero CAX	1.06	0	0	0	0
36-07156-P	7/17/2009	Schandler Hall Community Park Expansion	10.64	0	0	0	0
36-07175-P	8/24/2009	Chiquita boulevard Phase 2	64.31	0	0	0	0
36-07177-P	8/28/2009	Alico Penn	7.66	0.2	0.2	0	0
36-07186-P	9/10/2009	Manhein Ft Myers Fka Greather SW Fl Auto Action East	10.24	0	0	0	0
36-07185-P	9/10/2009	Cvs No 00196 at McGregor Blvd & San Carlos Blvd	2.97	0	0	0	0
36-07183-P	9/25/2009	Intermed Park	4.8	0	0	0	0
36-06532-P	10/5/2009	Leeward LLC and Steamboat LLC	14.75	0	0	0	0
36-07214-P	11/5/2009	Homestead Rd from S of Sunrise Blvd to N of Alabama	54.4	0.54	0.54	0	0
36-07222-P	11/6/2009	Summerlin Phase IV Transmission Line	27.6	0	0	0	0
36-07225-P	11/12/2009	Wild Turkey Strand Preserve Culvert Crossing	0.27	0	0	0	0
36-07205-P	11/24/2009	Persimmon Ridge Rd Bridge Replacement	0.08	0.02	0.02	0	0
36-07262-P	1/15/2010	Cohn Branch Drainage Improvements	2.59	0	0	0	0
36-07249-P	1/21/2010	Dean Steel Services Inc.	5.53	1.21	0.8	0.41	0
36-07259-P	2/3/2010	Mass Court	5.21	0	0	0	0
36-07271-P	2/4/2010	Deep Lagoon Preserve Site No 78	76.3	66.1	0	66.1	7.4
36-07277-P	2/17/2010	Bonita Beach Road East Water Storage Tank	14.38	1.01	0	1.01	0.8
36-07289-P	2/25/2010	Camp Caloosa	80	25.08	0	25.08	0
36-07283-P	3/1/2010	Arroyal Place	1.34	0.04	0	0.04	0
36-07276-P	3/3/2010	North River Plaza	41.59	0	0	0	6.42
36-07282-P	3/12/2010	Buckingham Airpark Road Improvements	10.18	0	0	0	0
36-07258-P	3/15/2010	Dean Street 6 Acres MPD	6.65	0.28	0	0.28	1.06
36-06993-P	4/21/2010	Village Square	3.94	0	0	0	0
36-07278-P	4/29/2010	US 41 from Corkscrew Road to San Carlos Blvd	50.82	0.08	0.03	0.05	0
36-07287-P	5/13/2010	Basin Based Neighborhood Improvements	49.14	0	0	0	0

Appendix 2F. Data - District ERP 2004 to 2010 - Mirasol Action Area Project List – Wood Storks.

PERMIT #	APPROVED	PROJECT NAME	PROJECT ACREAGE	WETLAND ACREAGE	WETLAND IMPACTS	WETLAND PRESERVE	UPLAND PRESERVE
36-07332-P	5/19/2010	Sonshine Worship Center	14.96	0	0	0	0
36-07346-P	5/20/2010	Shangri-La Regional Drainage Improvements	3.63	0	0	0	0
36-07184-P	9/8/2010	San Carlos Park Phase I	1	0	0	0	0
			6363.41	332.18	27.57	322.09	93.19

Appendix 2G. Data - Wood Stork Suitable Foraging Prey Base Loss (Development Area).

