United States Department of the Interior

FISH AND WILDLIFE SERVICE
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County: Miami-Dade

Dear Colonel Grosskruger:

This document is the Fish and Wildlife Service's (Service) amendment to our January 12, 2006, Biological Opinion for the Tamiami Trail portion of the Modified Water Deliveries (MWD) to Everglades National Park (ENP) project, and its effects on the eastern indigo snake (*Drymarchon corais couperi*), wood stork (*Mycteria americana*), Everglade snail kite (*Rostrhamus sociabilis plumbeus*), Everglade snail kite critical habitat, West Indian manatee (*Trichechus manatus*), West Indian manatee critical habitat, Cape Sable seaside sparrow (*Ammodramus matitimus mirabilis*), Cape Sable seaside sparrow critical habitat, and the Florida panther (*Puma concolor coryi*), in accordance with section 7 of the Endangered Species Act of 1973, as amended (ESA) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). The project site is located in Sections 01-06, Township 54 South, Range 37 East and Sections 07-11, Township 54 South, Range 38 East, Miami-Dade County, Florida (Figure 1).

Based on your request for formal consultation which was received in this office on May 15, 2008, you would like the Service to consider the preferred alternative, Alt 3.2.2a, and its effects on listed species within the project area. Alternative 3.2.2a consists of a 1-mile eastern bridge and raising the remaining roadway to support a 8.5-ft National Geodetic Vertical Datum (NGVD) stage in the L-29 Canal. This plan is similar to but has a smaller project footprint than the previous plan, Alternative 14, which consisted of 3 miles of bridging and raising the road to support a 9.7-ft NGVD stage in the L-29 Canal. A Biological Opinion for Alternative 14 was issued by this office on January 12, 2006, and is hereby incorporated by reference.

Corps' Effect Determinations

The range of the threatened eastern indigo snake overlaps the project area and the species may be present; however, there have been no recorded observations from general wildlife surveys conducted within the footprint. The eastern indigo snake could potentially be affected by construction activities, so U.S. Army Corps of Engineers (Corps) will include the "Standard Construction Precautions for the Indigo Snake" in the project design and implementation. The Corps has determined that the project "may affect, but is not likely to adversely affect" the eastern indigo snake.

The endangered wood stork uses suitable habitats throughout the project area. Two active nesting colonies occur near the project area, including the "Tamiami East" and "Tamiami West" colonies located just south of the Trail on the eastern end of the project area (Figure 2). The 1-mile bridge would be constructed midway between these two colonies, such that the bridge itself would not overlap the established Primary or Secondary Zones. Construction activities for the bridge on-ramps and raising portions of the road would impinge into the disturbance zones for the colonies. The Corps has agreed to manage the construction activities according to the Service's "Draft Supplemental Habitat Management Guidelines for the Wood Stork in the South Florida Ecological Services Consultation Area." The Service has reviewed and provided comments on the environmental monitoring section of the draft plans and specifications in an email to the Corps dated May 22, 2008. The Corps has concluded that the project "may affect, but is not likely to adversely affect" the wood stork.

Potential effects to the Everglade snail kite would result from construction activities during the 36 months it would take to complete the project. Based on nesting data from 1996 to 2007, the closest nest to Tamiami Trail was 285 feet (ft) from the road (2000 nest site) (Figure 3). Because this distance falls within 500-ft of the project site, and the potential for future nesting exists in this area, the Corps will follow the Service's Draft Snail Kite Management Guidelines (Appendix A). This guidance outlines means to minimize impacts to nesting snail kites through the establishment of buffer zones. In short, a 500-ft no-entry buffer zone (i.e., no construction activities) would be placed around any active nest in proximity to the project area. Additionally, a 1,400-ft zone of minimal disturbance would also surround active nests. (Please refer to Appendix A for more detailed information.) The Service and the Florida Fish and Wildlife Conservation Commission (FWC) monitor snail kite nesting and will notify the Corps should nests be detected in proximity to the project area. There is no designated critical habitat located within or adjacent to the project area, so none would be affected. The Corps concluded that the project "may affect, but is not likely to adversely affect" the Everglade snail kite.

The endangered West Indian manatee has rarely been documented in the project area. For the entire period of record spanning over 20 years, there has been only one recorded manatee utilizing the L-29 Canal adjacent to Tamiami Trail. The likelihood of a manatee occurring in the project area is negligible. There would be no activities in the canal during construction, therefore, the Corps has concluded that the project "may affect, but is not likely to adversely affect" the West Indian manatee.

The endangered Cape Sable seaside sparrow (CSSS) does not occur in the project footprint. The closest known sparrow habitat where sparrows are known to have nested lies 10 miles south of the project area. Construction activities would have no direct effect on this species. There is no designated critical habitat located within the project area, so none would be affected. The Corps concludes that the project "may affect, but is not likely to adversely affect" the CSSS.

Based on the reasons provided above, the Service concurs with the Corps' determination that the Tamiami Trail feature of the MWD to ENP Project "may affect, but is not likely to adversely affect" the eastern indigo snake, wood stork, Everglade snail kite, West Indian manatee, and CSSS and will have "no effect" on Everglade snail kite critical habitat, West Indian manatee critical habitat, and CSSS critical habitat. Therefore, the following Biological Opinion will focus on the Tamiami Trail project and its effects on the Florida panther.

In the Corps' draft letter on endangered species issues emailed to the Service on July 29, 2005, they determined that the Tamiami Trail portion of the MWD Project "may affect, but is not likely to adversely affect" the endangered Florida panther. In an email response dated September 8, 2005, and subsequent phone conversations, the Service recommended that the Corps submit a Biological Assessment (BA) containing all current information regarding the project effects on the panther and that a more appropriate effect might be determination to "may affect likely to adversely affect". The Corps' final determination of "may adversely affect" was received in a letter dated August 26, 2005. The Service responded with an email on September 8, 2005, requesting additional information on the project, mainly with regards to cumulative effects. This information was received in a letter dated December 19, 2005. The previous Biological Opinion (Service 2006a) concluded that the proposed construction of the Tamiami Trail modification was not likely to jeopardize the continued existence of the Florida panther and provided incidental take for the removal of 20.6 acres of panther habitat. Although the current proposed plan (3.2.2a) will result in roughly half the impact as the previous plan, the Service will reassess the project effects based the most recent scientific data in this amended Biological Opinion.

This amended Biological Opinion is based on information provided in the Corps' letter requesting reinitiation of formal consultation dated May 13, 2008, Draft Letter Reevaluation Report (LRR) and Environmental Assessment (EA) dated April 2008; BA dated August 26, 2005; the Service's Request for Additional Information delivered electronically to the Corps on September 8, 2005; the Corps' response to that request dated December 19, 2005; information submitted by the Corps' contractor GEC Incorporated on November 2, 2005, and March 31, 2008; and meetings, telephone conversations, email, and other sources of information. A complete administrative record of this consultation is on file at the Service's South Florida Ecological Services Office, Vero Beach, Florida.

The 16.4-acre construction footprint lies generally within 40 ft south of the Tamiami Trail along a 1-mile stretch where the bridge will be located. Based on Florida Land Use, Cover and Forms Classification System the site is comprised of 0.3 acre of open water, 4.8 acres of mixed wetland hardwoods-mixed shrubs, 4.18 acres of freshwater marshes, 0.13 acre of upland forest, and 6.99 acres of roads and highways. The dominant exotic species of vegetation throughout the project

area is Brazilian pepper (*Schinus terebinthifolius*) which occupies roughly 50 percent of the shoulder in the construction footprint. The project area is bounded on the north by Water Conservation Area 3B (WCA) and on the south by ENP.

Based on the analysis conducted by the Corps using concept-level design drawings, Alternative 3.2.2a will impact a total of 16.41 acres of habitat marginally suitable for use by the Florida panther. This acreage would be impacted due to permanent (9.28 acres) and temporary (7.13 acres) construction easements associated with the construction of the 1-mile bridge and associated on ramps. Once bridge construction has been completed, the 7.13 acres of temporary construction easement will be restored to its current state. In contrast, 8.5 acres of the existing road embankment will be removed where the 1-mile bridge will be constructed. Although the area under the bridges may provide safe passage for any panthers wishing to cross the Trail, it does not represent good quality panther habitat due to shading by the low bridge. The Corps will compensate for the permanent loss of 9.28 acres of panther habitat through the preservation and restoration of 10 acres located on the western side of the 8.5 Square Mile Area (SMA), which is part of the MWD Project.

POTENTIAL BENEFITS OF PROPOSED ACTION TO ENDANGERED SPECIES

This Biological Opinion assesses the direct impacts from construction in the project footprint on threatened and endangered species; however, the proposed action has the potential to benefit endangered species outside the footprint. This project represents a crucial first step toward integrating WCA-3A and 3B, and Northeast Shark River Slough (NESRS) back into the historical Everglades flow way (Figure 4). Allowing the redistribution of a portion of water flow east toward NESRS should have the immediate and long lasting effect of lowering high water levels in WCA-3A. Lower water levels in southern WCA-3A would benefit the endangered Everglade snail kite which has suffered recent declines from sustained water depth and hydroperiod in this area. Creating a more natural hydrology in WCA 3A could also improve tree island habitat in the longer term and therefore improve habitat for the Florida panther. An ancillary benefit of lowering water levels in WCA-3A would be reduced discharges through the S-12 structures which have impacted the CSSS habitat located in western Shark River Slough. Redistributing water to the east is the cornerstone of Everglades restoration (Curnutt et al. 1998; Corps 1999; Ogden 2007; SEI 2003) and modifying the Tamiami Trail, to pass greater volumes of water, will greatly aid in achieving the restoration envisioned. A panel of scientists concluded that there were strong indicators Everglades restoration when complete, would benefit the CSSS, Everglade snail kite, and wood stork (SEI 2003). MWD, including the Tamiami Trail modification, are a key first step in this effort.

Wood stork

Hydrologic restoration of NESRS and eastern ENP is essential to the recovery of wading bird populations such as the wood stork in ENP (Tabb 1963; Service 1990, 1991, 1999a; Corps 1992, 1999; Ogden et al. 1992). The population declines observed throughout ENP in the 1960s coincide with the hydrologic isolation of NESRS and subsequent lowering of water levels in the

upstream Everglades ecosystem by the compartmentalization of WCA-3 (Leach et al. 1972; Corps 1992; U.S. Department of Justice 1999). Augmentation of flows to NESRS would likely increase stages in the Rocky Glades and Taylor Slough areas. This movement toward historic seasonal flow distributions of water would likely increase water depths and hydroperiods within these areas that would improve the quality and quantity of forage fish that support wood stork nesting colonies in their current as well as historic locations.

Cape Sable seaside sparrow

Since 1992, the decline in the CSSS population has been substantive, and there has been little evidence of improvement (Pimm et al. 2002; Service 2006a; Elderd and Nott 2007). Subpopulation A, located in Northwest Shark River Slough (NWSRS) has been impacted by high water levels from both natural rainfall events and large, unseasonable S-12 discharges (Pimm et al. 2002; Pimm and Bass 2002; Service 2006a; Eldred and Nott 2007). This area once supported nearly half of the total sparrow population from 1981 to 1992 (Service 1999a, 2002, 2006a; Pimm et al. 2002; Pimm and Bass 2002; Elderd and Nott 2007). Conversely, CSSS subpopulations located on the eastern side of Shark Slough have experienced drier than normal conditions making them susceptible to increased fire risk. This risk was made clear earlier this year when a fire started near subpopulation F and burned roughly 30,000 acres of prairie and slough habitat in NESRS. This fire consumed roughly all of the habitat in Subpopulation F and 20 percent of habitat in Subpopulation E neither of which will return to sparrow habitat for at least two years (La Puma et al. In Press). Redistributing water from the current SRS water budget into NESRS would benefit CSSS in Subpopulation A by reducing S-12 A, B and C discharges during the early wet season. Furthermore, redistribution of flows to NESRS and increased stages downstream will help to restore historic hydroperiods in the eastern marl marshes of the Rocky Glades and Taylor Slough, benefiting eastern subpopulations of the CSSS which have been too dry.

Everglade snail kite

The Everglade snail kite has experienced pronounced population fluctuations over the past 30 years. These fluctuations are primarily associated with the regulation of water levels by the Central and Southern Florida project and natural meteorological conditions (Nicholson 1926; Howell 1932; Bent 1937; Sprunt 1945, 1954; Stieglitz and Thompson 1967; Service 1990, 1991, 1999a; Corps 1992). Specifically, in WCA-3A snail kites have been impacted by the maintenance of unnaturally high stages (Kitchens et al. 2002; Martin et al. 2003; Service 2006a). This condition is believed to have reduced suitable nesting substrate and foraging opportunities. The loss of over half of the wetlands in central and southern Florida during the last century, coupled with habitat degradation and fragmentation of many remaining wetlands, has increased the importance of WCA-3A in sustaining the overall snail kite population. Drought conditions in south Florida between 2000-2001 and 2007-2008 have also adversely affected the snail kite population. Redistributing water from the current SRS water budget into NESRS, when combined with future operational improvements to water management of WCA-3A and 3B, would likely reduce unnaturally high wet season stages in WCA-3A that have been impacting snail kite nesting substrate and reducing foraging opportunities. Additionally, restoration of the

historic SRS flow way would likely enhance the function of snail kite habitat in WCA-3B and NESRS. In short, MWD and the Tamiami Trail modification project are a key first step in Everglades restoration within this part of the system, and the best available science suggests Everglades restoration will benefit the snail kite (SEI 2003).

The Use of Best Scientific and Commercial Information by the Service

The Service uses the most current and up-to-date scientific and commercial information available. The nature of the scientific process dictates that information is constantly changing and improving as new studies are completed. The scientific method is an iterative process that builds on previous information. As the Service becomes aware of new information, we will ensure it is fully considered in our decisions, evaluations, reviews, and analyses as it relates to the base of scientific knowledge and any publications cited in our documents.

Specifically, there is one such document cited in this Biological Opinion the Service acknowledges has been affected in its cited form by new scientific information. This document is the South Florida Multi-Species Recovery Plan (MSRP) of 1999 (Service 1999b). The Service has taken new information related to this document that has become available since its publication into account when using this document to help guide our analysis and decisions.

South Florida Multi-Species Recovery Plan

The MSRP was designed to be a living document and it was designed to be flexible to accommodate the change identified through ongoing and planned research and would be compatible with adaptive management strategies. These principals are set forth in both the transmittal letter from the Secretary of the Interior and in the document itself. As predicted, this is what indeed occurred in the intervening years since the MSRP was published. The Service uses the MSRP in the context it still presents useful information when taken in conjunction with all the new scientific information developed subsequent to its publication.

SUPPLEMENTAL CONSULTATION HISTORY

In June 2007, in developing the WRDA of 2007 Congress expressed concern about the rapid cost increase and high cost of the 2005 Revised General Reevaluation Report plan (Alternative 14) and directed proponents in the Department of the Interior and Corps to re-evaluate the 2005 Plan as well as develop less costly alternatives.

On October 18 and 19, 2007, Service staff met with an interagency group at ENP to discuss performance measures for determining environmental benefits.

On October 23, 2007, interagency Project Delivery Team met at the Corps office in Jacksonville to discuss quantification of benefits methodology and reporting requirements for the Tamiami Trail Letter Reevaluation Report.

On March 6, 2008, the Service provided a Planning Aid Letter to the Corps summarizing the interagency environmental assessment methodology and results, noting potential benefits to endangered species, and stating support for the current preferred alternative.

On March 31, 2008, the Service received additional information compiled by the Corps' contractor, GEC Incorporated, on the Florida panther.

In April 2008, the Corps submitted the Tamiami Trail Modification Limited Reevaluation Report and Environmental Assessment. This document states the selected alternative, Alternative 3.2.2a, is the preferred alternative.

On May 15, 2008, the Service received a request for initiation of formal consultation from the Corps. In this letter they conclude that the preferred alternative may affect, but is not likely to adversely affect the previously identified listed species within the project area. This letter does not mention species specific determinations, rather references the prior BA and Biological Opinion, so the Service assumes the determination for the Florida panther would remain the same, "may adversely affect".

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

Proposed Action

The preferred alternative would create a 1-mile bridge opening through Tamiami Trail by removing up to a mile of the existing highway, embankment, and associated culverts. The remainder of the 10.7-mile stretch of road would be raised to allow the stage in L-29 to be raised to 8.5-ft NGVD. The project site is located along a 10.7-mile stretch of U.S. Highway 41 (US 41) (Tamiami Trail) between S-333 and S-334 in west Miami-Dade County, Florida. The construction footprint encompasses a total of 16.4 acres: 0.3 acre of open water, 4.8 acres of mixed wetland hardwoods-mixed shrubs, 4.18 acres of freshwater marshes, 0.13 acre of upland forest, and 6.99 acres of roads and highways. The dominant exotic species of vegetation throughout the project area is Brazilian pepper which occupies roughly 50 percent of the shoulder in the construction footprint for a width averaging between 10 and 30 ft.

The project will result in the "permanent removal" of 9.28 acres of habitat suitable for use by the Florida panther. The project is located within the Florida panther Primary Zone (Kautz et al. 2006) (Figure 10). The project is also within the panther focus area (Figure 5). The crown elevation of the roadway will be raised to 11.55 ft NGVD. Asphalt overlay will be used to raise the low portions of the road, thus eliminating the need for additional road widening to stabilize side slopes. The preferred alternative will require expansion of the highway footprint southward, in the vicinity of the 1-mile bridge and on ramps. The width of the expansion is estimated to to be 50 ft and will result in the conversion of roughly 9.28 acres of habitat marginally suitable for panther use into bridge and associated on ramps. In contrast, removal of the existing roadway

under the bridge associated with the Recommended Plan will result in the removal of 8.5 acres of fill which currently supports roadway.

The 8.5 acres of wetland habitat "produced" as a result of bridging a mile of the roadway will most likely result in open water habitat due to shading by the bridge spans. Although the quality of this type of habitat for use by panthers is not as good as the 9.28 acres being removed via road widening, it is thought that the wildlife underpass provided by the bridge for panthers and other wildlife will be a benefit once other barriers are removed via future Comprehensive Everglades Restoration Plan (CERP) projects. Additionally, the removal of the 9.28 acres of exotic infested habitat close to the roadway may prove beneficial in reducing the risk of road mortality to panthers by removing an attractive nuisance next to a major roadway. In addition to the restoration of usable wetland habitat and removal of exotic vegetation along the highway, implementation of the Recommended Plan would facilitate improvement 63,195 acres of wetland habitat in ENP through the restoration of deep sloughs in NESRS and the promotion of improved sheetflow characteristics south of Tamiami Trail. These benefits will be fully recognized once other CERP project components are constructed.

The Corps has proposed compensation for project effects to panther habitat through preservation and enhancement of approximately 10 acres of Primary Zone habitat near the 8.5 SMA, which is also a part of the MWD project. This preservation provides compensation for the loss of 9.28 acres of lower quality habitat on the project site for foraging and dispersal by the Florida panther through the off-site protection and restoration of approximately 10 acres of higher quality panther habitat closer to areas with higher densities of panthers (Figure 9).

Action Area

The consultation area for the Florida panther includes lands in Charlotte, Glades, Hendry, Lee, Collier, Palm Beach, Broward, Miami-Dade, and Monroe Counties, as well as the southern portion of Highlands County (Figure 5). 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 action area is larger than the proposed action area identified by the Corps' LRR/EA. The action area, which is a subset of the current panther range, includes those lands the Service believes may experience direct and indirect effects from the proposed action. Maehr et al. (1990b) 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. (2002) in a later report documents a "mean maximum dispersal distance" of 68.1 km (42.3 miles) for subadult males and 20.3 km (12.6 miles) for subadult females. In the same report Maehr et al. (2002) documents a "mean dispersal distance" of 37.3 km (23.1 miles) for subadult males. Comiskey et al. (2002) documents a "mean dispersal distance" for subadult male panthers as an average distance of

40.1 km (24.9 miles) from their natal range, which is similar to the dispersal distance referenced by Maehr et al. (2002).

Therefore, for both direct and indirect effects, the Service defined the action area (Figure 6) as all lands within a 25-mile radius of the proposed bridge span along the Tamiami Trail, which is slightly greater than the mean dispersal distance for subadult males. This action area does not include urban lands, lands east of the L-30 and L-31N levees, and lands outside the Service's panther consultation area. 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 occur.

STATUS OF THE SPECIES RANGEWIDE

Status - Panther Biology/Ecology

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 approximately 100 animals, located in south Florida.

When Europeans first came to this country, pumas roamed most all of North, Central, and South America. Early settlers attempted to eradicate pumas by every means possible. By 1899, it was believed that 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 eliminated (Tinsley 1970). In 1935, Dave Newell, a Florida sportsman, hired Vince and Ernest Lee, Arizona houndsmen, to hunt for panthers in Florida. They killed eight in the Big Cypress Swamp (Newell 1935). Every survey conducted since then has confirmed that a panther population occurs in southern Florida south of the Caloosahatchee River, and no survey since then has been able to confirm a panther population outside of southern Florida.