ACOE Area	FLUCCS Codes	DESCRIPTION	Project Wetland Acreage	Hydroperiod Class	Wetlands (m^2)	Habitat Suitability Value	Grams / m^2 / Hydroperiod Class	Wood Stork Consumption Percentage	Grams of Biomass
1	424/624	Melaleuca(>75%) / Cypress / Pine	2.37	2	9591.06	0.025	0.62	0.325	48.31
26	625/424	Pine Flatwoods / Melaleuca (>25%)	30.71	2	124279.07	0.639	0.62	0.325	16,001.99
34	625/424	Pine Flatwoods / Melaleuca (>25%)	19.51	2	78954.24	0.639	0.62	0.325	10,166.03
58	617	Mixed Wetland Hardwoods	1.25	2	5058.58	1	0.62	0.325	1,019.30
76	424/625	Melaleuca(>50%) / Pine Flatwoods	12.11	2	49007.47	0.372	0.62	0.325	3,673.50
89	424/625	Melaleuca(>50%) / Pine Flatwoods	0.74	2	2994.68	0.372	0.62	0.325	224.48
4	424	Melaleuca	42.5	3	171991.55	0.025	1.32	0.325	1,844.61
6	624/424	Pine / Cypress / Melaleuca (>50%)	6.97	3	28206.61	0.372	1.32	0.325	4,501.44
8	624	Pine / Cypress / Melaleuca (>75%)	8.19	3	33143.78	0.025	1.32	0.325	355.47
14	625/424	Pine Flatwoods / Melaleuca (>50%)	1.68	3	6798.72	0.372	1.32	0.325	1,084.99
20	424/625	Melaleuca(>50%) / Pine Flatwoods	29.71	3	120232.21	0.372	1.32	0.325	19,187.62
21	643	Disturbed Wet Prairie	3.44	3	13921.2	1	1.32	0.325	5,972.19
27	424	Melaleuca	9.24	3	37392.99	0.025	1.32	0.325	401.04
36	625/424	Pine Flatwoods / Melaleuca (>25%)	16.3	3	65963.82	0.639	1.32	0.325	18,082.73
38	424	Melaleuca	46.75	3	189190.71	0.025	1.32	0.325	2,029.07
42	624	Pine / Cypress / Melaleuca (>25%)	4.88	3	19748.68	0.639	1.32	0.325	5,413.73
44	424/625	Melaleuca(>50%) / Pine Flatwoods	18.44	3	74624.1	0.372	1.32	0.325	11,909.11
46	424/625	Melaleuca(>50%) / Pine Flatwoods	12.59	3	50949.97	0.372	1.32	0.325	8,131.00
47	424/625	Melaleuca(>75%) / Pine Flatwoods	3.29	3	13314.17	0.025	1.32	0.325	142.79
50	424/625	Melaleuca(>75%) / Pine Flatwoods	54.38	3	220068.25	0.025	1.32	0.325	2,360.23
57	424/624	Melaleuca(>50%)/Cypress/Pine	6.27	3	25373.81	0.372	1.32	0.325	4,049.36
61	424/625	Melaleuca(>75%) / Pine Flatwoods	28.91	3	116994.72	0.025	1.32	0.325	1,254.77
64	424/625	Melaleuca(>75%) / Pine Flatwoods	28.37	3	114809.42	0.025	1.32	0.325	1,231.33
65	424/625	Melaleuca(>75%) / Pine Flatwoods	8.91	3	36057.52	0.025	1.32	0.325	386.72
70	424/625	Melaleuca(>50%) / Pine Flatwoods	5.57	3	22541.01	0.372	1.32	0.325	3,597.27
71	424/625	Melaleuca(>25%) / Pine Flatwoods	8.85	3	35814.71	0.639	1.32	0.325	9,817.92
79	424/625	Melaleuca(>75%) / Pine Flatwoods	20.65	3	83567.66	0.025	1.32	0.325	896.26
86	424/625	Melaleuca(>75%) / Pine Flatwoods	3.84	3	15539.94	0.025	1.32	0.325	166.67
87	424/625	Melaleuca(>25%) / Pine Flatwoods	2.99	3	12100.11	0.639	1.32	0.325	3,317.02

Appendix 2G. Data - Wood Stork Suitable Foraging Prey Base Loss (Development Area).

ACOE Area	FLUCCS Codes	DESCRIPTION	Project Wetland Acreage	Hydroperiod Class	Wetlands (m^2)	Habitat Suitability Value	Grams / m^2 / Hydroperiod Class	Wood Stork Consumption Percentage	Grams of Biomass
90	424/625	Melaleuca(>75%) / Pine Flatwoods	98.6	3	399020.4	0.025	1.32	0.325	4,279.49
92	424/625	Melaleuca(>25%) / Pine Flatwoods	2.22	3	8984.03	0.639	1.32	0.325	2,462.80
100	424/625	Melaleuca(>50%) / Pine Flatwoods	27.49	3	111248.18	0.372	1.32	0.325	17,753.87
101	424/625	Melaleuca(>50%) / Pine Flatwoods	7.8	3	31565.51	0.372	1.32	0.325	5,037.48
102	424/625	Melaleuca(>75%) / Pine Flatwoods	0.14	3	566.56	0.025	1.32	0.325	6.08
		Short Hydroperiod Wetlandss	575.66						166,806.67
3	621	Cypress / Melaleuca (>50%)	2.5	4	10117.15	0.372	2.34	0.325	2,862.20
28	621	Cypress / Melaleuca (>50%)	0.69	4	2792.33	0.372	2.34	0.325	789.97
35	621	Cypress	0.03	4	121.41	1	2.34	0.325	92.33
41	621	Cypress / Melaleuca (>25%)	0.22	4	890.31	0.639	2.34	0.325	432.65
45	621	Cypress / Melaleuca (>25%)	0.7	4	2832.8	0.639	2.34	0.325	1,376.63
52	621	Cypress / Melaleuca (>50%)	1.31	4	5301.39	0.372	2.34	0.325	1,499.80
54	621	Cypress / Melaleuca (>50%)	1.5	4	6070.29	0.372	2.34	0.325	1,717.32
55	424/624	Melaleuca(>50%)/Cypress/Pine	3.36	4	13597.45	0.372	2.34	0.325	3,846.80
56	424/621	Cypress / Melaleuca (>50%)	1.75	4	7082.01	0.372	2.34	0.325	2,003.54
68	621	Cypress / Melaleuca (>25%)	1.02	4	4127.8	0.639	2.34	0.325	2,005.94
85	424	Melaleuca	55.55	4	224803.07	0.025	2.34	0.325	4,274.07
24	621	Cypress / Melaleuca (>25%)	0.82	5	3318.43	0.639	2.93	0.325	2,019.22
82	621	Cypress / Melaleuca (>50%)	0.24	5	971.25	0.372	2.93	0.325	344.05
		Long Hydroperiod Wetlands	69.69						23,264.53
		Total Acres	645.35			grams		kg	
		Total Biomass				190,071.20		190.06	
		Short Hydroperiod				166,806.67		166.80	
		Long Hydroperiod				23,264.53		23.26	