Attempts to eradicate panthers and a decline in panther prey (primarily white-tailed deer, *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 the Florida Fish and Wildlife Conservation Commission [FWC]) declared the panther a regulated game species due to concerns over declining numbers. The FWC removed panthers from the game animal list in 1958 and gave them complete legal protection. On March 11, 1967, the Service listed the panther as endangered (32 FR 4001) throughout its historic range, and these animals received Federal protection under the passage of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (ESA). 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 ESA, there was no formal listing package identifying threats to the species as currently required by section 4(a)(1) of the ESA. However, the technical/agency draft of the Florida Panther Recovery Plan, third revision, addressed the five factor threats analysis (Service 2006c). 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* species. Therefore, he assigned it full specific status and named it *Felis coryi* since *Felis floridana* had been used previously for a bobcat (currently, *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 subspecific status as *Felis concolor coryi.* This designation also incorporated *F. arundivaga*, which had been classified by Hollister (1911) from specimens collected in Louisiana, into *F. c. coryi*. Nowell and Jackson (1996) reviewed the genus *Felis* and placed mountain lions, including the Florida panther, in the genus *Puma*.

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

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 kilograms [kg]) in weight; but, typically adult males average around 116 lbs (52.6 kg) and stand about 24 to 28 inches (in) (60 to 70 centimeters [cm]) at the shoulder (Roelke 1990). Female panthers are smaller with an average weight of 75 lbs (34 kg) and length of 6 ft (1.8 m) Roelke 1990). 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; 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 (Land et al. 2004). In addition, to date, neither atrial septal defects nor cryptorchidism have been found in introgressed panthers (M. Cunningham, FWC, pers. comm. 2005). As of January 27, 2003, none of the eight female Texas panthers introduced in 1995 remain in the wild.

Population Trends and Distribution

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

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

Sarasota, and Volusia) north of the river (Belden et al. 1991, Belden and McBride 2005). However, no evidence of a female or reproduction has been documented north of the Caloosahatchee River since 1973 (Nowak and McBride 1974, Belden et al. 1991, Land and Taylor 1998, Land et al. 1999, Shindle et al. 2000, McBride 2002, Belden and McBride 2005).

Puma are wide ranging, secretive, and occur at low densities. However, their tracks, urine markers, and scats are readily found by trained observers, and resident populations are easily located. Van Dyke (1986a) determined that all resident puma, 78 percent of transient puma, and 57 percent of kittens could be detected by track searches in Utah. In south Florida, the Florida panther's limited range and low densities may make the population count derived from track searches more accurate than in Utah. During two month-long investigations – one late in 1972 and early 1973 and another in 1974 – funded by the World Wildlife Fund to determine if panthers still existed in Florida, McBride searched for signs of panthers in portions of south Florida. In 1972, McBride authenticated a road-killed male panther in Glades County and a female captured and released from a bobcat trap in Collier County (R. McBride, Livestock Protection Company, pers. comm. 2005). In 1973, McBride captured one female in Glades County (Nowak and McBride 1974). Based on this preliminary evidence, Nowak and McBride (1974) estimated the "population from the Lake Okeechobee area southward to be about 20 or 30 individuals." In 1974, McBride found evidence of only two additional panthers in the Fakahatchee Strand and suggested that "there could be as few as ten individuals panthers in the area around Lake Okeechobee and southward in the state" (Nowak and McBride 1975). This initial survey, while brief in nature, proved that panthers still existed in Florida and delineated areas where a more exhaustive search was warranted. After this initial investigation, more comprehensive surveys on both public and private lands were completed (Reeves 1978; Belden and McBride 1983a, b; Belden et al. 1991). Thirty individual panthers were identified during a wide-ranging survey in 1985 in south Florida (McBride 1985).

Maehr et al. (1991) provides the only published estimate of population density based on a substantial body of field data (Beier et al. 2003). Maehr et al. (1991) estimated a density of 1 panther/27,520 acres [11,137 hectares (ha)] based on 17 concurrently radio-collared and four uncollared panthers. They extrapolated this density to the area occupied (1,245,435 acres [504,012 ha]) by radio-collared panthers during the period 1985-1990 to achieve a population estimate of 46 adult panthers for southwest Florida (excluding Everglades National Park [ENP], eastern Big Cypress National Preserve [BCNP], and Glades and Highlands Counties). Beier et al. (2003), however, argued that this estimate of density, although "reasonably rigorous," could not be extrapolated to other areas because it was not known whether densities were comparable in those areas.

More recently, McBride (2000, 2001, 2002, 2003) reported minimum population counts (*i.e.*, number known alive) based on panthers treed with hounds, physical evidence (*e.g.*, tracks where radio-collared panthers were not known to occur), documentation by trail-camera photos, and sightings of uncollared panthers by a biologist or pilot from a monitoring plane or via ground telemetry. He counted adults and subadult panthers but not kittens at the den. The population estimate in 2000 was 62 panthers (McBride 2000), with estimates of 78 in 2001 (McBride 2001), 80 in 2002 (FWC 2002), 87 in 2003 (FWC 2003), 78 in 2004 (R. McBride, Personal Communication, 2006), 82 in 2005 (R. McBride, Personal Communication, 2006), 97 in 2006

(R. McBride, Personal Communication, 2006), and 117 in 2007 (R. McBride, Personal Communication, 2008). The 3-year running average of the verified panther population shows an annual increase in the population over the reported years.

Life History

Reproduction: Male Florida panthers are polygynous, maintaining large, overlapping home ranges containing several adult females and their dependent offspring. The first sexual encounters for males normally occur at about 3 years based on 26 radio-collared panthers of both sexes (Maehr et al. 1991). Based on genetics work, some males may become breeders as early as 17 months (W. Johnson, National Cancer Institute, pers. comm. 2005). Breeding activity peaks from December to March (Shindle et al. 2003). Litters (n = 82) are produced throughout the year, with 56-60 percent of births occurring between March and June (Jansen et al. 2005, Lotz et al. 2005). The greatest number of births occurs in May and June (Jansen et al. 2005, Lotz et al. 2005). Female panthers have bred as young as 18 months (Maehr et al. 1989) and successful reproduction has occurred up to 11 years old. The mean age of denning females is 4.6 ± 2.1 (standard deviation [sd]) years (Lotz et al. 2005). Age at first reproduction for 19 known-aged female panthers averaged 2.2 ± 0.246 (sd) years and ranged from 1.8-3.2 years. Average litter size is 2.4 ± 0.91 (sd) kittens. Seventy percent of litters are comprised of either two or three kittens. Mean birth intervals (elapsed time between successive litters) are 19.8 ± 9.0 (sd) months for female panthers (n = 56) (range 4.1-36.5 months) (Lotz et al. 2005). Females that lose their litters generally produce another more quickly; five of seven females whose kittens were brought into captivity successfully produced another litter an average of 10.4 months after the removal of the initial litter (Land 1994).

Den sites are usually located in dense, understory vegetation, typically saw palmetto (*Serenoa repens*) (Maehr 1990, Shindle et al. 2003). Den sites are used for up to two months by female panthers and their litters from birth to weaning. Independence and dispersal of young typically occurs at 18 months, but may occur as early as one year (Maehr 1992).

Survivorship and Causes of Mortality: Mortality records for uncollared panthers have been kept since February 13, 1972, and for radio-collared panthers since February 10, 1981. Through January 14, 2007, 210 mortalities have been documented, with 96 (45.7 percent) of known deaths occurring in the past 5 years (FWC 2007, FWC unpublished data). Documented mortality averaged 3.8 per year through December 2002, and 18.2 per year from January 2003 through December 2007. Of the 210 total mortalities, 116 were radio-collared panthers that have died since 1981 (FWC 2007, FWC unpublished data). From 1990-2004, mean annual survivorship of radio-collared adult panthers was greater for females (0.894 ± 0.099 sd) than males (0.779 ± 0.125 sd) (Lotz et al. 2005). Except for intraspecific aggression, the causes of mortality were found to be independent of gender (Lotz et al. 2005).

Intraspecific aggression was the leading cause of death for radio-collared panthers, accounting for 42 percent (Jansen et al. 2005, Lotz et al. 2005). Most intraspecific aggression occurs between male panthers; but, aggressive encounters between males and females have occurred,

resulting in the death of the female. Defense of kittens and\or a kill is suspected in half (5 of 10) of the known instances through 2003 (Shindle et al. 2003).

Unknown causes and collisions with vehicles accounted for 24 and 19 percent of radio-collared panther mortalities, respectively. From February 13, 1972, through June 30, 2007, Florida panther vehicular trauma (n = 112) averaged 3.1 per year for radio-collared and uncollared panthers (FWC 2007). Eight of the collisions were not fatal. Since the publication of the 2006-2007 report (FWC 2007), four additional panthers have been killed by vehicle collisions (FWC, unpublished data), bringing the total to 117 panthers killed or injured by vehicles since 1972.

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 three years and have established a home range that overlaps with females. Thirty-one male panthers were captured as kittens and 12 (38.7 percent) of these cats survived to become residents (Jansen et al. 2005, Lotz et al. 2005). "Successful male recruitment appears to depend on the death or home-range shift of a resident adult male" (Maehr et al. 1991). Turnover in the breeding population is low with documented mortality in radio-collared panthers being greatest in subadults and non-resident males (Maehr et al. 1991; Shindle et al. 2003).

Den sites of female panthers have been visited since 1992 and the number of kittens that survived to 6 months for 38 of these litters has been documented. Florida and introgressed panther kitten survival to 6 months were estimated to be 52 and 72 percent, respectively, but were not significantly different (P = 0.2776) (Lotz et al. 2005). Survival of kittens greater than 6 months old was determined by following the fates of 55 radio-collared dependent-aged kittens, including 17 introgressed panthers, from 1985 through 2004. Only one of these 55 kittens died before reaching independence, resulting in a 98.2 percent survival rate (Lotz et al. 2005). The FWC and NPS are continuing to compile and analyze existing reproductive and kitten data.

Dispersal: Panther dispersal begins after a juvenile becomes independent from its mother and continues until it establishes a home range. Dispersal distances are greater for males (n = 18) than females (n = 9) (42.5 mi [68.4 km] vs. 12.6 mi [20.3 km], respectively) and the maximum dispersal distance recorded for a young male was 139.2 mi (224.1 km) over a 7 month period followed by a secondary dispersal of 145 mi (233 km) (Maehr et al. 2002a). Males disperse an average distance of 25 mi (40 km); females typically remain in or disperse short distances from their natal ranges (Comiskey et al. 2002). Female dispersers are considered philopatric because they usually establish home ranges less than one average home range width from their natal range (Maehr et al. 2002a). Maehr et al. (2002a) reported 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 range becomes vacant (Maehr 1997).

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

Home Range Dynamics and Movements: Panthers require large areas to meet their needs. Numerous factors influence panther home range size, including: habitat quality, prey density, and landscape configuration (Belden 1988, Comiskey et al. 2002). Home range sizes of 6 radio-collared panthers monitored between 1985 and 1990 averaged 128,000 acres (51,800 ha) for resident adult males and 48,000 acres (19,425 ha) for resident adult females; transient males had a home range of 153,599 acres (62,160 ha) (Maehr et al. 1991). Comiskey et al. (2002) examined the home range size for 50 adult panthers (residents greater than 1.5 years old) monitored in south Florida from 1981-2000 and found resident males had a mean home range of 160,639 acres (65,009 ha) and females had a mean home range of 97,920 acres (39,627 ha). Beier et al. (2003) found home range size estimates for panthers reported by Maehr et al. (1991) and Comiskey et al. (2002) to be reliable. Annual minimum convex polygon home range sizes of 52 adult radio-collared panthers monitored between 1998 and 2002 ranged from 15,360 – 293,759 acres (6,216 – 118,880 ha), averaging 89,600 acres (36,260 ha) for 20 resident adult males and 44,160 acres (17,871 ha) for 32 resident adult females (Land et al. 1999, Shindle et al. 2000, Shindle et al. 2001, Land et al. 2002). The most current estimate of home-range sizes (minimum convex polygon method) for established, non-dispersing, adult, radio-collared panthers averaged 29,056 acres (11,759 ha) for females (n = 11) and 62,528 acres (25,304 ha) for males (n = 11) (Lotz et al. 2005). The average home range was 35,089 acres (14,200 ha) for resident females (n = 6) and 137,143 acres (55,500 ha) (n = 5) for males located at BCNP (Jansen et al. 2005). Home ranges of resident adults tend to be stable unless influenced by the death of other residents; however, several males have shown significant home range shifts that may be related to aging (D. Jansen, National Park Service [NPS], pers. comm. 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 one to seven days and usually result in pregnancy (Maehr et al. 1991). Aggressive interactions between males often result in serious injury or death. Independent subadult males have been known to associate with each other for several days and these interactions do not appear to be aggressive in nature. Aggression between males is the most common cause of male mortality and an important determinant of male spatial and recruitment patterns based on radio-collared panthers (Maehr et al. 1991, Shindle et al. 2003). Aggressive encounters between radio-collared males and females also have been documented (Shindle et al. 2003, Jansen et al. 2005).

Food Habits: Primary panther preys are white-tailed deer 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 8-11 days; this frequency would be 14-17 days for a resident female; and 3.3 days for a female with three 13-month-old kittens (Ackerman et al. 1986). Maehr et al. (1990b) documented domestic livestock infrequently in scats or kills, although cattle were readily available on their study area.

Infectious Diseases, Parasites, and Environmental Contaminants:

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

infected panthers had overlapping home ranges in the Okaloacoochee Slough ecosystem. Three panthers died due to suspected FeLV-related diseases (opportunistic bacterial infections and anemia) and the two others died from intraspecific aggression. Testing of serum samples collected from 1990-2005 for antibodies (indicating exposure) to FeLV indicated increasing exposure to FeLV beginning in the late 1990s and concentrated north of I-75. There was apparently minimal exposure to FeLV during this period south of I-75. Positive antibody titers in different areas at different times may indicate that multiple introductions of the virus into the panther population may have occurred. These smaller epizootics were apparently self-limiting and did not result in any known mortalities. Positive antibody titers, in the absence of an active infection (antigen positive), indicate that panthers can be exposed and overcome the infection (Cunningham 2005). Management of the disease includes vaccination as well as removal of infected panthers to captivity for quarantine and supportive care. As of June 1, 2005, about one-third of the population had received at least one vaccination against FeLV (FWC and NPS, unpublished data). No new positive cases have been diagnosed since July 2004.

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

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

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

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

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

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

Habitat Characteristics/Ecosystem

Landscape Composition: Noss and Cooperrider (1994) considered the landscape implications of maintaining viable panther populations. Assuming a male home range size of 137,599 acres (55,685 ha) (Maehr 1990), an adult sex ratio of 50:50 (Anderson 1983), and some margin of safety, they determined that a reserve network as large as 15,625 - 23,438 mi^2 (40,469 - 60,703 km^2) would be needed to support an effective population size of 50 individuals (equating to an actual adult population of 100 - 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 - 2,000 adult panthers [Ballou et al. 1989]), could require as much as 156,251 - 234,376 mi^2 (404,687-607,031 km^2). This latter acreage corresponds to roughly 60 - 70 percent of the Florida panther's historical range. Although it is uncertain whether this much land is needed for panther recovery, it does provide some qualitative insight into the importance of habitat conservation across large landscapes for achieving a viable panther population (Noss and Cooperrider 1994).

Between 1981 and 2003, more than 55,000 locations were collected from more than 100 radio-collared panthers. Belden et al. (1988), Maehr et al. (1991), Maehr (1997), Kerkoff et al. (2000), and Comiskey et al. (2002) provide information on habitat use based on various subsets of these data. Since almost all data from radio-collars have been collected during daytime hours (generally 0700 - 1100), and because panthers are most active at night (Maehr et al. 1990a), daytime radio locations are insufficient to describe the full range of panther habitat use

(Beyer and Haufler 1994, Comiskey et al. 2002, Beier et al. 2003, Dickson et al. 2005, Beier et al. 2006).

A landscape-level strategy for the conservation of the panther population in south Florida was developed using a Florida panther potential habitat model based on the following criteria: (1) forest patches greater than 4.95 acres (2 ha); (2) non-urban cover types within 656 ft (200 m) of forest patches; and (3) exclusion of lands within 984 ft (300 m) of urban areas (Kautz et al. 2006). In developing the model, data from radio-collared panthers collected from 1981 through 2000 were used to evaluate the relative importance of various land cover types as panther habitat, thus identifying landscape components important for panther habitat conservation. Those components were then combined with a least cost path analysis to delineate three panther habitat conservation zones for south Florida: (1) Primary Zone – lands important to the long-term viability and persistence of the panther in the wild; (2) Secondary Zone – lands which few panthers use contiguous with the Primary Zone, but given sufficient habitat restoration could accommodate expansion of the panther population south of the Caloosahatchee River; and (3) Dispersal Zone – the area which may facilitate future panther expansion north of the Caloosahatchee River (Kautz et al. 2006) (Figure 8). The Primary Zone is currently occupied and supports the breeding population of panthers. Although panthers move through the Secondary and Dispersal Zones, they are not permanently occupied. The Secondary Zone could support panthers with sufficient restoration.

These zones vary in size, ownership, and land cover composition. The Primary Zone is 2,270,711 acres (918,928 ha) in size, 73 percent of which is publicly owned (R. Kautz, Dennis, Breedlove, and Associates, pers. comm. 2005), and includes portions of the BCNP, ENP, Fakahatchee Strand Preserve State Park (FSPSP), FPNWR, Okaloacoochee Slough State Forest, and Picayune Strand State Forest. This zone's composition is 45 percent forest, 41 percent freshwater marsh, 7.6 percent agriculture lands, 2.6 percent prairie and shrub lands, and 0.52 percent urban lands (Kautz et al. 2006). The Secondary Zone is 812,157 acres (328,670 ha) in size, 38 percent of which is public land (R. Kautz, pers. comm. 2005). This zone's composition is 43 percent freshwater marsh, 36 percent agriculture, 11 percent forest, 6.1 percent prairie and shrub lands, and 2.3 percent low-density residential areas and open urban lands (Kautz et al. 2006). The Dispersal Zone is 28,160 acres (11,396 ha) in size, 12 percent of which is either publicly owned or in conservation easement. This zone's composition is 49 percent agriculture (primarily improved pasture and citrus groves), 29 percent forest (wetland and upland), 8.8 percent prairie and shrub land, 7.5 percent freshwater marsh, and 5.1 percent barren and urban lands (Kautz et al. 2006).

As part of their evaluation of occupied panther habitat, in addition to the average density estimate of one panther per 27,181 acres (11,000 ha) developed by Maehr et al. (1991), Kautz et al. (2006) estimated the present average density during the timeframe of the study, based on telemetry and other occurrence data, to average one panther per 31,923 acres (12,919 ha). In the following discussions of the number of panthers that a particular zone may support, the lower number is based on the 31,923 acres (12,919 ha) value (Kautz et al. 2006) and the higher number is based on the 27,181 acres (11,000 ha) value (Maehr et al. 1991).

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

Kautz et al.'s (2006) assessment of available habitat south of the Caloosahatchee River determined that non-urban lands in the Primary, Secondary, and Dispersal Zones were not sufficient to sustain a population of 240 individuals south of the Caloosahatchee River. However, Kautz et al. (2006) determined sufficient lands were available south of the Caloosahatchee River to support a population of 79 to 94 individuals (although not all lands are managed and protected).

Even though some suitable panther habitat remains in south-central Florida, it is widely scattered and fragmented (Belden and McBride 2005). Thatcher et al. (2006) used a statistical model in combination with a geographic information system to develop a multivariate landscape-scale habitat model based on the Mahalanobis distance statistic (D^2) to evaluate habitats in south central Florida for potential expansion of the Florida panther population. They identified four potential habitat patches: the Avon Park Bombing Range area, Fisheating Creek/Babcock-Webb Wildlife Management Area, eastern Fisheating Creek, and the Duette Park/Manatee County area. These habitat patches are smaller and more isolated compared with the current Florida panther range, and the landscape matrix where these habitat patches exist provides relatively poor habitat connectivity among the patches (Thatcher et al. 2006). Major highways and urban or agricultural development isolate these habitat patches, and they are rapidly being lost to the same development that threatens southern Florida (Belden and McBride 2005).

Diurnal Habitat Use: Diurnal panther locations appear to be within or closer to forested cover types, particularly cypress swamp, pinelands, hardwood swamp, and upland hardwood forests (Belden 1986, Belden et al. 1988, Maehr 1990, Maehr et al. 1991, Maehr 1992, Smith and Bass 1994, Kerkhoff et al. 2000, Comiskey et al. 2002). Dense understory vegetation comprised of saw palmetto provides some of the most important resting and denning cover for panthers (Maehr 1990). Shindle et al. (2003) show that 73 percent of panther dens were in palmetto thickets.

Radio-collar data and ground tracking indicate that panthers use the mosaic of habitats available to them as resting and denning sites, hunting grounds, and travel routes. These habitats include cypress swamps, hardwood hammocks, pine flatwoods, seasonally flooded prairies, freshwater marshes, and some agricultural lands. Although radio-collar monitoring indicates that forest is a preferred cover type, panthers also utilize non-forest cover types (Belden et al. 1988, Maehr et al. 1991, Comiskey et al. 2002). Compositional analyses by Kautz et al. (2006) confirmed previous findings that forest patches comprise an important component of panther habitat in south Florida, but that other natural and disturbed cover types are also present in the large landscapes that support panthers (Belden et al. 1988, Maehr et al. 1991, Comiskey et al. 2002). Kautz et al. (2006) found that the smallest class of forest patches (i.e., 9 - 26 acres [3.6 - 10.4 ha]) were the

highest ranked forest patch sizes within panther home ranges. This indicates that forest patches of all sizes appear to be important components of the landscapes inhabited by panthers, not just the larger forest patches.