Appendix 2H. Data - Wood Stork Suitable Foraging Prey Base Preserve (Pre Restoration).

ACOE AREA	FLUCCS CODE	DESCRIPTION	Project Wetland Acreage	Hydroperiod Class	Wetlands (m^2)	Habitat Suitability Value	Grams / m^2 / Hydroperiod Class	Wood Stork Consumption Percentage	Grams of Biomass
58	617	Mixed Wetland Hardwoods	0.14	2	566.56	0.639	0.62	0.325	72.95
26	625/424	Pine Flatwoods / Melaleuca (>25%)	0.96	2	3,884.99	0.639	0.62	0.325	500.23
89	424/625	Melaleuca(>50%) / Pine Flatwoods	15.91	2	64,385.54	0.372	0.62	0.325	4,826.21
46	424/625	Melaleuca(>50%) / Pine Flatwoods	0.02	3	80.94	0.372	1.32	0.325	12.92
44	424/625	Melaleuca(>50%) / Pine Flatwoods	0.16	3	647.5	0.372	1.32	0.325	103.33
70	424/625	Melaleuca(>50%) / Pine Flatwoods	0.42	3	1,699.68	0.372	1.32	0.325	271.25
57	424/624	Melaleuca(>50%)/Cypress/Pine	0.53	3	2,144.84	0.372	1.32	0.325	342.29
159	424/625	Melaleuca(>25%) / Pine Flatwoods	0.70	3	2,832.80	0.639	1.32	0.325	776.56
21	643	Disturbed Wet Prairie	0.85	3	3,439.83	1	1.32	0.325	1,475.69
42	624	Pine / Cypress / Melaleuca (>25%)	0.88	3	3,561.24	0.639	1.32	0.325	976.25
127	424/624	Melaleuca(>50%)/Cypress/Pine	1.29	3	5,220.45	0.372	1.32	0.325	833.12
38	424	Melaleuca	1.39	3	5,625.14	0.025	1.32	0.325	60.33
99	424/625	Melaleuca(>50%) / Pine Flatwoods	1.93	3	7,810.44	0.372	1.32	0.325	1,246.45
61	424/625	Melaleuca(>75%) / Pine Flatwoods	2	3	8,093.72	0.025	1.32	0.325	86.81
167	424/624	Melaleuca(>50%)/Cypress/Pine	2.25	3	9,105.44	0.372	1.32	0.325	1,453.12
93	625	Hydric Pine Flatwoods	2.34	3	9,469.65	1	1.32	0.325	4,062.48
36	625/424	Pine Flatwoods / Melaleuca (>25%)	2.72	3	11,007.46	0.639	1.32	0.325	3,017.49
71	424/625	Melaleuca(>25%) / Pine Flatwoods	2.83	3	11,452.61	0.639	1.32	0.325	3,139.52
50	424/625	Melaleuca(>75%) / Pine Flatwoods	3.17	3	12,828.55	0.025	1.32	0.325	137.59
20	424/625	Melaleuca(>50%) / Pine Flatwoods	3.43	3	13,880.64	0.372	1.32	0.325	2,215.18
143	422	Brazilian Pepper	3.59	3	14,528.23	0.025	1.32	0.325	155.82
156	424/625	Melaleuca(>50%)/ Pine Flatwoods	3.91	3	15,823.22	0.372	1.32	0.325	2,525.20
96	424/625	Melaleuca(>25%) / Pine Flatwoods	5.77	3	23,350.38	0.639	1.32	0.325	6,401.06
92	424/625	Melaleuca(>25%) / Pine Flatwoods	5.92	3	23,957.41	0.639	1.32	0.325	6,567.47
125	424/625	Melaleuca(>50%)/ Pine Flatwoods	6.37	3	25,778.50	0.372	1.32	0.325	4,113.94
115	424/625	Melaleuca(>75%) / Pine Flatwoods	6.59	3	26,668.81	0.025	1.32	0.325	286.02
158	424/625	Melaleuca(>50%)/ Pine Flatwoods	7.29	3	29,501.61	0.372	1.32	0.325	4,708.10
90	424/625	Melaleuca(>75%) / Pine Flatwoods	7.73	3	31,282.23	0.025	1.32	0.325	335.50
102	424/625	Melaleuca(>75%) / Pine Flatwoods	8.27	3	33,467.53	0.025	1.32	0.325	358.94
124	424/624	Melaleuca(>50%)/Cypress/Pine	9.14	3	36,988.30	0.372	1.32	0.325	5,902.89
86	424/625	Melaleuca(>75%) / Pine Flatwoods	10.35	3	41,885.00	0.025	1.32	0.325	449.22
138	424/625	Melaleuca(>50%)/ Pine Flatwoods	11.67	3	47,226.86	0.372	1.32	0.325	7,536.84
153	424/625	Melaleuca(>50%)/ Pine Flatwoods	12.43	3	50,302.47	0.372	1.32	0.325	8,027.67
179	625	Hydric Pine Flatwoods	12.78	3	51,718.87	1	1.32	0.325	22,187.40

Appendix 2H. Data - Wood Stork Suitable Foraging Prey Base Preserve (Pre Restoration).

ACOE AREA	FLUCCS CODE	DESCRIPTION	Project Wetland Acreage	Hydroperiod Class	Wetlands (m^2)	Habitat Suitability Value	Grams / m^2 / Hydroperiod Class	Wood Stork Consumption Percentage	Grams of Biomass
95	424/624	Melaleuca(>25%)/Cypress/Pine	20.43	3	82,677.35	0.639	1.32	0.325	22,664.42
101	424/625	Melaleuca(>50%) / Pine Flatwoods	22.84	3	92,430.28	0.372	1.32	0.325	14,750.76
150	424/625	Melaleuca(>75%) / Pine Flatwoods	25.99	3	105,177.89	0.025	1.32	0.325	1,128.03
137	424/625	Melaleuca(>75%) / Pine Flatwoods	32.88	3	133,060.64	0.025	1.32	0.325	1,427.08
168	424/625	Melaleuca(>75%)/Cypress/Pine	38.94	3	157,584.73	0.025	1.32	0.325	1,690.10
100	424/625	Melaleuca(>75%) / Pine Flatwoods	40.24	3	162,845.65	0.025	1.32	0.325	1,746.52
134	424/625	Melaleuca(>75%) / Pine Flatwoods	62.54	3	253,090.62	0.025	1.32	0.325	2,714.40
118	424	Melaleuca	107.97	3	436,939.47	0.025	1.32	0.325	4,686.18
		Short Hydroperiod	507.56						145,973.29
55	424/624	Melaleuca(>50%)/Cypress/Pine	0.09	4	364.22	0.372	2.34	0.325	103.04
35	621	Cypress	0.55	4	2,225.77	1	2.34	0.325	1,692.70
68	621	Cypress / Melaleuca (>25%)	0.64	4	2,589.99	0.639	2.34	0.325	1,258.63
170	424/624	Melaleuca(>50%)/Cypress/Pine	0.79	4	3,197.02	0.372	2.34	0.325	904.46
165	424/624	Melaleuca(>50%)/Cypress/Pine	0.89	4	3,601.71	0.372	2.34	0.325	1,018.95
126	621	Cypress	1.16	4	4,694.36	1	2.34	0.325	3,570.06
41	621	Cypress / Melaleuca (>25%)	1.27	4	5,139.51	0.639	2.34	0.325	2,497.59
54	621	Cypress / Melaleuca (>50%)	1.31	4	5,301.39	0.372	2.34	0.325	1,499.80
106	424/625	Melaleuca(>25%) / Pine Flatwoods	1.41	4	5,706.07	0.639	2.34	0.325	2,772.92
53	621	Cypress / Melaleuca (>25%)	1.82	4	7,365.29	0.639	2.34	0.325	3,579.23
147	424/624	Melaleuca(>50%)/ Pine / Cypress	2.53	4	10,238.56	0.372	2.34	0.325	2,896.55
23	624	Pine / Cypress	2.67	4	10,805.12	1	2.34	0.325	8,217.29
131	424	Melaleuca	2.71	4	10,966.99	0.025	2.34	0.325	208.51
108	424/625	Melaleuca(>75%) / Pine Flatwoods	2.85	4	11,533.55	0.025	2.34	0.325	219.28
169	424/624	Melaleuca(>50%)/Cypress/Pine	3.07	4	12,423.86	0.372	2.34	0.325	3,514.78
129	424/621	Melaleuca(>25%)/Cypress	3.46	4	14,002.14	0.639	2.34	0.325	6,804.47
60	621	Cypress	3.93	4	15,904.16	1	2.34	0.325	12,095.11
163	424	Melaleuca	4.34	4	17,563.37	0.025	2.34	0.325	333.92
45	621	Cypress / Melaleuca (>25%)	4.87	4	19,708.21	0.639	2.34	0.325	9,577.39
145	424	Melaleuca	5.34	4	21,610.23	0.025	2.34	0.325	410.86
30	621	Cypress	6.34	4	25,657.09	1	2.34	0.325	19,512.22
175	424/624	Melaleuca(>25%)/Cypress/Pine	6.67	4	26,992.56	0.639	2.34	0.325	13,117.29
105	424/625	Melaleuca(>75%) / Pine Flatwoods	7.55	4	30,553.79	0.025	2.34	0.325	580.90
149	424/625	Melaleuca(>25%) / Pine Flatwoods	9.28	4	37,554.86	0.639	2.34	0.325	18,250.14