Nocturnal Habitat Use: Maehr et al. (1990a) provides the only descriptions of panther nocturnal activities and represents the available radio-collar data collected during night time hours. However, this paper does not provide analyses of nocturnal habitat use. Dickson et al. (2005) examined the movements of 10 female and seven male puma at 15-minute intervals during 44 nocturnal periods of hunting or traveling in southern California. They found that traveling puma monitored over nocturnal periods used a broader range of habitats than what they appeared to use based on diurnal locations alone. The use of Global Positioning System (GPS) radio-collars is now being investigated to determine if this technology will be suitable to answer questions regarding Florida panther's nocturnal habitat use.

Prey Habitat Use: Panther habitat selection is related to prey availability (Janis and Clark 1999, Dees et al. 2001) and, consequently, prey habitat use. Adequate cover and the size, distribution, and abundance of available prey species are critical factors to the persistence of panthers in south Florida and often determine the extent of panther use of an area. Duever et al. (1986) calculated a deer population of 1,760 in BCNP, based on Harlow (1959) deer density estimates of 1/210 acres (85 ha) in pine forest, 1/299 acres (121 ha) in swamps, 1/1,280 acres (518 ha) in prairie, 1/250 acres (101 ha) in marshes, and 1/111 acres (45 ha) in hammocks. Schortemeyer et al (1991) estimated deer densities at 1/49-247 acres (20-100 ha) in three management units of BCNP based on track counts and aerial surveys. Labisky et al. (1995) reported 1/49 acres (20 ha) in southeastern BCNP. Using track counts alone, McCown (1994) estimated 1/183-225 acres (74-91 ha) on the FPNWR and 1/133-200 acres (54-81 ha) in the FSPSP.

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

Marshes, rangeland, and low-intensity agricultural areas support prey populations of deer and hogs. The importance of these habitat types to panthers cannot be dismissed based solely on use or lack of use when daytime telemetry are the only data available (Comiskey et al. 2002, Beier et al. 2003, Comiskey et al. 2004, Beier et al. 2006).

Travel and Dispersal Corridors: In the absence of direct field observations/measurements, Harrison (1992) suggested 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 - 10.9 mi (9.8 - 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 - 4 mi (1 - 7 km) should be more than 1,312 ft (400 m) wide. The Dispersal Zone encompasses 44 mi^2 (113 km^2) with a mean width of 3.4 mi (5.4 km). Although it is not adequate to support even one panther, the Dispersal Zone is strategically located and expected to function as a critical landscape linkage to south-central Florida (Kautz et al. 2006). Transient male panthers currently utilize this Zone as they disperse northward into south-central Florida.

Panther Recovery Objectives

The recovery objectives identified in the draft third revision of the Florida Panther Recovery Plan (Service 2006) are to: (1) maintain, restore, and expand the Florida panther population and its habitat in south Florida and, if feasible, expand the known occurrence of Florida panthers north of the Caloosahatchee River to maximize the probability of the long-term persistence of this metapopulation; (2) identify, secure, maintain, and restore habitat in potential reintroduction areas within the panther's historic range, and to establish viable populations of the panther outside south and south-central Florida; and (3) facilitate panther conservation and recovery through public awareness and education.

Panther Management and Conservation

Habitat Conservation and Protection

Panthers, because of their wide-ranging movements and extensive spatial requirements, are particularly sensitive to habitat fragmentation (Harris 1984). Mac et al. (1998) defines habitat fragmentation as: "The breaking up of a habitat into unconnected patches interspersed with other habitat which may not be inhabitable by species occupying the habitat that was broken up. The breaking up is usually by human action, as, for example, the clearing of forest or grassland for agriculture, residential development, or overland electrical lines." The reference to "unconnected patches" is a central underpinning of the definition. For panther conservation, this definition underscores the need to maintain contiguous habitat and protected habitat corridors in key locations in south Florida and throughout the panther's historic range. Habitat fragmentation can result from road construction, urban development, and agricultural land conversions.

Habitat protection has been identified as being one of the most important elements to achieving panther recovery. While efforts have been made to secure habitat (Figure 9 and Table 1), 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 FWS, NPS, Seminole Tribes of Florida, Miccosukee Tribe of Indians of Florida, FWC, Florida Department of Environmental Protection (FDEP), Florida Division of Forestry (FDOF), Water Management Districts (WMD), non-governmental organizations (NGO), counties, and private landowners.

Public Lands: Public lands in south Florida that benefit the panther are listed below and shown in Figure 9:

1. In 1947, ENP was established with 1,507,834 acres (610,199 ha) and in 1989 was expanded with the addition of 104,320 acres (42,217 ha).

2. In 1974, Congress approved the purchase and formation of BCNP, protecting 570,238 acres (230,767 ha); they later added 145,919 acres (59,051 ha).

3. In 1974, the State of Florida began acquiring land for the FSPSP, which encompasses over 80,000 acres (32,375 ha). Efforts are underway to acquire about 16,640 acres (6,734 ha).

4. In 1985, acquisition of Picayune Strand State Forest and Wildlife Management Area (WMA) began with the complex Golden Gate Estates subdivision buyouts and now comprises over 76,160 acres (30,821 ha). The Southern Golden Gate Estates buyout through State and Federal funds is complete. The South Belle Meade portion of Picayune Strand is about 90 percent purchased; and, although the State is no longer purchasing in South Belle Meade, Collier County's Transfer of Development Rights program is helping to secure the in-holdings.

5. In 1989, Florida Panther National Wildlife Refuge (FPNWR) was established and now protects 26,240 acres (10,619 ha).

6. In 1989, the Corkscrew Regional Ecosystem Watershed (CREW) Land and Water Trust, a public/private partnership, was established and to date has coordinated the purchase of approximately 60,000 acres (24,281 ha).

7. In 1996, the South Florida Water Management District purchased the 32,000-acre (12,950-ha) Okaloacoochee Slough State Forest.

8. In 2002 Spirit of the Wild WMA, consisting of over 7,040 acres (2,849 ha), was taken into public ownership by the State of Florida and is managed by the Florida Division of Forestry (FDOF).

9. In 2003, Dinner Island Ranch WMA, consisting of 21,760 acres (8,806 ha) in southern Hendry County, was taken into public ownership by the State of Florida and is managed by FDOF.

10. The State of Florida in 2006 in cooperation with Lee and Charlotte Counties and with coordination with the Babcock Ranch family, the Babcock Florida Company, interested environmental advocacy groups, and concerned citizens, acquired 73,575 acres of the 91,362-acre Babcock Ranch. The 73,575-acre acquisition is referred to as the Babcock Ranch Preserve. The remaining 17,787 acres were purchased by the Babcock Ranch Community, an affiliate Babcock Ranch family company. The purchase agreement for the Babcock Ranch Preserve expressly reserved the ability to utilize portions of the property acquired by the State for mitigation of impacts from the Babcock Ranch Community's proposed residential development. These reserved lands are referred to as the Babcock Ranch Mitigation Park and encompass about 16,925 acres

Tribal Lands: Lands of the Seminole Tribes of Florida and Miccosukee Tribe of Indians of Florida encompass over 350,079 acres (141,673 ha) in south Florida. Of these, 115,840 acres (46,879 ha) are used by panthers, and comprise 5 percent of the Primary Zone (R. Kautz, pers. comm. 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.

Private Lands: A variety of Federal, State, and private incentive programs are available to assist private landowners and other individuals with the protection and management of wildlife habitat. Voluntary agreements, estate planning, conservation easements, land exchanges, and mitigation banks are all methods that hold untapped potential for conserving private lands. In 1954, the National Audubon Society established the nearly 10,880-acre (4,403-ha) Corkscrew Swamp Sanctuary. However, little additional private land has been protected south of the Caloosahatchee River for panther conservation. A number of properties identified by the State Acquisition and Restoration Council for purchase by the Florida Forever Program are used by panthers (*e.g*., Devil's Garden, Half Circle F Ranch, Pal Mal, and Panther Glades). North of the Caloosahatchee River, the Fisheating Creek Conservation Easement consists of 41,600 acres (16,835 ha) in Glades County and is a private holding used by dispersing male panthers.

Habitat and Prey Management

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

Response to Management Activities

Few studies have examined the response of panthers to various land/habitat management activities. Dees et al. (2001) investigated panther habitat use in response to prescribed fire and found that panther use of pine habitats was greatest for the first year after the area had been burned and declined thereafter. Prescribed burning is believed to be important to panthers because prey species (*e.g.*, deer and hogs) are attracted to burned habitats to take advantage of changes in vegetation structure and composition, including exploiting hard mast that is exposed and increased quality or quantity of forage (Dees et al. 2001). Responses of puma to logging activities (Van Dyke et al. 1986b) indicate 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 ORV trails, (7) use of areas with concentrated human activity, and (8) habitat selection. Responses to hunting for variables most directly related to panther energy intake or expenditure (*i.e.*, activity rates, movement rates, predation success of females) were not detected (Janis and Clark 2002). However, panthers reduced their use of Bear Island, an area of concentrated human activity, and were found farther from ORV trails during the hunting season, indicative of a reaction to human disturbance (Janis and Clark 2002). Whereas the reaction to trails was probably minor and could be related to prey behavior, decreased use of Bear Island most likely reflects a direct reaction to human activity and resulted in increased use of adjacent private lands (Janis and Clark 2002).

Transportation Planning and Improvements

Construction of highways in wildlife habitat typically results in loss of habitat, traffic related mortality, and avoidance of associated human development. Roads can also result in habitat fragmentation, especially for females who are less likely to cross them (Maehr 1990).

There are presently 28 wildlife underpasses with associated fencing suitable for panther use along I-75 (Figure 6). The Florida Department of Transportation identified the location of and constructed six wildlife crossings on SR 29. Crossings A and B, completed in 2007, were constructed in an area of 10 documented collisions from 1980 to 2004. Crossings C and D, north of I-75, were installed in 1995. There were two recorded collisions in the vicinity of crossing D from 1979 to 1990, but none at either C or D since crossing installation. Crossing E was installed in 1997. There has been one collision about 1 mile to the north in 2002. Crossing F was installed in 1999. There was one documented collision in the immediate vicinity in 1981,

two collisions about 1.5 miles to the north since crossing installation, and one collision about 0.5 mile to the south in December 2005. Along SR29, two panther-vehicle collisions have been recorded in the immediate vicinity of wildlife crossings, one in December 2005 and one in June 2007. There have been no collisions on east-west I-75 in the vicinity of crossings since installation in 1991. Prior to 1991, there were five recorded deaths from collisions.

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.

Agriculture, Development, and Mining

The Service developed a Panther Habitat Assessment methodology and refugia design in 2003 to help guide the agency in evaluating permit applications for projects that could affect panther habitat (see discussion below). This methodology was a way to assess the level of impacts to panthers expected from a given project, and to evaluate the effect of any proposed compensation offered by the project applicant. Prior to the development of this methodology, the Service, from March 1984 through July 2003, concluded consultation on 42 projects involving the panther and habitat preservation (Table 1). The minimum expected result of these projects is impacts to 76,919 acres and the preservation on of 15,479 acres of panther habitat. Of the 76,919 acres of impacts, 38,932 acres are due to agricultural conversion and 37,982 acres to development and mining. Portions (10,370 acres) of the largest agricultural conversion project, 28,700 acres by U.S. Sugar Corporation, were re-acquired by the Federal Government as a component of the Talisman Land Acquisition (Section 390 of the Federal Agricultural Improvement and Reform Act of 1996 [Public Law 104-127] Farm Bill Cooperative Agreement, FB4) for use in the CERP. The non-agriculture impacts are permanent land losses, whereas the agricultural conversions may continue to provide some habitat functional value to panthers, depending on the type of conversion.

From August 2003 to November 2007, the Service concluded consultations on 70 projects affecting 24,106 acres with preservation of 22,864 acres (Table 1). Following our refugia design assessment approach, the projects affected 9,682 acres in the Primary Zone, 6,423 acres in the Secondary Zone, and 4,100 acres in the Other Zone. Compensation provided included 20,797 acres in the Primary Zone, 652 acres in the Dispersal Zone, 2 acres in the Secondary Zone, and 1,410 acres in the Other Zone. The project affected lands were primarily agricultural fields consisting of row crops and citrus groves and natural lands with varying degrees of exotic vegetation. Functional habitat value of these lands to the Florida panther, following our Panther Habitat Assessment methodology provided a PHU loss from development of 69,508 primary equivalent PHUs, with a corresponding PHU preservation and enhancement complement of 179,344 primary equivalent PHUs. The preservation lands were generally native habitat lands or disturbed lands that included restoration components. Restoration components included exotic species removal, fire management, wetland hydrology improvement, improved forest management practices, and full habitat restoration from agriculture uses to native habitats.

Panther Habitat Evaluation and Compensation

Population Viability Analysis

Population Viability Analysis (PVA) has emerged as a key component of endangered species conservation. This process is designed to incorporate demographic information into models that predict if a population is likely to persist in the future. PVAs incorporate deterministic and stochastic events including demographic and environmental variation, and natural catastrophes. PVAs have also been criticized as being overly optimistic about future population levels (Brook et al. 1997) and should be viewed with caution; however, they are and have been shown to be surprisingly accurate for managing endangered taxa and evaluating different management practices (Brook 2000). They are also useful in conducting sensitivity analyses to determine where more precise information is needed (Hamilton and Moller 1995, Beissinger and Westphal 1998, Reed et al. 1998, Fieberg and Ellner 2000).

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

Since 1981, 139 Florida panthers have been radio-collared and monitored on public and private lands throughout south Florida (Lotz et al. 2005). These data were used by researchers to estimate survival rates and fecundity and were incorporated into PVA models previously developed for the Florida panther (Seal et al. 1989, 1992, Cox et al. 1994, Kautz and Cox 2001, Maehr et al. 2002b). These models incorporated a range of different model parameters such as

general sex ratios, kitten survival rates, age distributions, and various levels of habitat losses, density dependence, and intermittent catastrophes or epidemics. The outputs of these models predicted a variety of survival scenarios for the Florida panther and predicted population levels needed to ensure the survival of the species.

Root (2004) developed an updated set of PVA models for the Florida panther based on RAMAS GIS software. These models were used to perform a set of spatially explicit PVAs. Three general single-sex (i.e., females only) models were constructed using demographic variables from Maehr et al. (2002b) and other sources. A conservative model was based on Seal and Lacy (1989), a moderate model was based on Seal and Lacy (1992), and an optimistic model was based on the 1999 consensus model of Maehr et al. (2002b). In each model, first-year kitten survival was set at 62 percent based on recent information from routine panther population monitoring (Shindle et al. 2001). All of the models assumed a 1:1 sex ratio, a stable age distribution, 50 percent of females breeding in any year, and an initial population of 41 females (82 individuals including males), which was the approximate population size in 2001-2002 (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 two of the model. Third, the Root (2004) model assumed females to have "a 50% 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. Finally, the Service notes that population modeling is only one of several tools used by the Service to assess possible effects on the panther. As detailed elsewhere in this Biological Opinion, the Service's conclusions about possible effects on the panther are also supported by the Service's assessment of remaining habitat, as well as consideration of other factors such as the overall recovery objectives and other cumulative effects from actions in the action area. In light of these factors, the Service believes that it is reasonable to use the best available count of 41 subadult and adult females as the breeding population for modeling purposes.

Basic Versions: The basic versions of each model incorporated no catastrophes or epidemics, no change in habitat quality or amount, and a ceiling type of density dependence. The basic versions of the models incorporated a carrying capacity of 53 females (106 panthers - 50/50 sex

ratio). Variants of the models were run with differing values for density dependence, various levels of habitat loss, and intermittent catastrophes or epidemics. Each simulation was run with 10,000 replications for a 100-year period. The minimum number of panthers needed to ensure a 95 percent probability of persistence for 100 years was estimated in a series of simulations in which initial abundance was increased until probability of extinction at 100 years was no greater than 5 percent. More detailed information concerning the PVA model parameters appears in Root (2004).

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

One Percent Habitat Loss: Model results were also provided by Root (2004) for probability of extinctions for 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 3-year average verified 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 and 117 panthers in 2007 is within Kautz et al.'s (2006) population guidelines representing a population that is likely stable but may still be subject to genetic problems.

The Service also believes that the model runs show that 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 subject to genetic problems. As discussed in the following section, the Service has developed a south Florida panther conservation goal that, through regulatory reviews and coordinated conservation efforts with land owners and resource management partners, provides a mechanism to achieve this goal.

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 that 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 that 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 (12,919 ha) per panther as determined by Kautz et al. (2006), the acreages of lands necessary to achieve this goal are 2,553,840 acres (1,033,520 ha) for 80 panthers and 3,192,300 acres (1,291,900 ha) 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 ESA. The Service coordinates with Federal agencies pursuant to section 7 of the ESA. 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 for Endangered Species (SLOPES) (Service 2000). 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 believed land alteration projects may affect the Florida panther.

In the original SLOPES, the consultation area map (MAP) was generated by the Service by overlaying existing and historical panther telemetry data on a profile of Florida and providing a connecting boundary surrounding most of these points. Since the development of the MAP, we have received more accurate and up-to-date information on Florida panther habitat usage. Specifically, we have received two documents that the Service believes reflect the most likely panther habitat usage profiles, although documentation clearly shows panther use of areas outside these locations. These documents are the publications by Kautz et al. (2006) and

Thatcher et al. (2006). Based on the information in these documents, we have clarified the boundaries of the MAP to better reflect areas where Florida panthers predominate (Figure 5) and refer to these areas cumulatively as the Panther Focus Area.

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

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

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

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.

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.

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.

Primary Dispersal/Expansion Area is the Fisheating Creek/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.

Landscape Preservation Need and Compensation Recommendations

Land Preservation Needs: To further refine the land preservation needs of the Florida panther and to specifically develop a landscape-level program for the conservation of the Florida panther population in south Florida, the Service appointed a Florida Panther Subteam in February 2000. The Subteam was charged with developing a landscape-level strategy for the conservation of the Florida panther population in south Florida. The results of this collaborative effort are partially presented in Kautz et al. (2006). One of the primary 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 ha); (2) non-urban cover types within 656 ft (200 m) of forest patches; and (3) exclusion of lands within 984 ft (300 m) of urban areas. The potential habitat map was reviewed in relation to telemetry data, recent satellite imagery (where available), and panther home range polygons. Boundaries were drawn around lands defined as the Primary Zone (Figure 10), 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 10), 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 10). The preservation of lands within this zone is important for the survival and recovery of the Florida panther, as these lands are the dispersal pathways for expansion of the south Florida panther population. The Primary Zone covers 2,270,590 acres (918,895 ha); the Secondary Zone covers 812,104 acres (328,654 ha); and the Dispersal Zone covers 27,883 acres (11,284 ha); providing a total of 3,110,578 acres (1,258,833 ha) (Kautz et al. 2006).

As part of their evaluation of occupied panther habitat, in addition to the average density estimate of one panther per 27,181 acres (11,000 ha) developed by Maehr et al. (1991), Kautz et al. (2006) estimated the present average density during the timeframe of the study, based on

telemetry and other occurrence data, to average 1 panther per 31,923 acres (12,919 ha). In the following discussions of the number of panthers that a particular zone may support, the lower number is based on the 31,923 acres (12,919 ha) value (Kautz et al. 2006) and the higher number is based on the 27,181 acres (11,000 ha) value (Maehr et al. 1991).

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

Kautz et al.'s (2006) assessment of available habitat south of the Caloosahatchee River determined that non-urban lands in the Primary, Secondary, and Dispersal Zones were not sufficient to sustain a population of 240 individuals south of the Caloosahatchee River. However, Kautz et al. (2006) determined sufficient lands were available south of the Caloosahatchee River to support a population of 79 to 94 individuals (although not all lands are managed and protected).

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 eight individuals greater than a population of 82 individuals, which according to the best available PVA (Root 2004) is 95 percent likely to persist over 100 years (assuming a 50:50 male to female ratio). These eight individuals provide a buffer for some of the assumptions in Root's (2004) PVA. Our process to determine compensation recommendations for project affects that cannot be avoided in both our section 7 and section 10 consultations is based on the amount and quality of habitat that we believe is necessary to support a population of 90 panthers in south Florida.

The Service, based on Kautz et al.'s (2006) average panther population density of 31,923 acres per panther, determined 2,873,070 acres of Primary Zone "equivalent" lands need to be protected and managed. 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 (1,258,833 ha) (Kautz et al. 2006). Currently, 2,073,865 acres of Primary Zone equivalent lands are preserved (Table 5), so 799,205 additional acres need to be preserved to support a population of 90 panthers in south Florida (2,873,070 minus 2,073,865 equals 799,205).

The Service also consults on lands outside of the Primary, Secondary, and Dispersal zones that may effect panthers, such as agricultural lands adjacent to the Panther Focus Area and proposals in urbanized areas that could generate traffic in or adjacent to the Panther Focus Area or have other identifiable impacts.

Primary Zone Equivalent Lands: Kautz et al. (2006), through their habitat evaluation of lands important to the Florida panther, identified three 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 10), include the majority of the home ranges of the current population of the Florida panther. The Service, in our evaluation of habitat needs for the Florida panther, expanded the boundaries of the Kautz et al. (2006) lands to include those lands south of the Caloosahatchee River where additional telemetry points historically were recorded. These additional lands (about 819,995 acres), referred to as the "Other" Zone, are added to the lands in Kautz et al.'s (2006) panther core lands (Figure 5) and represent the lands within the Service's 2000 consultation area boundary south of the Caloosahatchee River as shown in Figure 5. These lands (core lands and other zone lands) together are referred to by the Service as the Service's Panther Core Area (labeled on Figure 5 as "Original Panther Consultation Area South of the Caloosahatchee River"). The "Other" Zone lands, as well as the lands within the Secondary Zone, provide less landscape benefit to the Florida panther than the Primary and Dispersal Zones, but are important as a component of our goal to preserve sufficient lands to support a population of 90 panthers in South Florida.