Appendix 2H. Data - Wood Stork Suitable Foraging Prey Base Preserve (Pre Restoration).

ACOE AREA	FLUCCS CODE	DESCRIPTION	Project Wetland Acreage	Hydroperiod Class	Wetlands (m^2)	Habitat Suitability Value	Grams / m^2 / Hydroperiod Class	Wood Stork Consumption Percentage	Grams of Biomass
174	424	Melaleuca	11.86	4	47,995.76	0.025	2.34	0.325	912.52
119	424/625	Melaleuca(>25%) / Pine Flatwoods	12.63	4	51,111.84	0.639	2.34	0.325	24,838.28
157	424	Melaleuca	15.47	4	62,604.92	0.025	2.34	0.325	1,190.28
85	424	Melaleuca	18.53	4	74,988.32	0.025	2.34	0.325	1,425.72
146	424	Melaleuca	19.58	4	79,237.52	0.025	2.34	0.325	1,506.50
114	621	Cypress	21.11	4	85,429.21	1	2.34	0.325	64,968.91
107	424/625	Melaleuca(>50%) / Pine Flatwoods	21.33	4	86,319.52	0.372	2.34	0.325	24,420.31
135	424	Melaleuca	42.41	4	171,627.33	0.025	2.34	0.325	3,263.06
82	621	Cypress / Melaleuca (>50%)	0.13	5	526.09	0.372	2.93	0.325	186.36
97	621	Cypress	0.39	5	1,578.28	1	2.93	0.325	1,502.92
59	621	Cypress	0.88	5	3,561.24	1	2.93	0.325	3,391.19
178	621	Cypress	0.89	5	3,601.71	1	2.93	0.325	3,429.73
161	640	Flag Pond	1.43	5	5,787.01	1	2.93	0.325	5,510.68
172	621	Cypress	2.12	5	8,579.34	1	2.93	0.325	8,169.68
81	621	Cypress / Melaleuca (>50%)	2.6	5	10,521.84	0.372	2.93	0.325	3,727.23
166	621	Cypress	3.05	5	12,342.92	1	2.93	0.325	11,753.55
132	424/621	Melaleuca(>25%)/Cypress	3.67	5	14,851.98	0.639	2.93	0.325	9,037.25
22	621	Cypress	4.36	5	17,644.31	1	2.93	0.325	16,801.79
177	621	Cypress	5.49	5	22,217.26	1	2.93	0.325	21,156.39
162	424/621	Melaleuca(>50%)/Cypress/Pine	7.42	5	30,027.70	0.372	2.93	0.325	10,636.92
144	621	Cypress	9.11	5	36,866.89	1	2.93	0.325	35,106.50
160	621	Cypress	9.58	5	38,768.92	1	2.93	0.325	36,917.70
148	424/621	Melaleuca(>25%)/Cypress	15.38	5	62,240.64	0.639	2.93	0.325	37,872.67
94	621	Cypress	18.57	5	75,150.19	1	2.93	0.325	71,561.77
84	540	Cattle Pond	0.08	6	323.75	1	3.36	0.325	353.54
109	540	Cattle Pond	0.19	6	768.9	1	3.36	0.325	839.64
TOTALS		Long Hydroperiod	323.79						514,204.66
							Kg		Grams
		Long Hydroperiod	323.79				514.2047		514,204.66
		Short Hydroperiod	507.56				145.9733		145,973.29
		Total	831.35				660.178		660,177.95

Appendix 2I. Data - Wood Stork Suitable Foraging Prey Base Preserve (Post Restoration).

ACOE AREA	FLUCCS CODE	DESCRIPTION	Project Wetland Acreage	Hydroperiod Class	Wetlands (m^2)	Habitat Suitability Value	Grams / m^2 / Hydroperiod Class	Wood Stork Consumption Percentage	Grams of Biomass
58	617	Mixed Wetland Hardwoods	0.14	2	566.56	1	0.62	0.325	152.69
26	625/424	Pine Flatwoods / Melaleuca (>25%)	0.96	2	3,884.99	1	0.62	0.325	1,047.00
89	424/625	Melaleuca(>50%) / Pine Flatwoods	15.91	2	64,385.54	1	0.62	0.325	17,351.90
46	424/625	Melaleuca(>50%) / Pine Flatwoods	0.02	3	80.94	1	1.32	0.325	50.3
44	424/625	Melaleuca(>50%) / Pine Flatwoods	0.16	3	647.5	1	1.32	0.325	402.42
70	424/625	Melaleuca(>50%) / Pine Flatwoods	0.42	3	1,699.68	1	1.32	0.325	1,056.35
57	424/624	Melaleuca(>50%)/Cypress/Pine	0.53	3	2,144.84	1	1.32	0.325	1,333.02
159	424/625	Melaleuca(>25%) / Pine Flatwoods	0.7	3	2,832.80	1	1.32	0.325	1,760.59
21	643	Disturbed Wet Prairie	0.85	3	3,439.83	1	1.32	0.325	2,137.85
42	624	Pine / Cypress / Melaleuca (>25%)	0.88	3	3,561.24	1	1.32	0.325	2,213.31
127	424/624	Melaleuca(>50%)/Cypress/Pine	1.29	3	5,220.45	1	1.32	0.325	3,244.51
38	424	Melaleuca	1.39	3	5,625.14	1	1.32	0.325	3,496.02
99	424/625	Melaleuca(>50%) / Pine Flatwoods	1.93	3	7,810.44	1	1.32	0.325	4,854.19
61	424/625	Melaleuca(>75%) / Pine Flatwoods	2	3	8,093.72	1	1.32	0.325	5,030.25
167	424/624	Melaleuca(>50%)/Cypress/Pine	2.25	3	9,105.44	1	1.32	0.325	5,659.03
93	625	Hydric Pine Flatwoods	2.34	3	9,469.65	1	1.32	0.325	5,885.39
36	625/424	Pine Flatwoods / Melaleuca (>25%)	2.72	3	11,007.46	1	1.32	0.325	6,841.14
71	424/625	Melaleuca(>25%) / Pine Flatwoods	2.83	3	11,452.61	1	1.32	0.325	7,117.80
50	424/625	Melaleuca(>75%) / Pine Flatwoods	3.17	3	12,828.55	1	1.32	0.325	7,972.94
20	424/625	Melaleuca(>50%) / Pine Flatwoods	3.43	3	13,880.73	1	1.32	0.325	8,626.87
143	422	Brazilian Pepper	3.59	3	14,528.23	1	1.32	0.325	9,029.29
156	424/625	Melaleuca(>50%)/ Pine Flatwoods	3.91	3	15,823.22	1	1.32	0.325	9,834.13
96	424/625	Melaleuca(>25%) / Pine Flatwoods	5.77	3	23,350.38	1	1.32	0.325	14,512.26
92	424/625	Melaleuca(>25%) / Pine Flatwoods	5.92	3	23,957.41	1	1.32	0.325	14,889.53
125	424/625	Melaleuca(>50%)/ Pine Flatwoods	6.37	3	25,778.50	1	1.32	0.325	16,021.34
115	424/625	Melaleuca(>75%) / Pine Flatwoods	6.59	3	26,668.81	1	1.32	0.325	16,574.66
158	424/625	Melaleuca(>50%)/ Pine Flatwoods	7.29	3	29,501.61	1	1.32	0.325	18,335.25

Appendix 2I. Data - Wood Stork Suitable Foraging Prey Base Preserve (Post Restoration).