To account for the lower landscape importance of these lands in our preservation goals and in our habitat assessment methodology, we assigned lands in the Other Zone a value of 0.33 and lands in the Secondary Zone a value of 0.69 to convert these lands to Primary Zone value, *i.e.*, Primary Zone equivalents (Table 4). Dispersal Zone lands are considered equivalent to Primary Zones lands with a 1/1 value.

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

At-risk lands in the Other Zone total 819,995 acres. Actions on some of the Other Zone lands, such as some actions in areas that have already been urbanized, will not have an impact on panthers or their habitat; and these case-specific determinations will be made based on a review of the specific proposals. We estimate 80 percent of these actions will have an impact on achieving the panther population goal, and will monitor this carefully as we review proposed actions (819,995 times 0.8 equals 655,996 acres). Multiply 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 1/1 for the Dispersal Zone, are important components in our assessment of compensation needs for a project in the panther consultation area and are components of our habitat assessment methodology as discussed below.

Habitat Assessment Methodology

To evaluate project effects to the Florida panther, the Service considers the contributions the project lands provide to the Florida panther, recognizing not all habitats provide the same functional value. Kautz et al. (2006) also recognized that not all habitats provide the same habitat value to the Florida panther and developed cost surface values for various habitat types, based on use by and presence in home ranges of panthers. The FWC (2006), using a similar concept, assigned likely use values of habitats to dispersing panthers. The FWC's habitats were assigned habitat suitability rank between 0 and 10, with higher values indicating higher likely use by dispersing panthers.

The Service chose to evaluate project effects to the Florida panther through a similar process. We incorporated many of the same habitat types referenced in Kautz et al. (2006) and FWC (2006) with several adjustments to the assigned habitat use values reflecting consolidation of similar types of habitats and the inclusion of Everglades Restoration water treatment and retention areas. We used these values as the basis for habitat evaluations and the recommended compensation values to minimize project effects to the Florida panther (Table 3), as discussed below.

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

The available Primary Zone equivalent lands are estimated at 3,276,563 acres (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]) (see Table 4). Currently 2,073,865 acres of Primary Zone equivalent lands (actual acreage is 2,578,152 acres) of non-urban lands are preserved. The remaining non-urban, at-risk, private lands are estimated at 1,202,698 acres of Primary Zone equivalent lands (actual acreage is 1,798,295 acres). 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 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 we 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.

We also realize that habitat losses from individual single-family residential developments will collectively compromise the Service's goal to secure sufficient lands for a population of 90 panthers. We believe that, on an individual basis, single-family residential developments by individual lot owners on lots no larger than 2.0 ha (5.0 acres) will not result in take of panthers on a lot-by-lot basis; however, collectively these losses may impact the panther. Panthers are a wide ranging species, and individually a 2.0 ha (5.0 acre) habitat change will not have a measurable impact. Compensation for such small-scale losses on a lot-by-lot basis is unlikely to result in meaningful conservation benefits for the panther versus the more holistic landscape level conservation strategy used in our habitat assessment methodology. To account for these losses, we estimated that about 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.

We also realize there is a need for road crossings in strategic locations and we believe there are projects that may not have habitat loss factors but will have traffic generation factors. The Service considers increases in traffic as an indirect effect from a project which can contribute to panther mortality. Therefore, we have added another 0.02 to the base ratio to address traffic impacts, which could provide an incentive to implement crossings in key locations. Following the same approach shown above, we adjusted the base ratio from 2.48 to 2.5. The Service intends to re-evaluate this base ratio periodically and adjust as needed to make sure all adverse effects are adequately ameliorated and offset as required under section 7 of the ESA and 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 6 provides the landscape compensation multipliers for various compensation scenarios. As an example, if a project is in the Other Zone and compensation is proposed in the Primary Zone, a Primary Zone equivalent multiplier of 0.33 is applied to the PHUs (see discussion below) developed for the project. If the project is in the Secondary Zone and compensation is in the Primary Zone, then a Primary Zone equivalent multiplier of 0.69 is applied to the PHUs developed for the project.

Panther Habitat Units – Habitat Functional Value: Prior to applying the base ratio and landscape multipliers discussed above, we evaluate the project site and assign functional values to the habitats present. This is done by assigning each habitat type on site a habitat suitability value from the habitats shown in Table 3. The habitat suitability value for each habitat type is then multiplied by the acreage of that habitat type resulting in a number representing PHUs. These PHUs are summed for a site total, which is used as a measurement of the functional value the habitat provides to the Florida panthers. This process is also followed for the compensation sites.

Exotic Species Assessment: Since many habitat types in south Florida are infested with exotic plant species, which affects the functional value a habitat type provides to foraging wildlife species (*i.e.,* primarily deer and hog), we believe the presence of these species and the value these species provide to foraging wildlife needs to be considered in the habitat assessment methodology. As shown in Table 6, we have a habitat type and functional value shown for exotic species. This category includes not only the total acres of pure exotic species habitats present but also the percent-value acreages of the exotic species present in other habitat types.

For example, a site with 100 acres of pine flatwoods with 10 percent exotics would be treated in our habitat assessment methodology as 90 acres of pine flatwoods and 10 acres of exotics. Adding another 100 acres of cypress swamp with 10 percent exotics would change our site from 90 acres of pine flatwoods and 10 acres of exotics to 90 acres of pine flatwoods, 90 acres of cypress swamp, and 20 acres of exotics.

Habitat Assessment Methodology Application – Example: To illustrate the use of our habitat assessment methodology, we provide the following example. A 100-acre project site is proposed for a residential development. Plans call for the entire site to be cleared. The project site contains 90 acres of pine flatwoods and 10 acres of exotic vegetation, and is located in the "Secondary Zone." The applicant has offered habitat compensation in the "Primary Zone" to minimize the impacts of the project to the Florida panther. To calculate the PHUs provided by the site, we multiply the habitat acreage by the "habitat suitability value" for each habitat type and add those values to obtain a value of 840 PHUs ((90 acres of pine flatwoods x 9 [the habitat suitability value for pine flatwoods] = 810 PHUs) + (10 acres of exotic vegetation x 3 [the habitat suitability value for exotics] = 30 PHUs) = 840 PHUs). The value of 840 PHUs is then multiplied by the 2.5 (the base ratio) and 0.69 (the landscape multiplier) resulting in a value of 1,149 PHUs for the project site. In this example, the acquisition of lands in the Primary Zone containing at least 1,149 PHUs is recommended to compensate for the loss of habitat to the Florida panther resulting from this project.

Analysis of the species likely to be affected

The Florida panther is an endangered animal restricted to 2 to 3 million acres of land (6 to 9 percent of the total land area of Florida) in south Florida. The panther is a wide-ranging species that requires a biotically diverse landscape to survive. Dispersing subadult males wander widely through unforested and disturbed habitat. Human population in south Florida has dramatically increased, from 1 million in 1950 to almost 8 million in 2000, resulting in secondary disturbances such as increased human presence and noise, light, air, and water

pollution. Increasing human population has resulted in increasing impacts on native habitat and flora and fauna. Resulting threats to panthers include road mortality, habitat loss, habitat fragmentation, and human disturbance.

ENVIRONMENTAL BASELINE

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

As stated previously, for the purposes of this consultation, the action area includes the Corps' project area and surrounding lands frequently visited by panthers (Figure 6). The action area is a subset of the current geographic range of the panther and includes those lands that the Service believes may experience direct and indirect effects from the proposed development. Therefore, for both direct and indirect effects, the action area is defined as all lands within a 25-mile radius of the project. This action area does not include urban lands, lands east of the protective levee, and lands that are outside of the Service's panther consultation area. The proposed action may have direct and indirect effects on the ability of panthers to breed, feed, and find shelter, and to disperse within the population.

The Service used current and historical radio-telemetry data, information on habitat quality, prey base, and evidence of uncollared panthers to evaluate panther use in the action area. Panther telemetry data are collected 3 days per-week from fixed-wing aircraft, usually in early to midmorning. However, researchers have shown that panthers are most active between dusk and dawn (Maehr et al. 1990a; Beier 1995) and are typically at rest in dense ground cover during daytime monitoring flights (Land 1994). Therefore, telemetry locations may present an incomplete picture of panther activity patterns and habitat use (Comiskey et al. 2002).

Although telemetry data may not provide a complete picture of panther activity patterns, since less than half of the panther population is currently monitored, telemetry locations are a good indicator, due to the extensive data set, of the approximate boundaries of home ranges, panther travel corridors, and the range of Florida panthers south of the Caloosahatchee River. The FWC also uses observational data collected during telemetry flights to assess the yearly breeding activity of radio-collared panthers. Female panthers accompanied by kittens or male panthers within close proximity of an adult female were assumed to have engaged in breeding activity during that year. Documentation by Land et al. (FWC 2005) shows that between July 2004 and June 2005, only one Florida panther (male #125) which was captured on February 13, 2004, traveled within 5 miles of the project site. He ranged eastward from the loop road area of BCNP just under the current L-67 extension and then northeastward in a semi-circle motion ending near the cross section of Krome Avenue and Tamiami Trail (Figure 7).

There have been a total of 5 panthers (4 male and 1 female) recorded within 5 miles of the project site on 117 occasions using telemetry data from February 1989 though June 2005

(Figure 6). This translates to an average of 7.3 occurrences per year, which equates to an average of one occurrence every 50 days. Several telemetry records indicate that one or more of the four panthers ranged very near to Tamiami Trail and most likely within the construction footprint located around the bridge location. Four of the five panthers are no longer alive. All four panthers (FP 16-male, FP 27-female, FP 42-male and FP 85-male) died of unknown causes and none had ranged within 5 miles of the project area since 2001. Four panthers have been involved in vehicle collisions within the 25-mile action area (Figure 6). Three of the four deaths occurred as a result of vehicle strikes on Tamiami Trail west of the project area (FP 26-male (1998), FP 62-female (2004), and FP 71-male (2005). The most recent of these collisions took place just east of 11 Mile Road which is roughly 10 miles west of the project area. The status and activities of uncollared Florida panthers within the action area are unknown; however, it is presumed that they could be present.

Factors Affecting Species Environment within the Action Area

Factors that affect the species environment (positive and negative) within the action area include, but are not limited to, highway, urban, agriculture, resource extraction, public lands management (prescribed fire, public use, exotic eradication, etc.), hydrological restoration projects, public and private land protection efforts, effects of genetic inbreeding, and genetic restoration.

Development activities may result in avoidance or limited use of remaining suitable habitat by panthers as well as habitat loss, habitat fragmentation, habitat degradation, and also an increase in risk of vehicular collision (*e.g.*, injury or death).

Public and private land management practices can have a positive, neutral, or negative effect, depending on the management goals. Land protection efforts will help to stabilize the extant population. Hunting of the panther is no longer sanctioned, although there still may be instances of intentional or unintentional shooting of individuals for various reasons.

EFFECTS OF THE ACTION

This section analyzes the direct and indirect effects of the project on the Florida panther and Florida panther habitat.

Factors to be Considered

Residential, commercial, and industrial development, as well as restoration projects, may have a number of direct and indirect effects on the Florida panther and panther habitat. Direct impacts, which are primarily habitat based, may include: (1) the permanent loss and fragmentation of panther habitat; (2) the permanent loss and fragmentation of habitat that supports panther prey; (3) the loss of available habitat for foraging, breeding, and dispersing panthers; and (4) a reduction in the geographic distribution of habitat for the species. Indirect effects may include: (1) an increased risk of roadway mortality to panthers traversing the area due to the increase in vehicular traffic; (2) increased disturbance to panthers in the project vicinity due to human activities; (3) the reduction in panther prey; (4) the reduction in value of panther habitat adjacent

to the project due to habitat fragmentation; and (5) a potential increase in intraspecific aggression between panthers (and an increase in mortality of subadult male panthers) due to reduction of the geographic distribution of habitat for the panther. These indirect effects are habitat based, with the exception of vehicular mortality, which could result in lethal impacts. Intraspecific aggression, though habitat based, could also result in lethal impacts

This project site contains marginal quality panther habitat, is located on the edge of occupied panther habitat, and panther habitat value has been diminished by the encroachment of exotic vegetation and its proximity to a major roadway. The timing of specific construction activities for this project, relative to sensitive periods of the panther's lifecycle, is unknown. Panthers have the potential to be found on and adjacent to the proposed construction footprint year-round but are less likely during the rainy season when water levels could be considerably higher in NESRS. The project will be constructed in a single event and result in permanent loss and alteration of a portion of the existing ground cover on the project site. The project will also result in the conversion of roadway embankment back into usable panther habitat and also provide wildlife passage in the form of a bridge. The time required to complete construction of the project is estimated to be 36 months.

Analyses for Effects of the Action

The 16.4-acre Tamiami Trail construction footprint is located along a 10.7-mile corridor just south of US 41 in the Florida panther Primary Zone as designated by Kautz et al. 2006, and is located inside the panther consultation area as defined by the Service (2000). The site currently provides habitat of marginal quality for the Florida panther. The project site is located on the edge of occupied habitat, is adjacent to a major roadway, and is not located within known dispersal corridors (FWC 2006) between larger publicly owned lands. The project will result in the conversion of 9.28 acres of marginal quality panther habitat on-site into shoulder of the existing roadway.

Compensation for the loss of 9.28 acres of marginal quality panther habitat will be through the off-site protection and restoration of approximately 10 acres or the equivalent of 90 PHU's of similar quality habitat in the core habitat area (Figure 5) and Primary Zone (Kautz et al. 2006) of the Florida panther. These "core area" lands include the majority of home ranges of the current population of the Florida panther (see definition of core panther area in Effects of the Action – Primary Equivalent Lands). Off-site compensation is located in an area with a moderate level of documented panther usage (telemetry data) in replacement for the loss of 28 PHUs in an area bordered by a major highway and exhibiting lower documented panther usage (telemetry data).

Habitat Assessment: In this section, we assess habitat compensation recommended to offset project impacts to Florida panther habitat. Through the methodology described below, we assess how to compensate when habitat loss or degradation resulting from a proposed project cannot be avoided and when adverse effects have been minimized, but loss will still occur. The purpose of this assessment is to ensure that adequate compensation will occur to prevent any significant reductions in the likelihood of survival and recovery of the species due to habitat loss. The Service, in coordination with the Corps, agreed to evaluate the project's effects to the Florida

panther through a habitat assessment methodology that incorporates many of the habitat importance values referenced in Kautz et al. (2006) and FWC (2006). Our analysis evaluates habitats from 0 to 10 with low scores reflecting low habitat value to the Florida panther (Table 3). The habitat suitability scores as developed by the Service incorporate a direct calculation per acre with a base ratio (2.5) multiplier to compensate for unavoidable project effects to the Florida panther.

Our process to determine compensation is based on the amount of habitat that we believe is necessary to support a population of 90 panthers in south Florida, which is the mid-point (90 panthers) in Kautz et al.'s (2006) management guidelines that a population of 80 to 100 panthers is likely to be stable, although subject to genetic problems and assumptions previously stated, through 100 years. More importantly, a population of 90 individuals is eight individuals greater than a population of 82 individuals, which according to the best available PVA (Root 2004) is 95 percent likely to persist over 100 years (assuming a 50:50 male to female ratio). These 8 individuals provide a buffer for some of the assumptions in Root's (2004) PVA. 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 (see discussion of Primary Zone equivalent lands below) need to be protected and managed. Currently, 2,073,865 acres of Primary Zone equivalent lands are preserved, 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).

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 10), include the majority of the home ranges of the current population of the Florida panther. The Service, in our evaluation of habitat needs for the Florida panther, expanded the boundaries of the Kautz et al. (2006) lands to include those lands south of the Caloosahatchee River where additional telemetry points historically were recorded. These additional lands (about 819,995 acres), referred to as the "Other" Zone, are added to the lands in Kautz et al.'s (2006) panther core lands (Figure 5) and represent the lands within the Service's 2000 consultation area boundary south of the Caloosahatchee River as shown in Figure 5. These lands (core lands and other zone lands) together are referred to by the Service as the Service's Panther Core Area (labeled on Figure 5 as "Original Panther Consultation Area South of the Caloosahatchee River"). The "Other" Zone lands, as well as the lands within the Secondary Zone, provide less landscape benefit to the Florida panther than the Primary and Dispersal Zones, but are important as a component of our goal to preserve sufficient lands to support a population of 90 panthers in South Florida.

To account for the lower landscape importance of these lands in our preservation goals and in our habitat assessment methodology, we assigned lands in the Other Zone a value of 0.33 and lands in the Secondary Zone a value of 0.69 to convert these lands to Primary Zone value, *i.e.*, Primary Zone equivalents (Table 4). Dispersal Zone lands are considered equivalent to Primary Zones lands with a 1/1 value.

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

At-risk lands in the Other Zone total 819,995 acres. Actions on some of the Other Zone lands, such as some actions in areas that have already been urbanized, will not have an impact on panthers or their habitat; and these case-specific determinations will be made based on a review of the specific proposals. We estimate 80 percent of these actions will have an impact on achieving the panther population goal, and will monitor this carefully as we review proposed actions (819,995 times 0.8 equals 655,996 acres). Multiply 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 1/1 for the Dispersal Zone, are important components in our assessment of compensation needs for a project in the panther consultation area and are components of our habitat assessment methodology as discussed below.

Habitat Assessment Methodology Application: The application of the habitat assessment methodology including the base ratio, landscape multiplier, PHU determinations, and compensation recommendations, are presented below for the Tamiami Trail and compensation areas.

Table 7 illustrates the PHU calculations for the Tamiami Trail project with impacts to 16.41 acres of land in the Primary Zone (9.28 ac are permanent impacts and 7.13 ac are temporary impact construction easements) with compensation provided by preservation and enhancement of approximately 10 acres in the Primary Zone. Calculations show the 16.4-acre on-site impact area will result in the loss of 29 PHUs before applying a landscape compensation multiplier. Since the project is located in the Primary Zone and compensation is in the Primary, the base ratio PHUs are adjusted by the landscape compensation multiplier of (29 x 2.5), to provide a combined recommended compensation need of 72.5 PHUs.

The 10-acre compensation site provides 90 PHUs after restoration. Therefore, the Service believes the habitat values lost by the proposed development will be offset by the compensation actions proposed by the Corps. The lands proposed for construction are on the edge of occupied habitat and panther habitat value has been diminished by the presence of exotic vegetation and the close proximity to a major roadway. Lands proposed for preservation will be in the Primary Zone, adjacent to other natural lands, and will be 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.

Wildlife Assessment: As discussed previously in the status of the species and in the environmental baseline, the Service believes the existing habitat conditions present on a site and the foraging value that a site provides to the Florida panther and panther prey species are an important parameter in assessing the importance of the project site to the Florida panther and other wildlife species. In order to assess this importance, the Service requires wildlife surveys and plant species compositions as part of the Corps' BA prepared for the project. To assess the foraging value of the project site the Service relied on an inter-agency Wetland Rapid Assessment Procedure (WRAP) and road mortality studies conducted by the Service along Tamiami Trail. The complete findings of both of these studies can be found in the Final Fish and Wildlife Coordination Act Report and supplements to that report (Service 2003, 2005, 2006b). Very few mammals of the size sufficient for panthers (*i.e.*, deer, hogs, etc) were identified in road mortality studies along the Trail. An occasional raccoon or opossum was encountered. Similarly, no prey or signs of prey sufficient for panthers was observed (*e.g.*, scat or tracks) on-site during WRAP assessments.

As discussed previously, white-tailed deer densities and other prey species are influenced by the quality of the foraging habitat present in an area. Monotypic stands of poor quality foraging plant species and the invasion of a site by exotic plants provide lower habitat foraging values and affect the utilization by and density of foraging species. The habitats in the project area have experienced similar vegetation changes. The site consists of a mixture of native and disturbed communities with an exotic coverage, primarily Brazilian pepper, varying from 30 percent to more than 50 percent in some locations.

Deer densities in the wet prairie/tree island complex of BCNP and ENP have been estimated by Labisky et al., 1995, to be 3.5-4.0 deer per 247 acres and 4.5-5.0 deer per 247 acres respectively. These densities are lower than those found in northern Florida and other parts of the white-tail range, most likely due to the limited production of quality forage in the Everglades wetlands. The Tamiami Trail project site is located in the deeper portions of NESRS which further limits the production of quality browse for deer.

Deer are ruminants with small stomach capacities and are selective for high quality forage to meet their nutritional needs. To meet these high quality forage needs, deer selectively move through the mosaic of habitat types taking advantage of the seasonal forage that provide the most benefit to the deer. The invasion of habitats along the Tamiami Trail by exotics have resulted in the growth unpalatable plant species that provide poor quality foraging needs for resident deer, hog, and other prey species.

The proposed compensation site is located within the 8.5 SMA in southwestern Miami-Dade County. The 8.5 SMA project is an integral feature of MWD which when complete will provide restorative flows and hydropattern to NESRS. Upon implementation of MWD as authorized, the net increase in water introduced to NESRS would potentially raise elevations of ground water in the adjacent 8.5 SMA. As a result, the volume of storage of ground water available to retain

runoff form rainfall would be reduced. This would raise the potential for flooding impacts. Consequently, the ENP Protection and Expansion Act (the MWD authorization) authorized a system to provide mitigation to the area.

The original proposed alignment of the flood mitigation works for the 8.5 SMA included an outer levee and seepage canal alignment on the western boundary of the 8.5 SMA. In preparation for construction of this alternative, the "recommended plan" in the 1992 General Design Memorandum (GDM), the Corps acquired privately owned lands along the levee alignment. That portion of those acquired lands that fell into the ENP land acquisition area is under transfer or has been transferred to ENP. A total of 868 acres of short-hydroperiod marl marsh located in core panther habitat, were so preserved and added to the Park. The formerly proposed levee will not be built, and these lands are in natural short-hydroperiod marsh. Lands now proposed for levee and seepage canal construction are former residential plots of low value as panther habitat.

In 2000, the GDM was revised with the identification of a new Recommended Plan (Alternate 6D, Figure 9), and additional lands were identified for restoration totaling 2,280 acres. These lands have either already been acquired or are in the process of acquisition via willing sellers or condemnation, for construction of the 8.5 SMA plan. They will be transferred to the South Florida Water Management District and will be restored. This acreage represents former farm/residential lands that will be restored to natural marshes. There are a few tree islands included in these lands that with the removal of residences, businesses, and farms, will provide additional habitat for panthers.

Compensation for the loss of 9.28 acres impacted during the raising of Tamiami Trail will be achieved through the acquisition and preservation of 10 of the aforementioned 2,280 acres in the 8.5 SMA. Wetland function and vegetation at the compensation site have been affected by reduced hydroperiod due to its proximity to the L-31N Canal and the absence of historical sheetflow through NESRS. This site will receive hydrological restoration and enhancement of the wetlands on-site via restoration of sheetflow to the area and removal of exotic species such as, melaleuca (*Melaleuca quinquenervia*) and, to a lesser extent, Brazilian pepper. Removal of these species will directly benefit the native vegetation on-site and will yield quality forage to panther prey species, especially resident deer populations.

Conservation Measures: The beneficial effects of the project include the preservation and enhancement of approximately 10 acres within the 8.5 SMA. This site is also located in the Primary Zone and overlaps with some of the home ranges of panthers that inhabit the eastern side of Shark Slough in ENP. The habitat quality provided to the Florida panther through preservation and enhancement is superior to that of the areas to be impacted. Enhancement in hydrological restoration of sheetflow to acres of disturbed marl marsh along with the eradication of exotic vegetation, primarily melaleuca, and to a lesser degree, Brazilian pepper, will improve suitability for the panther primarily through the resultant improvement in panther prey base. There have been several telemetry locations of panthers recorded on the periphery and just west of the compensation area during the period of record. Within a 3.5-mile range of the proposed compensation site, there have been a total of 165 records for four individual panthers: FP

16-male, FP 42-male, FP 61-F, and FP 85-male (Figure 9). Three of these panthers are now dead from unknown causes. The remaining cat FP 85-female was last recorded within 3 miles of the compensation site in August 2002. The Service considers the compensation site to be a valuable area for breeding, foraging, and dispersal habitat that is important to panthers located on the eastern side of NESRS. The amount of use of the compensation site and the project site by uncollared panthers is unknown and none have been documented at either site.

Direct Effects

Direct effects are those effects that are caused by the proposed action, at the time of construction, are primarily habitat based, and are reasonably certain to occur. We have identified four types of direct effects that may result from the proposed action. The four types include: (1) the permanent loss and fragmentation of panther habitat; (2) the permanent loss and fragmentation of habitat that supports panther prey; (3) the loss of available habitat for foraging, breeding, and dispersing panthers; and (4) a reduction in the geographic distribution of habitat for the Florida panther. Panthers may also be subject to harassment by construction activities. The direct effects this project will have on the Florida panther within the action area are discussed below.

Permanent Loss of Habitat: The project will result in the loss of 9.28 acres of habitat available for occasional use by panthers. The project lands are located inside the panther Primary Zone. The land will be converted to roadway shoulder along the southern edge of the Tamiami Trail. A one-time WRAP and road mortality study did not document site utilization by white-tailed deer, a primary panther prey species; however, a few smaller prey items were identified in the road mortality study. Telemetry shows very little documented panther utilization of the site. Habitat quality is generally poor, as it consists of a mixture of exotic infested native and disturbed communities. Based on the above analysis, we believe the loss of the habitat associated with these lands is minimal.

Fragmentation of Habitat: 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." The reference to "unconnected patches" is a central underpinning of the definition. For panther conservation, this definition underscores the need to maintain corridors connecting habitat in key locations of south Florida. The project site is located along a thin corridor adjacent to a major roadway that bisects WCA-3B and ENP. Although no passageway currently exists for panthers to move north and south between these areas, the project as currently proposed would potentially provide 1 mile of safe wildlife passage underneath the bridge. The remaining obstacles standing in the way of complete reconnection of WCA-3B and NESRS are the L-29 canal and the L-29 levee both located just north of and run parallel to Tamiami Trail. Removal of the L-29 levee and land bridges across the L-29 canal were recommended by the Service in its FWCA Reports (Service 2003, 2005). As such, fragmentation of panther habitat and panther prey species habitat is not expected and connectivity could actually be improved by the project.

Road Way Improvements: Improvements to the Tamiami Trail within the project area in the form of raising and resurfacing the 9.7 mi unbridged portions are proposed in association with the project. This action is not expected to increase traffic volume or have any other negative effect on panthers other than the loss of 9.28 acres of marginally suitable habitat.

Construction: The timing of construction for this project, relative to sensitive periods of the panther's lifecycle, is unknown. Panthers have the potential to be found on and adjacent to the proposed construction footprint year-round but are less likely to be found there during the rainy season when water levels in Shark Slough are considerable higher. The project will be constructed in a single event and result in permanent loss and alteration of a portion of the existing ground cover on the project site. The time required to complete construction of the project has been estimated to be 36 months. Some of the disturbance associated with the project will be permanent and result in a loss of marginal habitat currently available to the panther.

Compensation: The Service believes the habitat values lost by the raising of Tamiami Trail will be offset by the preservation and restoration actions in other portions of the MWD project area (8.5 SMA). The lands proposed for construction are on the edge of the panther's occupied range and panther habitat value has been diminished by on-site infestation of exotic vegetation and close proximity to a major roadway. The lands proposed for preservation are consistent with the Service's panther conservation strategy to locate, preserve, and restore sets of lands containing sufficient area, access, and appropriate cover types to ensure the long-term survival of the Florida panther south of the Caloosahatchee River.

Interrelated and Interdependent Actions

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

Indirect Effects

Indirect effects are those effects that are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside of the area directly affected by the action. We have identified five types of indirect effects that may result from the proposed action. The five types include: (1) an increased risk of roadway mortality to panthers traversing the area due to the increase in vehicular traffic; (2) increased disturbance to panthers in the project vicinity due to human activities (human/panther interactions); (3) the reduction in panther prey; (4) the reduction in value of panther habitat adjacent to the project due to habitat fragmentation; and (5) a potential increase of intraspecific aggression between panthers due to reduction of the geographic distribution of habitat for the panther.

Increased Risk of Roadway Mortality: In evaluating a project's potential to increase roadway mortality to the Florida panther, we consider the location of the project in relation to surrounding native habitats, preserved lands, and wildlife corridors that are frequently used by the Florida

panther. We also consider the current configuration and traffic patterns of surrounding roadways and the projected increase and traffic patterns expected to result from the proposed action. We evaluate the habitats present on-site, their importance in providing foraging needs for the Florida panther and panther prey species, and if the site development would further restrict access to surrounding lands important to the Florida panther and panther prey species.

The project will not result in an increase in vehicular traffic during and after construction. Vehicular mortality data provided by the FWC indicate that collisions with motor vehicles are a potential source of panther mortality in the project vicinity (Figure 5); however, due to the lack of increased vehicular traffic associated with the project, it is unlikely that the construction of the Tamiami Trail modifications will increase the risk of roadway mortality to panthers. In actuality, the risk may be reduced as the project will provide a potential wildlife crossing in the form of a bridge. The completion of future restoration projects which will completely remove the L-29 levee and canal and install more bridges in Tamiami Trail may attract more panthers. Should the incidence of panther road mortality increase due to the attraction of more animals to the opening in the roadway, other means of deterrence such as fencing should be used to prevent the animals entering the roadway.

Habitat Fragmentation: The project site is adjacent to a major roadway which bisects and eliminates connectivity between WCA-3B and NESRS which are considered Secondary and Primary panther habitat respectively. This project, when completed, will provide a crucial first step towards reconnecting these important public lands, therefore, the proposed action will not fragment panther habitat or panther prey habitat.

Panther and Prey Disturbance (Panther/Human Interactions) and Intraspecific Aggression: Potential increases in intraspecific aggression and disturbance to the Florida panther were evaluated. As discussed previously in our assessment of fragmentation, we considered habitat quality related factors and occurrence data for the Florida panther and panther prey species. This information is also the basis of our evaluation of disturbance and intraspecific aggression to the Florida panther and to panther prey species. The habitats on the construction footprint provide little forage value for prey species, which directly affects the frequency and duration of use of the property by panthers. Therefore, since we do not believe that Florida panthers utilize the property on a frequent basis, the loss of the limited use of the site by panthers will not significantly increase the risk of disturbance to panthers in the project action area due to human activities, will not increase mortality from intraspecific aggression between panthers, and will not significantly increase disturbance to panthers and panther prey species in the project action area.

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 bridge and road modification is not anticipated to increase risk of disturbance to panthers.

The project will result in the loss of the small amount (9.28 acres) of low quality panther habitat, which represents less than 0.0003 percent of a female panther's home range (29,056 acres) and approximately 0.0001 percent of a male panther's home range (62,528 acres). Because the project area provides poor quality panther habitat and panthers are not known to commonly use the project area, we do not expect that the project will significantly affect use of the area by the panther.

Panthers are sensitive to habitat fragmentation. However, the project site is located on the eastern fringe of occupied habitat, is adjacent to a major roadway, and is not located within known dispersal corridors (FWC 2006) between larger publicly owned managed lands. This project may actually restore ecological connectivity between WCA-3B and NESRS once complete. Therefore, fragmentation of panther habitat is not expected to result from project implementation.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, Tribal, local, or private actions reasonably certain to occur in the action area considered in this Biological Opinion. Future Federal actions unrelated to the proposed action but located in the action area are not considered in this section because they require separate consultations pursuant to section 7 of the ESA.

A majority of the lands in and adjacent to the project footprint are publicly owned and managed in the form of WCA-3 to the North, ENP to the South, and Big Cypress National Preserve to the West. The only private lands in proximity are small parcels associated with the air boat concessions and Tribal lands located along the trail. Therefore, any impacts to Florida panthers as a result of non-federal actions are considered unlikely, and if occurred, would be of small size and result in negligible impacts to panthers.

SUMMARY OF EFFECTS

Panther Usage: According to telemetry data, no panther activity has been recorded on-site within the past 6 years. The status and activities of uncollared Florida panthers within the action area is unknown. There are no known den sites within 5 miles of the project boundaries and the quality and quantity of the foraging prey base is low. Therefore, we believe panther usage of the site is limited and we do not believe project construction will result in direct panther mortality.

Traffic: Although there may be minor changes in vehicular traffic patterns in the project vicinity during construction, we believe as discussed above and in previous sections, the lands on the project site provide limited value to the Florida panther and panther prey species; the site is adjacent to a major roadway. The Service believes, based on the current habitat conditions on the site, the existence of the adjacent roadway, the lack of documented recent use of the site by the Florida panther, and the lack of increased vehicular traffic associated with the project, the project will not significantly increase the risk of roadway mortality or injury to panthers. In fact, the proposed project will potentially provide 1 mile of safe passage for panthers under the Tamiami Trail.

Habitat Loss: The Service, based on the habitat evaluations discussed previously, believes the project will result in the direct loss of 9.28 acres of mostly low quality panther habitat within the Primary Zone. Habitat types are primarily a mixture of exotic infested native and disturbed communities. Lack of wildlife utilization of the site shows limited foraging values to panther prey species. This loss of 9.28 acres of panther habitat represents a negligible percentage of the 1,962,294 acres of available non-urban private lands in the core area. The Service believes this small loss of non-urban public lands adjacent to an existing major roadway will not adversely affect the Service's land conservation and preservation goals.

Compensation: On the other hand, the project will also provide for the preservation of approximately 10 acres of Primary Zone habitat in southwestern Miami-Dade County in the 8.5 SMA which will be protected within ENP and is known to support panthers. Approximately 3,148 acres of disturbed marl marsh and slough habitat including the 10 acre compensation site will be enhanced through hydrological restoration of sheetflow and subsequent eradication of exotic vegetation. Therefore, we believe the preservation of approximately 10 acres of panther habitat in the panther core area will have a beneficial effect on the panther and will offset the loss of lower quality habitat and further the Service's goal in panther conservation.

Fragmentation: The project site is also located on the edge of occupied habitat, is adjacent to a major roadway, and is not located within known dispersal corridors to larger publicly owned and managed lands important to the panther. Therefore, fragmentation of panther habitat is not expected to result from project implementation. In fact, the project will potentially reconnect Primary panther habitat (NESRS) and Secondary panther habitat (WCA-3B) via passage under the 1-mile bridge.

Intraspecific Aggression: Potential increase in intraspecific aggression and disturbance to the Florida panther was evaluated. However, the Service believes, as previously discussed, the habitat on the property provides low quality foraging for prey species, which directly affects the frequency and duration of use of the property by panthers. Therefore, the Service believes it is unlikely the loss of this limited use of the site by panthers will significantly increase the risk of mortality from intraspecific aggression between panthers and increase disturbance to panthers in the project action area due to human activities.

Cumulative Analysis: Most of the lands in and adjacent to the project footprint are publicly owned and managed in the form of WCA-3 to the North, ENP to the South, and Big Cypress National Preserve to the West. Therefore, the majority of the impacts to Florida panthers in this area are anticipated to be related to future Federal actions that will require a separate consultation. Impacts to panthers resulting from non-federal actions are unlikely and if they were to occur they would be of such small size that impacts to panthers would be minimal.

CONCLUSION

In conclusion, the Service believes there will be no direct take in the form of mortality or injury of the Florida panther resulting from this project. The loss of habitat from implementing the

project, taking into consideration the status of the species, remaining habitat, and other factors considered in this biological opinion, such as the overall recovery objectives and other cumulative effects from actions in the action area, will be offset by the conservation/restoration of other, more functionally valuable habitat. Therefore, the proposed construction of the Tamiami Trail modification is not likely to jeopardize the continued existence of the Florida panther. No critical habitat has been designated for this species; therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. "Take" is defined as "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 ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

AMOUNT OR EXTENT OF TAKE

Although there may be minor and temporary changes to traffic patterns with the construction of the project, we believe as discussed in previous sections, the lands on the project site provide limited value to the Florida panther and panther prey species. Furthermore, the site is adjacent to existing urban development and the proposed action will further restrict suitability of the site for use by either resident or dispersing panthers. The Service believes, based on the current habitat conditions on the site, the proximity to a major roadway, the lack of documented recent use of the site by the Florida panther, and the absence of increases in traffic generated by operation of the proposed project on the surrounding roads, the project will not significantly increase the risk of roadway mortality or injury to panthers. Therefore, the Service does not anticipate the proposed action will result in the direct mortality or injury of any Florida panthers. Accordingly, the Service is not anticipating any direct take in the form of mortality or harm to the Florida panther.

However, the Service anticipates incidental take of panthers in the form of harm associated with the loss of 9.28 acres of panther habitat within the Primary Zone lands. Based on the analysis provided in the previous sections, the Service believes this level of anticipated incidental take is not likely to jeopardize the continued existence of the species.

EFFECT OF THE TAKE

In the accompanying Biological Opinion, the Service determined this level of anticipated take is not likely to result in jeopardy to the species. The amount of panther habitat affected by the proposed action is a negligible percentage of an estimated 2 million acres of habitat occupied by the panther.

The proposed action will result in the loss of 9.28 acres of mostly low quality panther habitat. The proposed action will increase the impacts from direct and indirect effects to panther habitat from residential and commercial developments, mining, and agriculture by an insignificant amount (< 0.001 percent).

The proposed action will result in the restoration and preservation of approximately 10 acres of panther habitat in the Florida panther Primary Zone, in southwestern Miami-Dade County. The proposed action will increase the preservation and enhancement acreage of panther habitat through permitted Federal actions by about 0.0003 percent from 39,500 acres to approximately 39,510 acres (Table 1). The cumulative increase in the preservation and enhancement of panther habitat to permitted Federal actions will be from 700 acres in 1990 to 39,510 acres.

The lands proposed for compensation/preservation from the proposed incidental take of panther habitat are lands adjacent to other larger tracts of natural and preserved lands and are consistent with the Service's panther goal to 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 south of the Caloosahatchee River. Therefore, based on the evaluations provided above for the project's direct, indirect and cumulative effects, the status of the species, and the compensation proposed by the Corps, the Service believes that the proposed construction and operation of the Tamiami Trail modifications will not jeopardize the survival and recovery of the Florida panther.

REASONABLE AND PRUDENT MEASURES

The Service believes the Corps has incorporated all reasonable and prudent measures necessary and appropriate to minimize impacts of incidental take of Florida panthers into the design of the proposed action. In summary, the Corps will ensure that no more than 9.28 acres of panther habitat will be lost as a result of implementation of the proposed action and that approximately 10 acres in panther Primary Zones will be preserved to benefit the Florida panther and its prey.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, 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 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 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 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 Corps will adhere to the conservation measures listed below and the description of the proposed action that commits the Corps to purchase, preserve, and manage high quality panther habitat, which is necessary and appropriate to minimize incidental take of panthers by the proposed action. Specifically, to compensate for impacts to 9.28 acres of Florida panther habitat, the Corps proposes to restore and preserve 10 acres in ENP, southwestern Miami-Dade County;

2. The preservation site will be enhanced through restoration of sheetflow characteristics and more natural hydrologic regimes as outlined in MWD authorization;

3. The Corps will monitor the permit conditions regarding conservation measures to minimize incidental take of panthers by providing the Service a report on implementation and compliance with the conservation measure within 1 year of the start of construction;

4. The Corps will provide documentation to the Service for completion of proposed off-site enhancement and restoration;

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

6. Care should be taken in handling sick or injured specimens to ensure effective treatment and care or in the handling of dead specimens to preserve biological material in the best possible state for later analysis as to the cause of death. In conjunction with the care of sick or injured panthers or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

CONSERVATION RECOMMENDATIONS

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

1. The Corps has and should continue to implement the Service's SLOPES guidance whenever covered species could be encountered within or near a construction area. The SLOPES guidance for snail kites has been included in this report as Appendix A.

2. The Corps should place caution signs on Tamiami Trail, a reasonable distance from both ends of the bridge, to alert motorists to the possibility of encountering panthers in the roadway.

3. Should panthers be sighted in and around the project area after construction is complete, the Corps should consider fencing the road embankment at both ends of the bridge. This will serve to funnel panthers under the bridge rather than up onto the roadway. The Corps should contact the Service for specifics regarding the latest fencing specifications.

REINITIATION NOTICE

This concludes formal consultation on the Tamiami Trail portion of the MWD to ENP 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 Kevin Palmer at 772-562-3909.

Sincerely yours,

Paul Souza
Field Supervisor
South Florida Ecological Services Office

cc:
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Table 1. Biological Opinions and habitat preservation efforts resulting from consultations with the Service for projects affecting Florida panther habitat from March 1984 through November 2005.