ACOE AREA	FLUCCS CODE	DESCRIPTION	Project Wetland Acreage	Hydroperiod Class	Wetlands (m^2)	Habitat Suitability Value	Grams / m^2 / Hydroperiod Class	Wood Stork Consumption Percentage	Grams of Biomass
90	424/625	Melaleuca(>75%) / Pine Flatwoods	7.73	3	31,282.23	1	1.32	0.325	19,441.90
102	424/625	Melaleuca(>75%) / Pine Flatwoods	8.27	3	33,467.53	1	1.32	0.325	20,800.07
124	424/624	Melaleuca(>50%)/Cypress/Pine	9.14	3	36,988.30	1	1.32	0.325	22,988.23
86	424/625	Melaleuca(>75%) / Pine Flatwoods	10.35	3	41,885.00	1	1.32	0.325	26,031.53
138	424/625	Melaleuca(>50%)/ Pine Flatwoods	11.67	3	47,226.86	1	1.32	0.325	29,351.49
153	424/625	Melaleuca(>50%)/ Pine Flatwoods	12.43	3	50,302.47	1	1.32	0.325	31,262.98
179	625	Hydric Pine Flatwoods	12.78	3	51,718.87	1	1.32	0.325	32,143.28
95	424/624	Melaleuca(>25%)/Cypress/Pine	20.43	3	82,677.35	1	1.32	0.325	51,383.97
101	424/625	Melaleuca(>50%) / Pine Flatwoods	22.84	3	92,430.28	1	1.32	0.325	57,445.42
150	424/625	Melaleuca(>75%) / Pine Flatwoods	25.99	3	105,177.89	1	1.32	0.325	65,368.06
137	424/625	Melaleuca(>75%) / Pine Flatwoods	32.88	3	133,060.76	1	1.32	0.325	82,697.26
168	424/625	Melaleuca(>75%)/Cypress/Pine	38.94	3	157,584.73	1	1.32	0.325	97,938.91
100	424/625	Melaleuca(>75%) / Pine Flatwoods	40.24	3	162,845.65	1	1.32	0.325	101,208.57
134	424/625	Melaleuca(>75%) / Pine Flatwoods	62.54	3	253,090.62	1	1.32	0.325	157,295.82
118	424	Melaleuca	107.97	3	436,939.47	1	1.32	0.325	271,557.88
Total		Short Hydroperiod	507.56						1,252,345.40
55	424/624	Melaleuca(>50%)/Cypress/Pine	0.09	4	364.22	1	2.34	0.325	420.67
35	621	Cypress	0.55	4	2,225.77	1	2.34	0.325	2,570.77
68	621	Cypress / Melaleuca (>25%)	0.64	4	2,589.99	1	2.34	0.325	2,991.44
170	424/624	Melaleuca(>50%)/Cypress/Pine	0.79	4	3,197.02	1	2.34	0.325	3,692.56
165	424/624	Melaleuca(>50%)/Cypress/Pine	0.89	4	3,601.71	1	2.34	0.325	4,159.97
126	621	Cypress	1.16	4	4,694.36	1	2.34	0.325	5,421.98
41	621	Cypress / Melaleuca (>25%)	1.27	4	5,139.51	1	2.34	0.325	5,936.14
54	621	Cypress / Melaleuca (>50%)	1.31	4	5,301.39	1	2.34	0.325	6,123.10
106	424/625	Melaleuca(>25%) / Pine Flatwoods	1.41	4	5,706.07	1	2.34	0.325	6,590.51
53	621	Cypress / Melaleuca (>25%)	1.82	4	7,365.29	1	2.34	0.325	8,506.90
147	424/624	Melaleuca(>50%)/ Pine / Cypress	2.53	4	10,238.56	1	2.34	0.325	11,825.53
23	624	Pine / Cypress	2.67	4	10,805.12	1	2.34	0.325	12,479.91
131	424	Melaleuca	2.71	4	10,966.99	1	2.34	0.325	12,666.87

Appendix 2I. Data - Wood Stork Suitable Foraging Prey Base Preserve (Post Restoration).