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
03/29/84	4-1-83-195	83M-1317	CMC Development Corporation (Ford Test Track)	Collier	530	0	0	0
02/21/85	4-1-85-018	FAP #?	USDOT, FHA (conversion of Hwy 84 to I-75)	Broward Collier	1,517	0	0	0
10/17/86	4-1-87-016 4-1-87-017	unknown	NPS, BCNP (Exxon Master Plan Modification)	Collier	9	0	0	0
01/07/87	4-1-86-303	86IPM-20130	Collier Enterprises (citrus grove)	Collier	11,178	0	0	0
01/11/88	4-1-88-029	unknown	NPS, BCNP (NERCO - Clements Energy, Inc.)	Collier	3	0	0	0
02/23/88	4-1-88-055	unknown	NPS, BCNP (Shell Western E&P, Inc.)	Collier Dade Monroe	0	0	0	0
02/10/89	4-1-89-001	FAP IR-75-4(88)81	USDOT, FHA (SR 29/I-75 Interchange)	Collier	350	0	0	0
08/15/90	4-1-90-289	unknown	NPS, BCNP [I-75 Rec. Access Plan (MM 31, 38, 49)]	Collier	150	0	0	0
09/24/90	4-1-90-212	89IPD-20207	U.S. Sugar Corp (46 mi2 ag conversion)	Hendry	28,740	700	0	700
03/12/91	4-1-91-229	90IPO-02507	Lourdes Cereceda (commercial rock mine)	Dade	97	0	0	0
01/14/92	4-1-91-325	199101279 (IP-HH)	Dooner Gulf Coast Citrus (32 acre citrus grove)	Collier	40	40	0	40
09/25/92	4-1-92-340	unknown	BIA, STOF, BCSIR (1,995 acre citrus grove)	Hendry	1,995	0	0	0
06/18/93	4-1-93-217	199200393 (IP-SL)	Lee County DOT (Corkscrew Road)	Lee	107	0	0	0
02/25/94	4-1-94-209	199301131 (IP-KC)	Lee County DOT (Daniels Road extension)	Lee	65	0	0	0
05/09/94	4-1-93-251	199202019 (IP-KA)	Corkscrew Enterprises (The Habitat)	Lee	900	100	100	200

Table 1 Continued

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
10/27/94	4-1-94-430	199302371 (IP-BB) 199400807 (IP-BB) 199400808 (IP-BB)	Timberland and Tiburon Florida Gulf Coast University Treeline Boulevard	Lee	1,088	526	0	526
05/24/95	4-1-95-230	199302130 (IP-TB)	FDOT, I-75 (Turner River access @ MM 70)	Collier	1,936	0	0	0
08/07/95	4-1-95-274	199405501 (IP-AW)	Bonita Bay Properties, Inc. (golf course)	Collier	509	491	0	491
08/15/95	4-1-94-214	199301495 (IP-MN)	SWFIA, Northeast Access Road	Lee	14	0	0	0
09/19/96	4-1-95-F-230	199302052 (IP-TB) 199301404 (IP-TB)	FDOT, I-75 (Central and West Broward access) FDOT, I-75 (Miami Canal Access)	Broward	116	0	0	0
03/10/98	4-1-98-F-3	L30(BICY)	NPS, BCNP (Calumet Florida, Inc. seismic testing)	Collier Dade Broward	0	0	0	0
03/27/98	4-1-97-F-635	199604158 (IP-SB)	Bonness, Joseph D., Jr. Trustee (Willow Run Quarry)	Collier	359	190	0	190
06/11/99	4-1-98-F-398	199800622 (IP-SS)	STOF, BCSIR (water conservation plan)	Hendry	1,091	0	0	0
09/27/99	4-1-98-F-310	199130802 (IP-SB)	Lee County DOT (Daniels Parkway extension)	Lee	2,093	0	94	94
12/08/99	4-1-98-F-517	199607574 (IP-MN)	Kaufmann Holdings, Inc. (Cypress Creek Farms)	Collier	239	0	24	24
04/17/00	4-1-98-F-428	199507483 (IP-AM)	Miromar Development, Inc. (Miromar Lakes)	Lee	1,323	0	194	194
06/09/00	4-1-99-F-553	199900619 (IP-SB)	Vineyards Development Corp. (Naples Reserve GC)	Collier	833	0	320	320
02/21/01	4-1-00-F-135	199803037 (IP-SR)	Wortzel & Landl, Co-Trustees (Corkscrew Ranch)	Lee	106	0	0	0

Table 1 Continued

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
04/17/01	4-1-00-F-584	200001436 (IP-MN)	WCI Communities, Inc. (Sun City - Ft. Myers)	Lee	1,183	0	408	408
07/30/01	4-1-94-357	199003460 (IP-TB)	Naples Golf Estates	Collier	439	175	0	175
08/31/01	4-1-00-F-183	199900411 (IP-SR)	Worthington Communities, Inc. (Colonial G&CC)	Lee	1,083	0	640	640
12/14/01	4-1-00-F-585	199301156 (IP-MN)	SWFIA, Mid-field Terminal Expansion	Lee	8,058	0	6,986	6,986
01/30/02	4-1-98-F-372	199402492 (IP-ML)	Florida Rock Industries, Inc. (Fort Myers Mine #2)	Lee	2,913	1,959	0	1,959
03/07/02	4-1-00-F-178	199901251 (IP-MH)	Benton, Charles (Southern Marsh GC)	Collier	121	75	80	155
04/24/02	4-1-01-F-148	199901378 (IP-SR)	Schulman, Robert, Trustee (Hawk's Haven)	Lee	1,531	267	0	267
09/24/02	4-1-01-F-135	200001574 (IP-DY)	State Road 80, LLC (Verandah)	Lee	1,456	0	320	320
10/08/02	4-1-02-F-014	199602945 (IP-DY)	Barron Collier Company (Winding Cypress)	Collier	1,088	840	1,030	1,870
05/19/03	4-1-02-I-1741	200200970 (IP-DEY)	Apex Center	Lee	95	10	18	28
06/10/03	4-1-01-F-1955	200003795 (IP-DY)	Walnut Lakes	Collier	157	21	145	166
06/18/03	4-1-01-F-136	199701947 (IP-SR)	Twin Eagles Phase II	Collier	593	57	98	155
06/23/03	4-1-01-F-143	199905571 (IP-SR)	Airport Technology Center	Lee	116	55	175	230
07/02/03	4-1-98-F-428	199507483 (IP-MN)	Addition to Miromar Lakes	Lee	342	158	340	498
09/04/03	4-1-02-F-1486	200206725 (IP-MN)	State Road 80 Widening	Lee	33	2	12	14
10/06/03	4-1-02-F-0027	200102043 (IP-MN)	Bonita Beach Road Development	Lee	1,117	145	640	785
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

Table 1 Continued

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
04/08/05	4-1-04-F-8176	2004-5312 (AEK)	Big Cypress Rock Mine	Broward	110	0	220	220
04/29/05	4-1-04-F-5780 4-1-04-F-5982	2003-5331 (IP-TWM) 2003-6965 (IP-TWM)	Worthington Holdings - Arborwood Worthington Holdings - Treeline Avenue Extension	Lee	2,330	0	1,700	1,700
06/06/05	4-1-03-F-7855	2003-11156 (IP-RMT)	Collier Regional Medical Center	Collier	44	0	64	64
02/25/05 03/16/05 06/29/05 04/04/06	4-1-04-F-6866	200309416 (NW-MAE)	Ava Maria University	Collier	5,027	0	6,114	6,114
06/29/05	4-1-03-F-3915	199806220 (IP-MAE)	Wenthworth Estates - V.K. Development	Collier	917	0	458	458
07/15/05	4-1-04-F-5786	199405829 (IP-CDC)	Land's End Preserve	Collier	231	0	61	61
09/26/05 10/26/05	4-1-04-F-9348	2004-1122 (IP-RMT)	Super Target/Brentwood Land Partners	Collier	34	0	20	20
11/23/05	4-1-04-F-6043	20039414	Waterways Join Venture IV	Collier	108	0	61	61
11/29/05	4-1-04-F-8847	20048995	Seminole Tribe of FL Administrative Complex	Collier	6	0	8	8
12/06/05	4-1-03-F-3483	200302409	Southwest Florida Investment Property, LLC	Lee	207	0	305	305
12/6/05	4-1-04-F-6691	200310689	Rattlesnake Hammock Road	Collier	47	0	23	23
01/04/06	4-1-04-F-8388	2004554	Immokalee Regional Airport - Phase I	Collier	163	0	43	43
01/04/06	4-1-04-F-9777	20048577	Logan Boulevard Extension	Collier	40	0	10	10
01/13/06	4-1-04-F-6707	20042404	Journey's End	Collier	66	0	34	34
01/26/06	4-1-04-F-8940	20047053	The Orchard	Lee	93	0	81	81
02/09/06	4-1-05-11724	2005384	Firano at Naples	Collier	24	0	19	19
02/22/06	4-1-04-F-6505	200101122	Corkscrew Road	Lee	63	0	47	47
02/23/06	4-1-04-F-5244	200312276	Summit Church	Lee	10	0	13	13
03/31/06	4-1-05-PL-11343	20051909	Coral Keys Homes	Dade	31	0	61	61

Table 1 Continued								
Date	**Service Log No.**	**Corps Application No.**	**Project Name**	**County**	**Habitat Impacts (Acres)**	**Habitat Preserved On-site (Acres)**	**Habitat Preserved Off-site (Acres)**	**Total Habitat Preserved (Acres)**
05/05/06	41420-2006-I-0274	2005-6176	Santa Barbara , Davis to Radio Road, Widening	Collier	6	0	3	3
05/09/06	41420-2006-I-0263	2005-6298	Santa Barbara and Radio Road Widening	Collier	29	0	20	20
05/09/06	41420-2006-F-0089	200403248	Collier Boulevard, Immokalee Rd. to Goldengate Blvd.	Collier	14	0	16	16
05/16/06	4-1-05-F-10309	19971924	Sabal Bay	Collier	1,017	1,313	223	1,536
06/05/06	4-1-05-PL-8486	20041688	Seacrest School	Collier	31	0	16	16
06/09/06	4-1-05-PL-10965	200303733	HHJ Development	Dade	3	0	4	4
06/14/06	4-1-05-F-11855	200411010	Keysgate School Site	Dade	39	0	62	62
06/15/06	41420-2006-I-0362	20056176	Collier County Wellfield	Collier	29	0	36	36
07/12/06	41420-2006-F-0282	200311150	Cypress Shadows	Lee	244	0	160	160
07/28/06	4-1-05-F-12330	20047920	Hamilton Place	Dade	10	0	50	50
07/28/06	4-1-04-F-7279	20041695	Raffia Preserve	Collier	131	0	119	119
08/15/06	41420-2006-I-0151	20031963	Naples Custom Homes	Collier	10	0	9	9
08/21/06	41420-2006-I-0540	20041813	ASGM Business Park	Dade	41	0	25	25
08/21/06	4-1-03-F-3127	19956797	Atlantic Civil Ag Permit Extension	Collier	981	0	1,553	1,553
09/12/06	41420-2006-F-0554	20057414	Miccosukee Government Complex	Dade	17	0	37	37
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

Table 1 Continued

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
10/25/06	41420-2006-F-0442	20047046	Koreshan Boulevard Extension	Lee	14	0	31	31
10/26/06	41420-2006-F-0787	200306755	Jetway Tradeport	Collier	38	0	52	52
10/26/06	41420-2006-I-0849	20055702	Marina Del Lago	Lee	49	0	36	36
10/27/06	41420-2006-I-0203	20057180	Living Word Family Church	Collier	18	0	35	35
10/27/06	41420-2006-I-0607	20064878	Seminole Reservation Access Road	Hendry	2	0	5	5
11/15/06	41420-2006-TA-0727	N/A	Liberty Landing	Collier	27	0	19	19
11/15/06	41420-2007-FA-0222	200412415	Barry Goldmeier 5th Avenue Estates	Dade	15	0	18	18
11/16/06	41420-2006-TA-0060	N/A	Collier County Elementary School K	Collier	26	0	17	17
12/05/06	41420-2006-FA-1179	20057179	The Roberts Group CPD	Lee	58	0	29	29
12/07/06	41420-2006-FA-0781	20041689	Cypress Landing	Collier	46	0	18	18
01/19/07	41420-2006-I-0871	20061359	Brighton Veterans Center	Glades	9	0	8	8
03/09/07	4-1-04-F-6112	20021683	Alico Airpark (Haul Ventures)	Collier	241	75	315	390
03/09/07	41420-2006-F-0850	200312445	Airport Interstate Commerce Park	Lee	323	0	371	371
04/13/07	41420-2007-TA-0618	NA	Collier County School Site J - Everglades Blvd.	Collier	39	0	56	56
02/21/03 03/9/05 03/02/07 05/03/07	4-1-01-F-607	200001926 (IP-SB)	Mirasol	Collier	773	940	182	1,122
03/09/07	41420-2007-TA-0623	NA	Abercia North	Collier	25	0	31	31
03/09/07	41420-2007-I-0581	1999-4313	Savanna Lakes	Lee	124	0	140	140

Table 1 Continued								
Date	**Service Log No.**	**Corps Application No.**	**Project Name**	**County**	**Habitat Impacts (Acres)**	**Habitat Preserved On-site (Acres)**	**Habitat Preserved Off-site (Acres)**	**Total Habitat Preserved (Acres)**
05/01/07	41420-2006-I-0992	20045223	Seminole Motocross	Hendry	58	5	19	23
06/19/07	41420-2007-I-0997	2006-2583	Caloosa Reserve	Collier	111	0	139	139
07/03/07	41420-2007-TA-0818	NA	Woodcrest Development	Collier	11	0	15	15
07/17/07	41420-2007-I-0330	2006-6377	Faith Landing	Collier	35	0	18	18
07/30/07	41420-2007-I-0866	2006-7022	Collier county School Site L	Collier	32	0	21	21
09/05/07	41420-2006-I-0051	2005-4186	Gulf Coast Landfill Expansion	Lee	123	0	65	65
06/14/04 03/21/05 08/24/07	4-1-04-F-5744	199603501 (IP-TWM)	Terafina	Collier	437	210	261	471
10/31/07	41420-2007-F-1035	2004-3931	Big Cypress Regional General Permit - 83	Hendry Broward	2,357	4,144	0	4,144
11/13/07	41420-2006-FA-1430	2005-782	Summit Lakes	Collier	139	0	134	134
9/8/2005 02/15/08	4-1-04-F-5260 and 41420-2008-F-0112	200106580	Parklands Collier	Collier	487	157	434	591
				Total:	**94,787**	**12,655**	**26,845**	**39,500**

Table 2. *Targeted and acquired acreage totals of Conservation Lands in south Florida directly affecting the panther.

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 2 was excerpted from the Brief of Amicus (2003). However, the lands shown as acquired in this table may include some private in-holdings and may include lands currently under sales negotiations or condemnation actions.

Table 3. Habitat suitability values for use in assessing habitat value to the Florida panther.

Land Cover Type	Value	Land Cover Type	Value	Land Cover Type	Value
Water	0	STA	4.5	Cypress swamp	9
Urban	0	Shrub swamp	5	Sand pine scrub	9
Coastal strand	1	Shrub and brush	5	Sandhill	9
Reservoir	1.5	Dry prairie	6	Hardwood-Pine forest	9
Mangrove swamp	2	Grassland/pasture	7	Pine forest	9
Salt marsh	2	Freshwater marsh	9	Xeric oak scrub	10
Exotic plants	3	Bottomland hardwood	9	Hardwood forest	10
Cropland	4	Bay swamp	9		
Orchards/groves	4	Hardwood swamp	9		

Table 4. Undeveloped Privately Owned Land within Florida Panther Core Area.

Zone	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

*About 819,995 acres are at risk in the other zone with about 80 percent with resource value.

Table 5. Land Held for Conservation within the Florida Panther Core Area.

Zone	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

Table 6. 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 7. Florida Panther Habitat Matrix

Land Cover Types	Habitat Values	Project Footprint 16.4 acres				Off-site Compensation in Primary Zone **10 acres**			
		Functional Units Needed = 72.5				Functional Units Provided = 90			
Land Cover Type	**Score**	**Pre**		**Post**		**Pre**		**Post**	
		Acres	PHU	Acres	PHU	Acres	PHU	Acres	PHU
Urban	0	3.5	0	9.28	0	10	0		
Water	0	0.3	0	0	0				
Exotics	3	3.49	10	0	0				
Shrub Swamp	5	0.66	3	0.66	3				
Freshwater Marsh	9	4.18	38	3.57	32			10	90
Cypress Swamp	9	4.15	37	2.77	25				
Hardwood Forest	10	0.13	1	0.13	1				
Subtotal		16.4	90	16.4	61	10	0	10	90

PHUs needed - 29 times the base multiplier of 2.5 equals 72.5 PHUs. Project is in the Primary Zone with compensation in the Primary Zone.

The Corps is providing 90 PHUs.

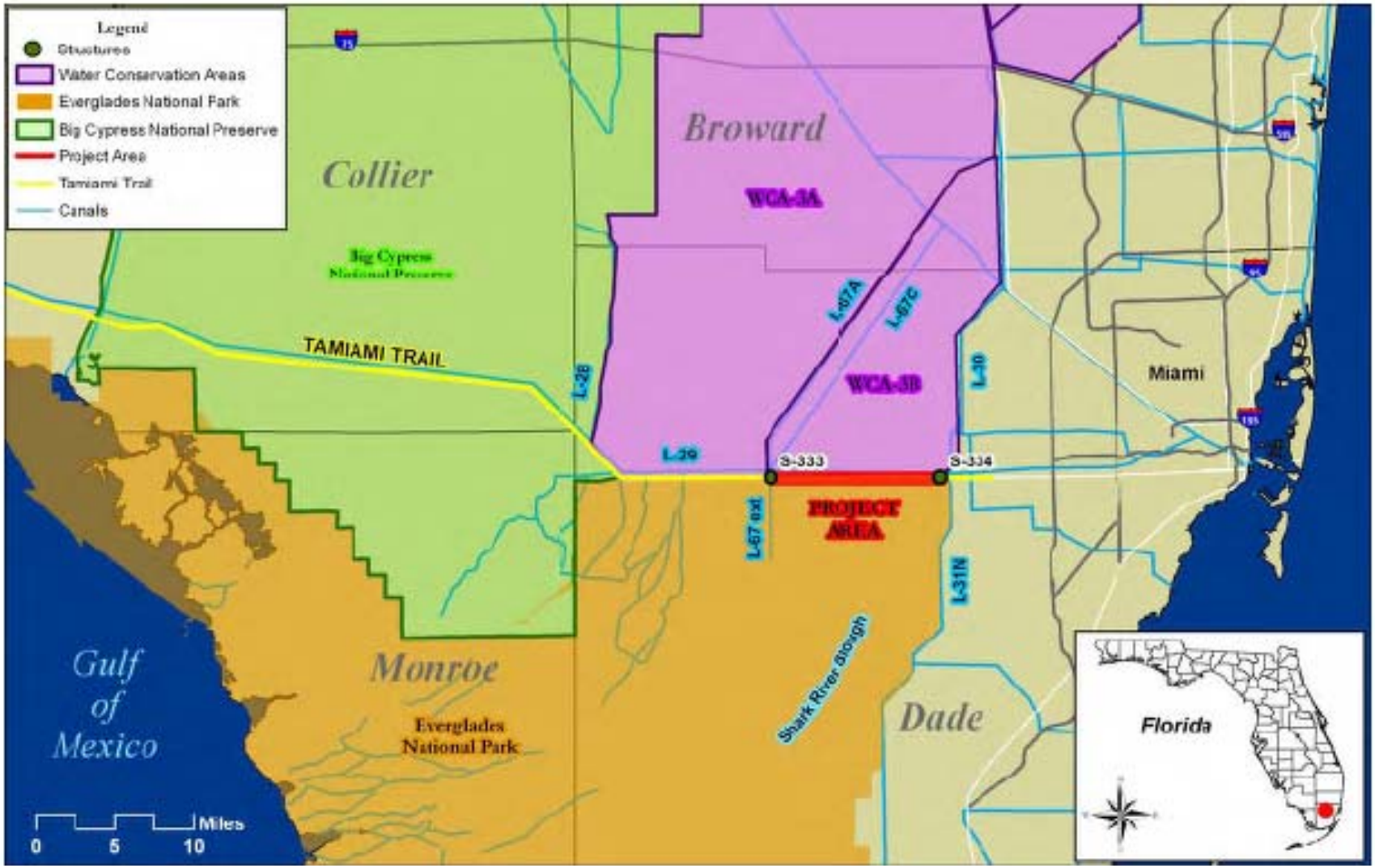

Figure 1. Tamiami Trail Modification project location map.

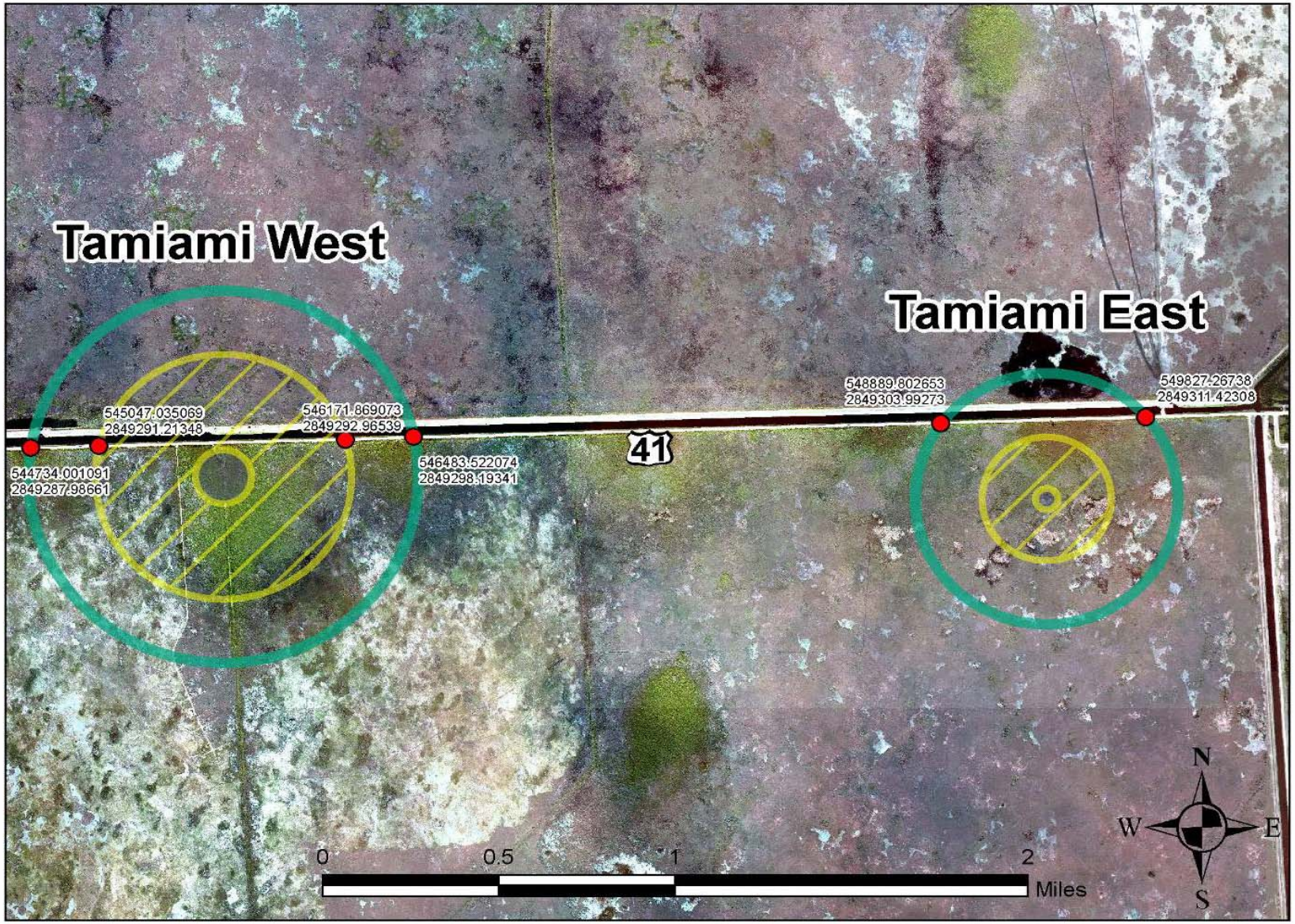

Figure 2. Aerial photograph depicting the core, primary, and secondary zones of the Tamiami West and East wood stork colonies located on the eastern end of the project area just south of Tamiami Trail.