ACOE AREA	FLUCCS CODE	DESCRIPTION	Project Wetland Acreage	Hydroperiod Class	Wetlands (m^2)	Habitat Suitability Value	Grams / m^2 / Hydroperiod Class	Wood Stork Consumption Percentage	Grams of Biomass
108	424/625	Melaleuca(>75%) / Pine Flatwoods	2.85	4	11,533.55	1	2.34	0.325	13,321.25
169	424/624	Melaleuca(>50%)/Cypress/Pine	3.07	4	12,423.86	1	2.34	0.325	14,349.56
129	424/621	Melaleuca(>25%)/Cypress	3.46	4	14,002.14	1	2.34	0.325	16,172.47
60	621	Cypress	3.93	4	15,904.16	1	2.34	0.325	18,369.30
163	424	Melaleuca	4.34	4	17,563.37	1	2.34	0.325	20,285.70
45	621	Cypress / Melaleuca (>25%)	4.87	4	19,708.21	1	2.34	0.325	22,762.98
145	424	Melaleuca	5.34	4	21,610.23	1	2.34	0.325	24,959.82
30	621	Cypress	6.34	4	25,657.09	1	2.34	0.325	29,633.94
175	424/624	Melaleuca(>25%)/Cypress/Pine	6.67	4	26,992.56	1	2.34	0.325	31,176.40
105	424/625	Melaleuca(>75%) / Pine Flatwoods	7.55	4	30,553.79	1	2.34	0.325	35,289.63
149	424/625	Melaleuca(>25%) / Pine Flatwoods	9.28	4	37,554.86	1	2.34	0.325	43,375.86
174	424	Melaleuca	11.86	4	47,995.76	1	2.34	0.325	55,435.10
119	424/625	Melaleuca(>25%) / Pine Flatwoods	12.63	4	51,111.84	1	2.34	0.325	59,034.18
157	424	Melaleuca	15.47	4	62,604.92	1	2.34	0.325	72,308.69
85	424	Melaleuca	18.53	4	74,988.32	1	2.34	0.325	86,611.50
146	424	Melaleuca	19.58	4	79,237.52	1	2.34	0.325	91,519.33
114	621	Cypress	21.11	4	85,429.21	1	2.34	0.325	98,670.74
107	424/625	Melaleuca(>50%) / Pine Flatwoods	21.33	4	86,319.52	1	2.34	0.325	99,699.05
135	424	Melaleuca	42.41	4	171,627.33	1	2.34	0.325	198,229.57
82	621	Cypress / Melaleuca (>50%)	0.13	5	526.09	1	2.93	0.325	723.38
97	621	Cypress	0.39	5	1,578.28	1	2.93	0.325	2,170.13
59	621	Cypress	0.88	5	3,561.24	1	2.93	0.325	4,896.70
178	621	Cypress	0.89	5	3,601.71	1	2.93	0.325	4,952.34
161	640	Flag Pond	1.43	5	5,787.01	1	2.93	0.325	7,957.14
172	621	Cypress	2.12	5	8,579.34	1	2.93	0.325	11,796.60
81	621	Cypress / Melaleuca (>50%)	2.6	5	10,521.84	1	2.93	0.325	14,467.52
166	621	Cypress	3.05	5	12,342.92	1	2.93	0.325	16,971.52
132	424/621	Melaleuca(>25%)/Cypress	3.67	5	14,851.98	1	2.93	0.325	20,421.47
22	621	Cypress	4.36	5	17,644.31	1	2.93	0.325	24,260.93
177	621	Cypress	5.49	5	22,217.26	1	2.93	0.325	30,548.73
162	424/621	Melaleuca(>50%)/Cypress/Pine	7.42	5	30,027.70	1	2.93	0.325	41,288.09
144	621	Cypress	9.11	5	36,866.89	1	2.93	0.325	50,691.98
160	621	Cypress	9.58	5	38,768.92	1	2.93	0.325	53,307.26

Appendix 2I. Data - Wood Stork Suitable Foraging Prey Base Preserve (Post Restoration).

ACOE AREA	FLUCCS CODE	DESCRIPTION	Project Wetland Acreage	Hydroperiod Class	Wetlands (m^2)	Habitat Suitability Value	Grams / m^2 / Hydroperiod Class	Wood Stork Consumption Percentage	Grams of Biomass
148	424/621	Melaleuca(>25%)/Cypress	15.38	5	62,240.71	1	2.93	0.325	85,580.97
94	621	Cypress	18.57	5	75,150.19	1	2.93	0.325	103,331.51
84	540	Cattle Pond	0.08	6	323.75	1	3.36	0.325	516.38
109	540	Cattle Pond	0.19	6	768.9	1	3.36	0.325	1,226.40
TOTALS		Long Hydroperiod	323.79						1,589,700.47
			Acres			kg		grams	
		Long Hydroperiod	323.79			1,589.70		1,589,700.47	
		Short Hydroperiod	507.56			1,252.35		1,252,345.40	
		Total	831.35			2,842.05		2,842,045.87	
		Biomass Increase Following Restoration				2,181.87		2,181,867.92	
			Short Hydroperiod			1,106.37		1,106,372.11	
			Long Hydroperiod			1,075.50		1,075,495.81	