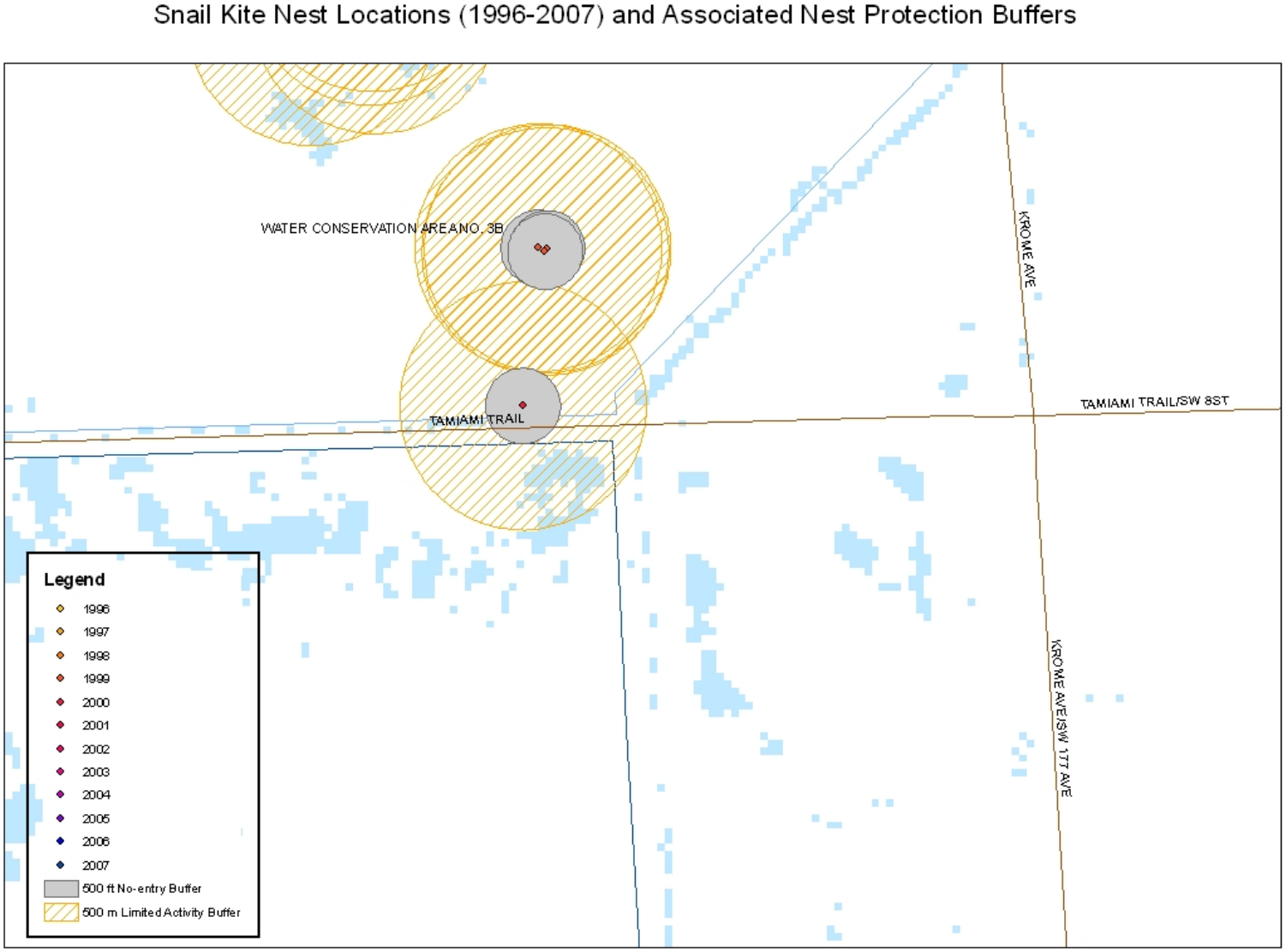

Figure 3. Map showing snail kite nest locations in proximity to the eastern end of the Tamiami Trail. The gray buffers represent the 500-ft no access area surrounding active nests. The yellow buffers represent areas where disturbances should be kept to a minimum around active nests (500 m).

Figure 4. Historic Shark River Slough flow path.

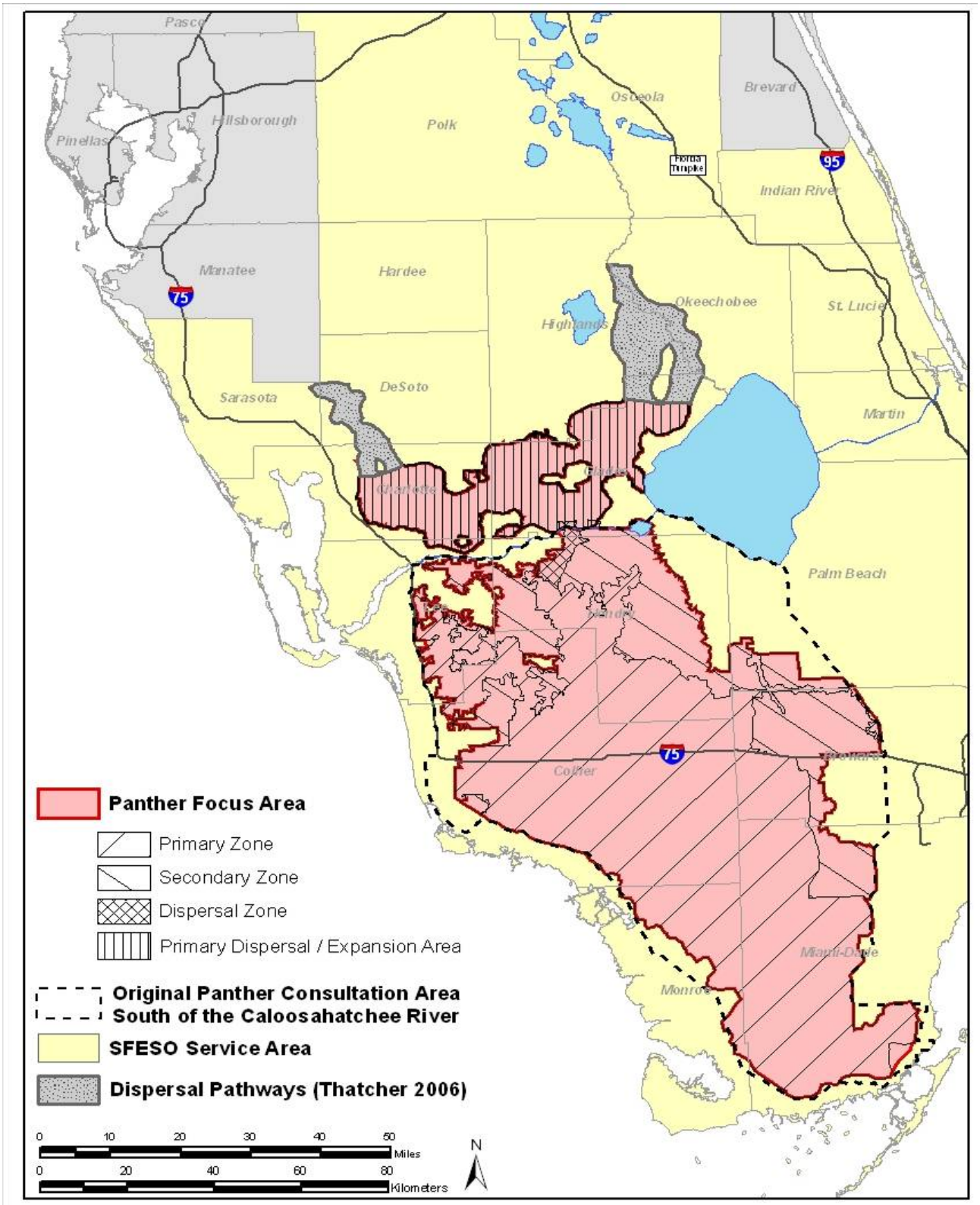

Figure 5. Florida Panther Focus Area and Original Panther Consultation Area.

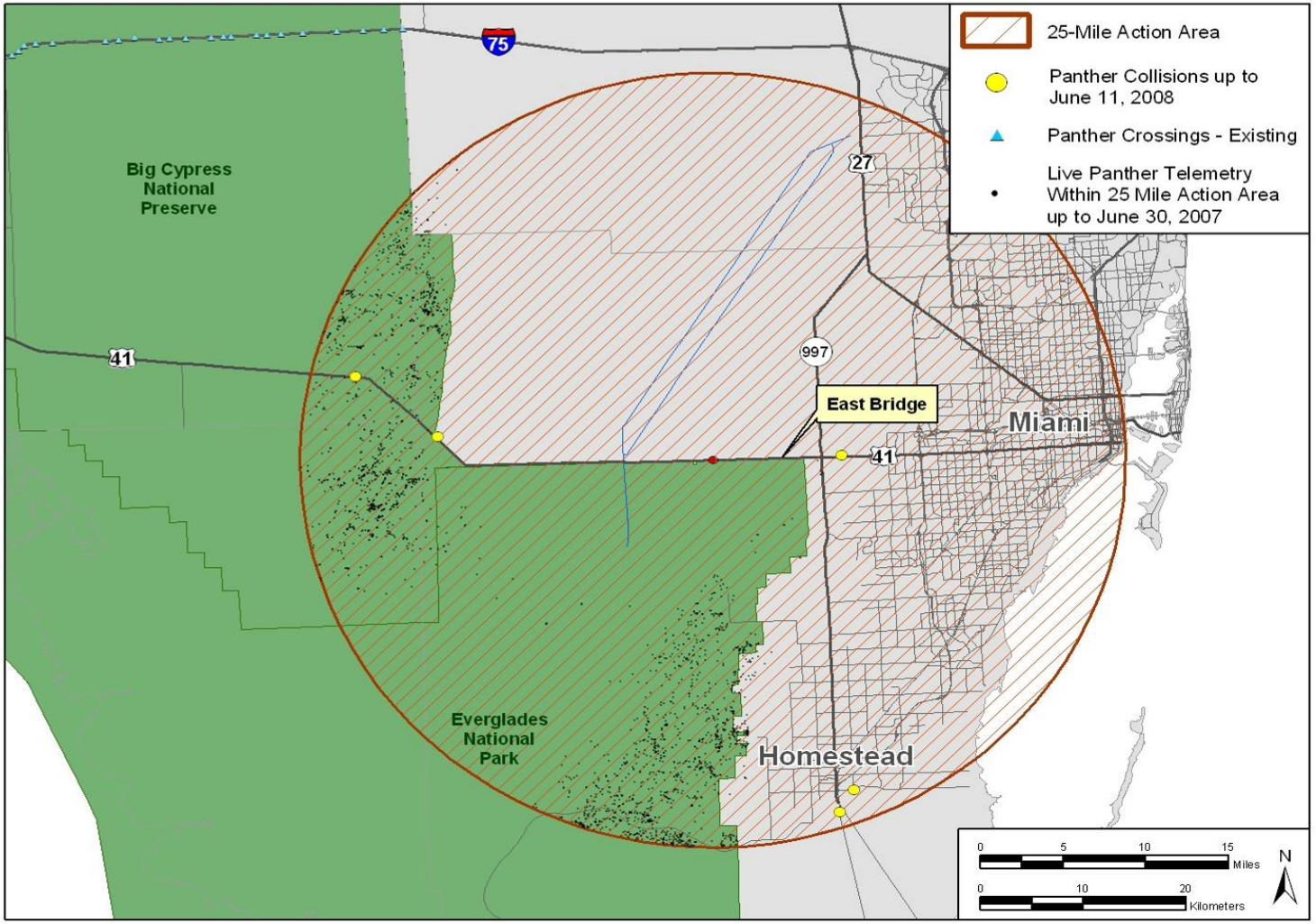

Figure 6. 25-mile action area showing all panther telemetry records, panther collisions, and existing panther crossings.

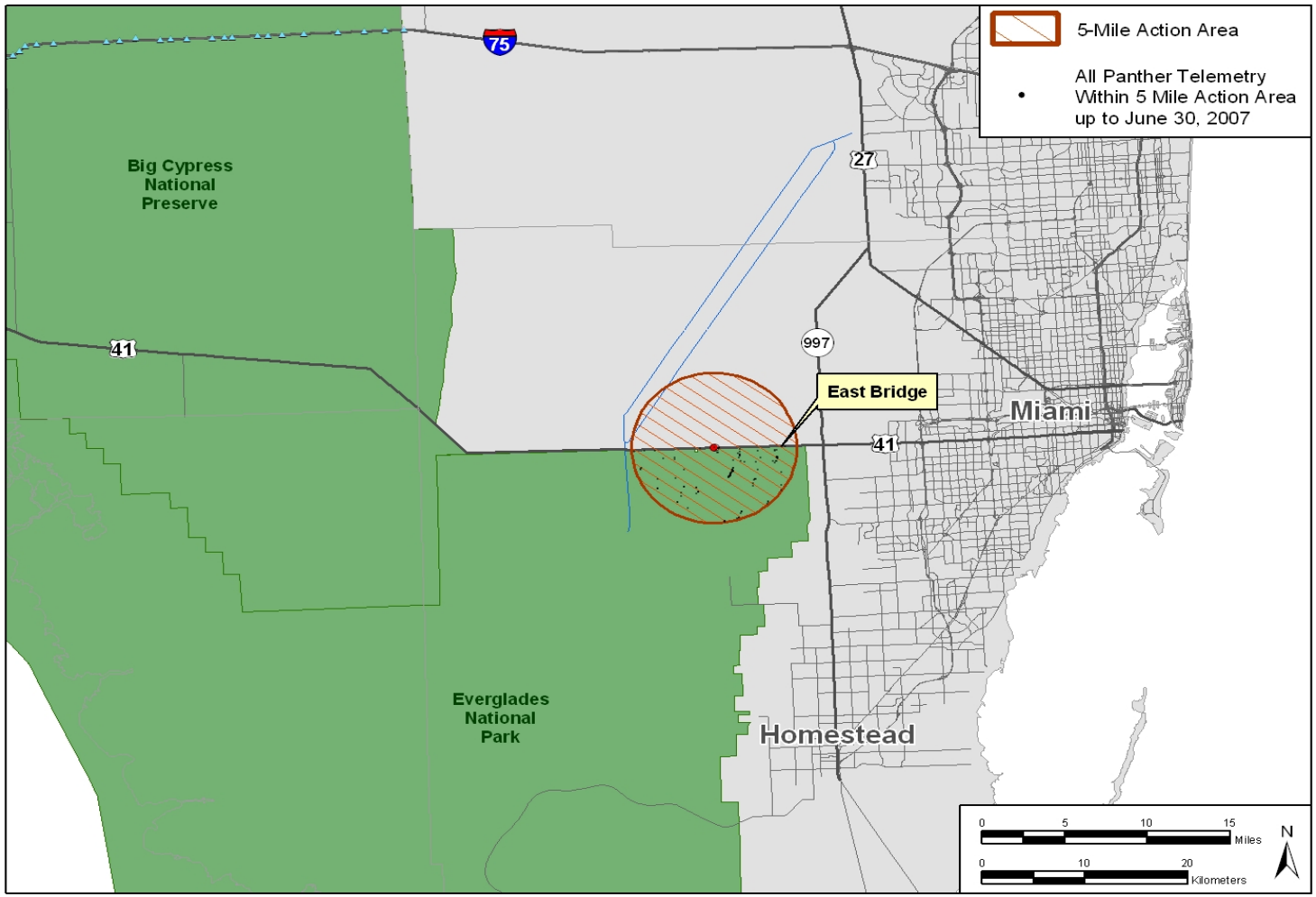

Figure 7. 5-mile action area showing all panther telemetry points

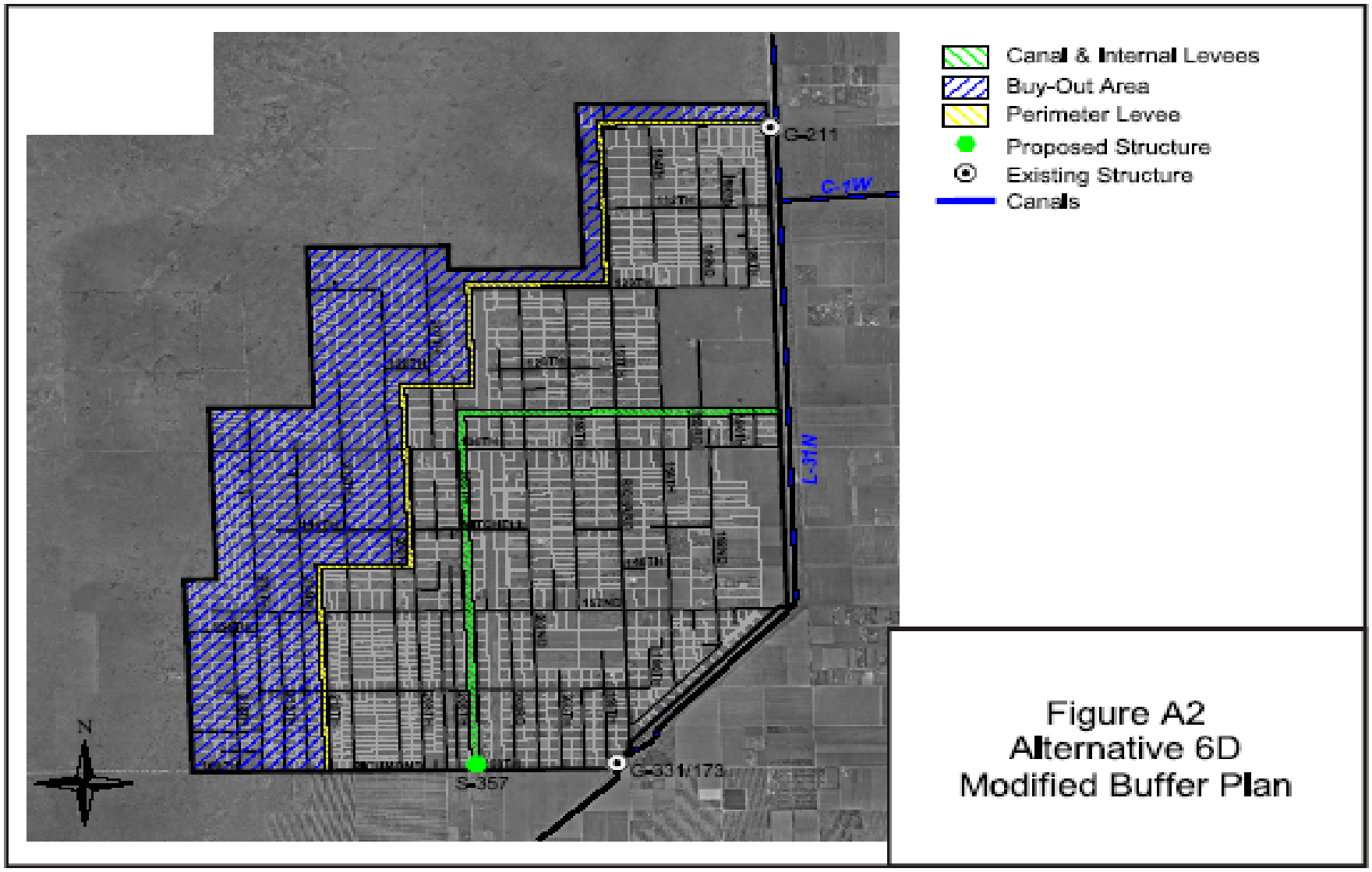

Figure 8. 8.5 SMA alternative 6D showing canal and levee alignments and buy-out area which will all serve as compensation for Tamiami Trail.

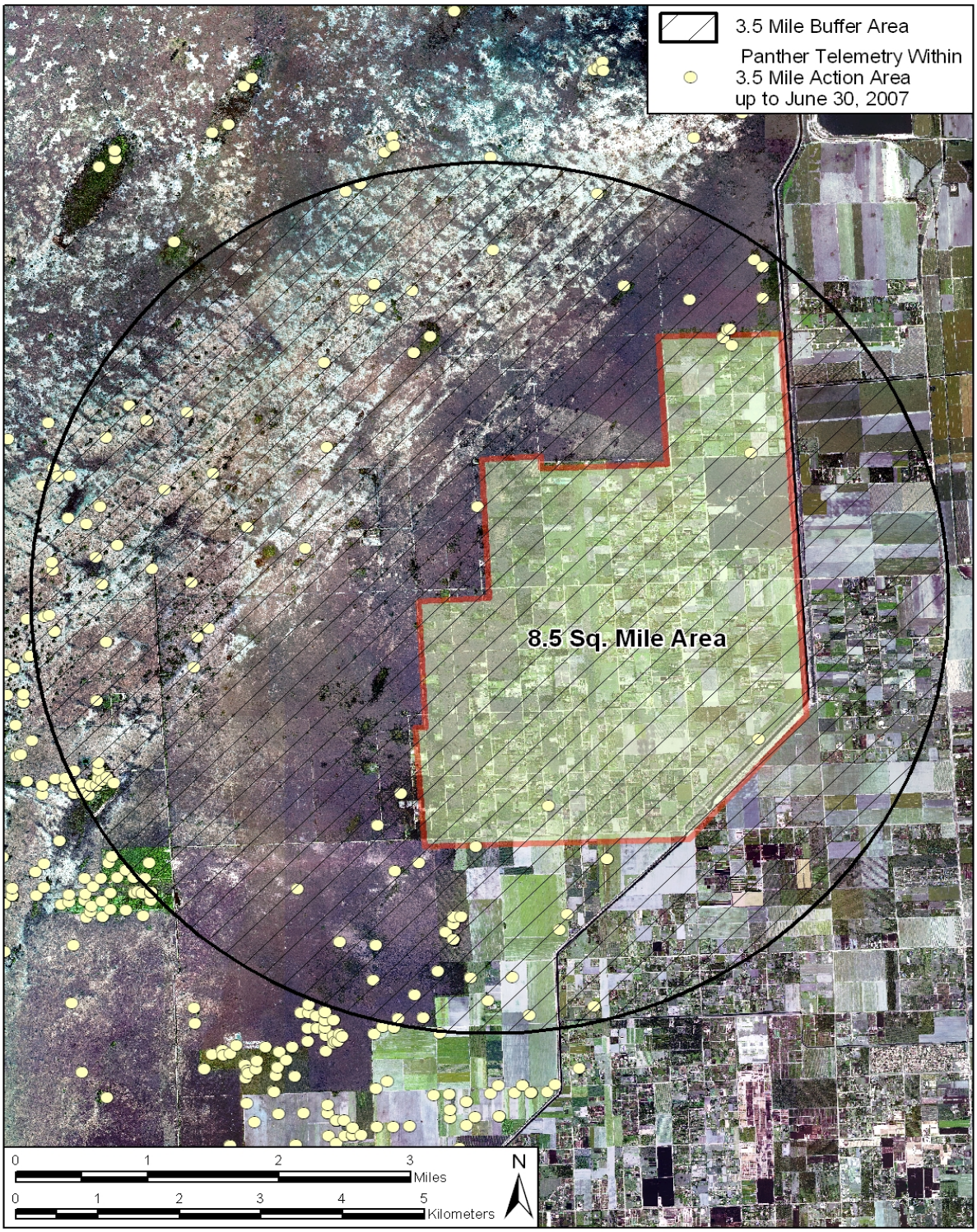

Figure 9. Aerial showing 3.5-mile buffer around the compensation area with all panther telemetry.

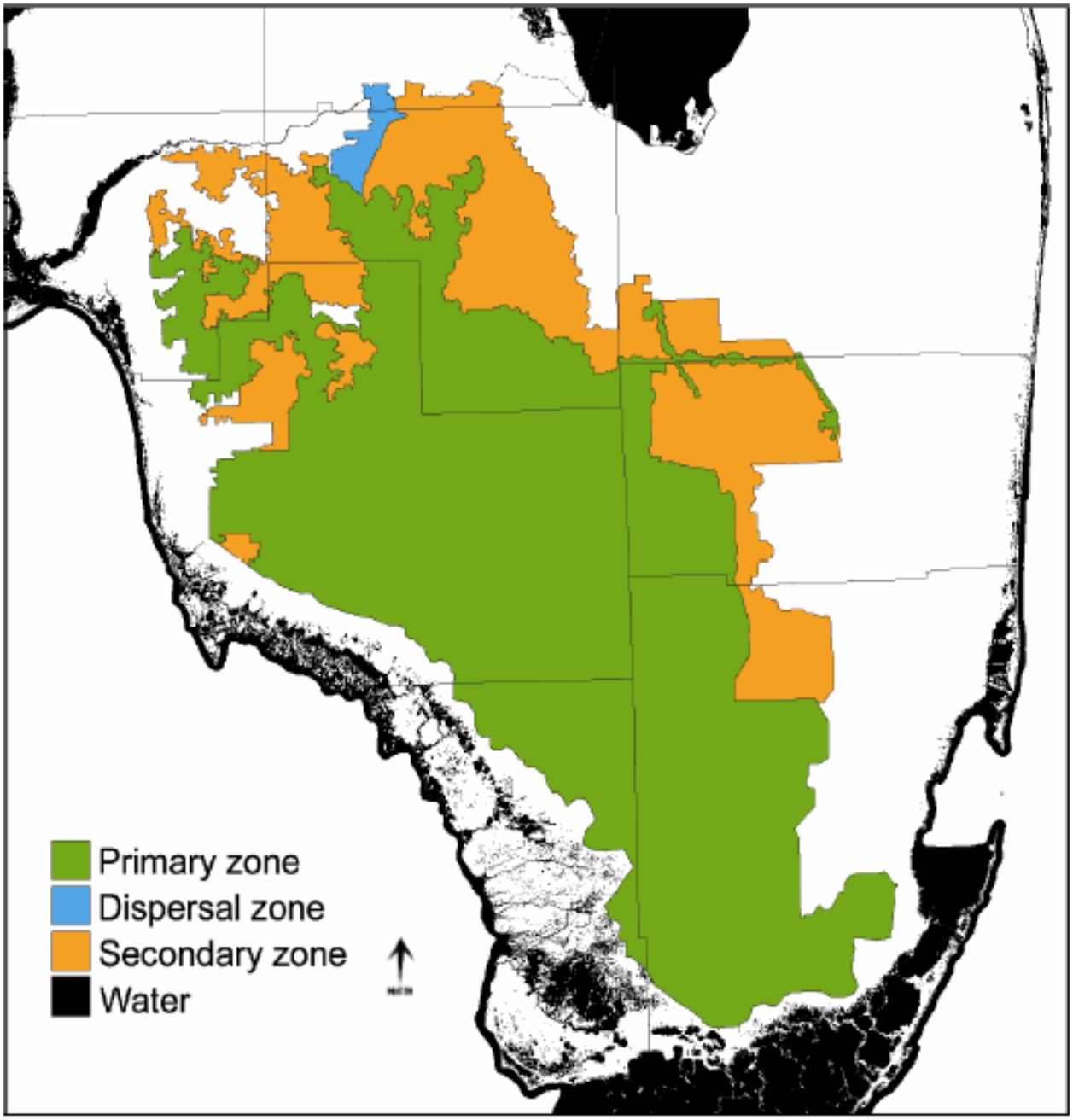

Figure 10. Florida panther Primary, Secondary, and Dispersal Zones. Kautz et al. (2006).

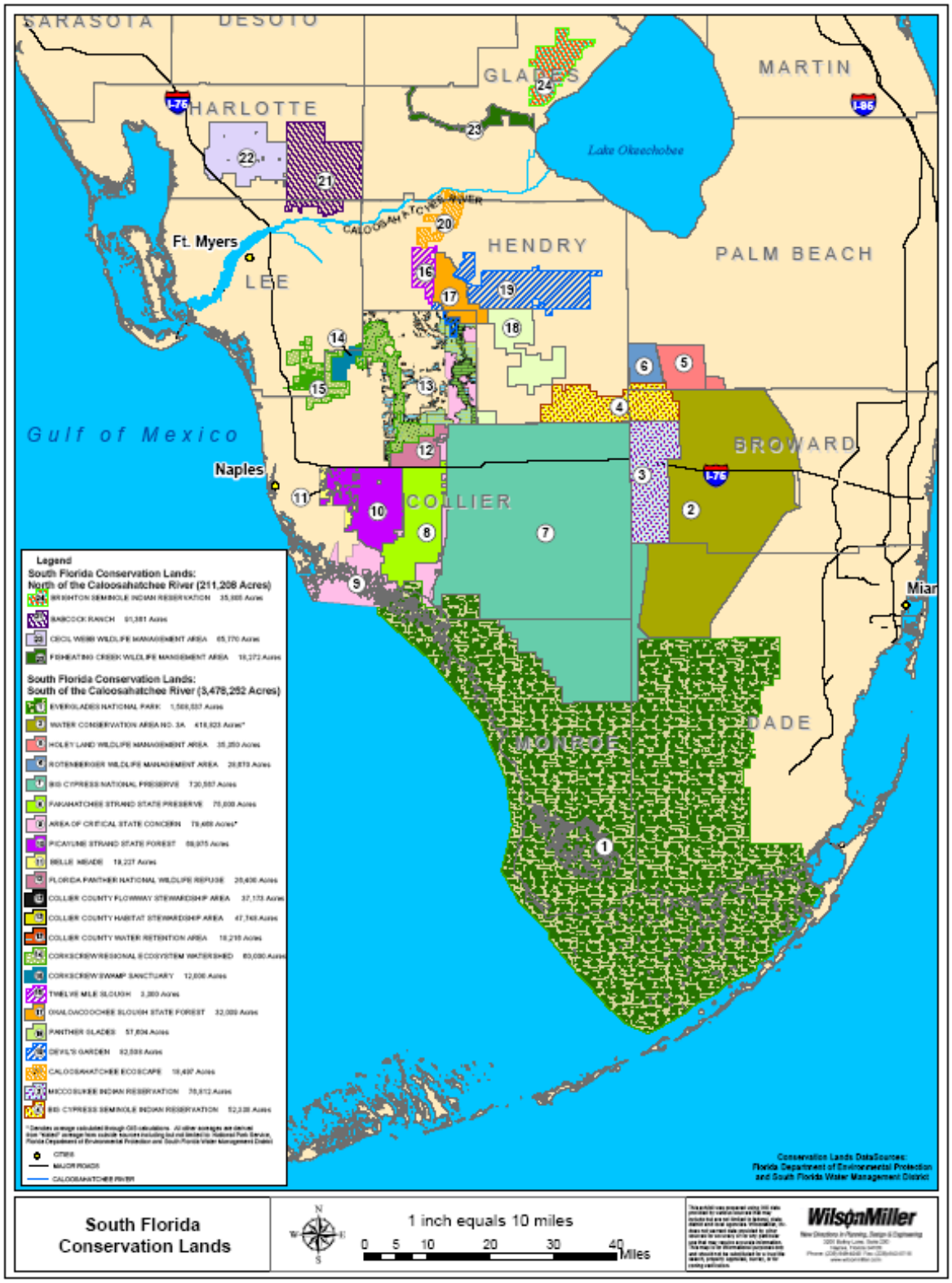

Figure 11. South Florida conservation lands.

APPENDIX A

Draft Snail Kite Management Guidelines
February 21, 2006

U.S. Fish and Wildlife Service

Draft Snail Kite Management Guidelines
February 21, 2006

These guidelines were developed to help resource managers and other interested parties avoid detrimental impacts to endangered Everglade snail kites and their habitat, and to provide information that will allow managers to improve conditions for snail kites. Everglade snail kites are listed as endangered under Federal and Florida State laws. Any disturbance to snail kites or their nests, including flushing perched birds, interrupting foraging, flushing adults from nest sites, interfering with feeding and protection of nestling kites, and impacting vegetation that supports kite nests is prohibited. Adherence to these guidelines will minimize the likelihood that actions result in prohibited impacts to snail kites. If you see snail kites, we always recommend that you simply avoid the immediate area where kites are present. If in doubt about whether an activity may affect kites, please contact a U.S. fish and Wildlife Service (Service) or Florida Fish and Wildlife Conservation Commission (FWC) office.

MINIMIZING IMPACTS TO KITE NESTING DURING BREEDING SEASON

During each nesting season (generally December 1 to July 31, but including all periods when active nests are known), locations of all known snail kite nests will be provided to the Service from researchers and resource managers, and then distributed to appropriate agency representatives. Maps and coordinates of nest sites, kite protection buffers, and priority kite management zones will be distributed to established points of contact for agencies and organizations that conduct management actions in kite habitat. These points of contact will be responsible for disseminating the information to personnel working on the ground.

Nest Protection Buffers

Two buffer zones will be established around every active snail kite nest. This includes all nests reported to the Service by researchers and any unreported nest that is encountered during other activities. These buffer zones will be in effect from when kites begin nest building through the time when breeding activity is no longer observed at the site. Because kites can renest, and often renest in the same area as previous attempts, buffer zones may remain in place past the time when fledglings leave the area if adult kites continue to show breeding activity, including courtship, in the general area. Kites do not exhibit fidelity to a specific nest site from year to year. Consequently, all restrictions within these buffer zones will be lifted once breeding activity has ceased.

1. No-entry Buffer Zones - A 500-foot (ft) (~150 meter) radius no-entry buffer zone will be established around all active nests that are discovered. The purpose of this buffer zone is to protect kites from direct disturbance that may affect the fate of nesting.

- Airboats, personnel, helicopters, and other equipment and activity must stay outside of these areas at all times when kite breeding activity is occurring.
- These buffers are slightly larger than the estimate of 430 ft (131 m) recommended in a study of disturbance to birds from airboats (Rodgers and Schwikert 2003). This larger buffer was selected because the disturbance tested in their study does not necessarily represent the types of activity that may occur during land management activities because they monitored the responses of perched birds and not nesting birds.

2. Limited Activity Buffer Zones - A 1,640 ft (500 meter) radius limited-activity buffer zone will be established around all active kite nests. This buffer zone is intended to maintain and protect foraging opportunities and habitat conditions around each nest to allow the nest to succeed. The goal is to maintain habitat conditions for the entire nesting period similar to those that were present when the birds selected the site.

- Airboats, personnel, helicopters, and other equipment and activity should stay outside of this buffer when possible, and activity within the buffer should be limited to the minimum time necessary to complete appropriate management activities.
- Only management activities that are expected to maintain or improve the existing kite foraging and nesting habitat within these areas should occur while there is evidence of kite breeding activity.
    - Exotic and invasive plant control efforts, including water hyacinth, water lettuce, and hydrilla, and similar invasive species that may rapidly encroach on native vegetation communities may be treated within limited-activity buffer zones during kite breeding, so long as treatments are not expected to result in impacts to vegetation species that contribute to snail kite and apple snail habitat. Treatments expected to result in changes > 10 percent in the cover or occurrence of native vegetation species including spike rushes, bulrushes, maidencane, and other emergent vegetation should be avoided.
    - Treatments of invasive and undesirable woody plants, cattails, tussocks, and other similar vegetation should not occur within these buffer zones during kite nesting. These treatments should be postponed until after kite breeding activity has ceased.
    - These buffer distances are intended to encompass the primary foraging area around a nest. The buffer distance is larger than the 820 ft (250 meter) radius recommended by Sykes (1987), and is a better representation of the area that kites use for foraging during nesting.

Priority Kite Management Areas

Snail kite nesting does not occur randomly within wetland systems. Instead, there are generally areas within wetlands, where kite nesting is concentrated. The density of kite nests, frequency of nesting within each area, and the sizes of these "priority kite nesting areas" are highly variable, but identifying these areas may help resource managers to focus management actions. In most years, the majority of kite nesting will occur within these areas, though new nesting areas may become active. At the end of each nesting season, primary kite nesting areas will be delineated based on the current year's nest locations and nesting in the previous 10 years.

- The polygons that delineate priority kite nesting areas, are 'kernels' that represent the 90 percent probability density function for kite nests over a 10-year period (1996-2005 in this case). These polygons were delineated under the assumption that the density of kite nests over the past 10 years indicates the likelihood of future kite nesting, and approximately 90 percent of the kite nesting, on average, will occur within these polygons if patterns of nest site selection continue as in the past.
- These areas will be provided to agency representatives soon after the end of the kite breeding season (July), and represent areas where resource management activities are likely to be limited due to kite nesting activity. Proposed management actions should incorporate pre-treatment kite surveys, or avoid these areas during the early part of the following breeding season (from January 1 to May 31) when kites are selecting nesting

sites. These also represent the areas where proactive management for snail kite foraging habitat may be most beneficial.

- This information will be provided (in most years) several months prior to the beginning of the kite breeding season to allow land managers to avoid impacts to kite nesting through early planning by timing proposed treatments in these areas to avoid critical periods for kites.
- The extent of these areas will generally not change dramatically from year-to-year.
- Management actions do not have to be excluded from these areas during the entire nesting season, but surveys for kite nesting activity should be conducted prior to working in these areas during the kite nesting season, and avoiding work in these areas during the breeding season is recommended whenever possible.
- There is good potential for kite nesting to occur outside of these areas, and resource managers should always look for evidence of snail kites and kite breeding activity prior to conducting management actions.

MANAGING FOR SNAIL KITE HABITAT

Active management of wetlands to benefit snail kites has not been regularly conducted. However, there are several actions and considerations that resource managers can adopt that may benefit snail kites.

- Foraging habitat – maintaining Florida apple snail populations, and the vegetation types that support healthy Florida apple snail populations is critically important to maintaining snail kite habitat. Not all areas where there are abundant apple snails support snail kite nesting, but most of these areas provide foraging habitat for snail kites at some time.
  - Shallow wetlands with emergent vegetation such as spike rush, bulrush, and other native emergent wetland plant species provide good snail kite foraging habitat as long as the vegetation is not so dense that kites would have difficulty locating apple snails. The specific conditions and vegetation species that provide good snail kite foraging habitat vary depending on the specific conditions of each wetland (lake or marsh, variability in water depths, soil characteristics, etc.).
  - Control of exotic and invasive plant species such as water hyacinth and water lettuce may be necessary to maintain the open character of vegetation within kite foraging habitat.
  - Non-native species of apple snails may provide forage for snail kites. However, initial evidence suggests that these species are not consistent with maintaining sustainable wetland communities. Maintaining a healthy population of Florida's native apple snail, and working to control non-native snail species is a more sustainable management strategy.
- Nesting habitat – kites are not particularly discriminating about their nest sites, and they may nest in a wide variety of substrates and situations. However, kite nests are generally most successful in low woody species such as willow, buttonbush, pond apple, and other wetland shrubs that remain inundated for the entire nesting period, and efforts to maintain or produce favorable nesting sites may help maintain kite nesting.
  - Planting woody wetland species in areas that support snail kite foraging habitat and do not dry out completely during the kite breeding season may facilitate snail kite nesting and nest success. Any planted woody vegetation should be managed for long-term persistence.

  - Nests that occur in dense cattails, bulrush, and other herbaceous species are more vulnerable to collapse than those in woody substrates.
  - Potential nesting areas that dry out during the nesting period are vulnerable to land-based predators such as raccoons.
  - Nesting areas are almost always located within areas of good foraging habitat.
  - Invasive and exotic woody vegetation may be used by snail kites as nesting substrate, but these species are not components of sustainable snail kite habitat. Controlling invasive and exotic woody vegetation outside of snail kite nesting season, and replanting with native wetland woody plant species where needed will be a more effective long-term strategy for managing snail kite nesting habitat.
- Managing hydroperiod – Changes in water regimes and depth and duration of inundation are important characteristics for wetland vegetation that supports snail kite nesting and foraging habitat, Florida apple snails, and all aspects of snail kite and apple snail life history.
  - Continuous inundation and stabilized water levels for long periods will probably result in unfavorable vegetation conditions.
  - Long periods of drying (> 1-2 months) will detrimentally affect Florida apple snail populations, and reduce the likelihood of use by snail kites. However, occasional drying for shorter periods may be beneficial.
  - Rapid changes and large changes in the depth of water within wetlands have the potential to detrimentally affect kite nesting and apple snail populations.
    - Rapid and/or large drops in water level increase the risk of snail kite nest predation by drying out the substrate beneath nests and allowing land-based predators to access nests.
    - Rapid and/or large increases in water depth may detrimentally affect desirable vegetation, and can flood out Florida apple snail eggs, leading to reductions in apple snail populations and reduced snail kite foraging.

COMMENTS, FEEDBACK, AND NEW INFORMATION

We always request feedback, new information, and recommendations for improving guidelines and snail kite management from resource managers and on-the-ground crews.

- We request that individuals report snail kite nesting activity outside of documented nesting areas.
- We welcome questions about managing snail kites, snail kite habitat, and apple snail populations.
- Additional information about snail kites and their habitat can be found at the Service's South Florida Ecological Services Office web site at: http://www.fws.gov/verobeach/index.htm
- Questions, comments, and inquiries can be directed to Tylan Dean by e-mailing: Tylan_Dean@fws.gov, or by calling (772) 562-3909, extension 284.

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Rodgers, J.A. Jr. and S.T. Schwikert. 2003. Buffer zone distances to protect foraging and loafing waterbirds from disturbance by airboats in Florida. Waterbirds 26(4):437-443.

Sykes, P.W. Jr. 1987. The feeding habits of the snail kite in Florida, USA. Colonial Waterbirds 10(1):84-92.