United States Department of the Interior

FISH AND WILDLIFE SERVICE
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Project: Modified Water Deliveries; Tamiami Trail
County: Miami-Dade

Dear Colonel Pantano:

The U.S. Fish and Wildlife Service (Service) has reviewed your letter, received by this office on October 15, 2010, requesting reinitiation of formal consultation on the Tamiami Trail (U.S. Highway 41, hereafter the Trail) portion of the Modified Water Deliveries to Everglades National Park (ENP) project, and its effects on the wood stork (*Mycteria americana*) and Florida panther (*Puma concolor coryi*). The following amendment to the June 25, 2008, Biological Opinion is provided in accordance with section 7 of the Endangered Species Act of 1973, as amended (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).

The purpose of this amendment is two-fold: First, it serves to update the status, environmental baseline, and cumulative effects for the Florida panther from the June 25, 2008, Biological Opinion submitted by this office. Secondly, it provides an analysis of the effects of the action on the wood stork given new information about a new colony in the middle of the project area. Determinations for all of the other threatened or endangered species in the project area remain the same as stated in the previous opinion. Likewise, any agreements for the protection of threatened or endangered species in the previous opinion are still valid and should be adhered to by the U.S. Army Corps of Engineers (Corps) and its contractors.

PROJECT DESCRIPTION

As evaluated in the previous Biological Opinion (Service 2008b), this project consists of constructing a 1-mile eastern bridge and raising the remaining US Highway 41 roadway to

support an 8.5-ft National Geodetic Vertical Datum stage in the L-29 Canal. The endangered wood stork, as well as other State listed wading birds use suitable habitat throughout the project area. Two well documented annual 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, inset). The 1-mile bridge is to 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 the remaining portions of the roadway however, would impinge into the disturbance zones for these two colonies. Conditions for these two areas have not changed.

However, as a direct result of having qualified avian observers on site, the Corps' contractor (Kiewit Southern), identified and alerted the Corps, Service, and Everglades National Park (ENP) staff to a previously undefined colony located directly in the middle and just south of the 1-mile bridge construction site. This report was later verified by researchers at ENP who frequently conduct aerial surveys of wading bird colonies in the area. Based on numerous discussions with researchers, other biological staff at ENP and the Corps, and through aerial photograph interpretation, the Service identified this colony as East-2 and issued updated zones and construction guidance to minimize impacts to this nesting colony (see Service 2010a).

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 of the project footprint. This project represents the completion of the critical first step in integrating Water Conservation Area (WCA) 3A, 3B, and Northeast Shark River Slough (NESRS) back into the historical Everglades flow way. 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 (*Rosthamus sociabilis plumbeus*) 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 Cape Sable seaside sparrow (CSSS) habitat located in the western Shark River Slough (SRS) (Pimm et al. 2002). Redistributing water to the east is the cornerstone of Everglades restoration (Curnutt et al. 1998; Corps 1999; Ogden 2007; Sustainable Ecosystems Institute [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). The Modified Water Deliveries to ENP Project (MWD), including the Tamiami Trail portion is 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, white ibis, great egrets and tricolor herons (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 which would improve the quality and quantity of forage fish that support wood stork nesting colonies in both their current and 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 2006c; Elderd and Nott 2007). Subpopulation A, located in Northwest SRS 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 2006c; Eldred and Nott 2007). This area once supported nearly half of the total sparrow population from 1981 to 1992 (Service 1999a, 2002, 2006c; 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 recently when, in 2008, a fire started near subpopulation F and burned roughly 30,000 acres of prairie and slough habitat in NESRS. This fire consumed roughly the entire habitat in subpopulation F and 20 percent of the habitat in Subpopulation E, neither of which will be suitable sparrow habitat for at least 2 years (La Puma et al. 2007). 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 the habitat of the 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 2006c). This condition is believed to have reduced suitable nesting substrate and foraging habitat. 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 to 2001 and 2007 to 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, completion of the MWD Project and the Tamiami Trail Modification: Next Steps Project are critical steps towards advancing the Comprehensive Everglades Restoration Plan (CERP) in this part of the system, and the best available science suggests that the CERP 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 that 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 to 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

As analyzed in the original Biological Opinion dated January 12, 2006, (and later amended on June 25, 2008), and incorporated herein by reference, the Corps made determinations that the project “may affect, but is not likely to adversely affect” the wood stork and “may adversely affect” the Florida panther. The Service analyzed the impacts to the Florida panther and required the Corps to mitigate for the permanent loss of 9.28 acres of panther primary zone habitat by restoring 10 acres in the 8.5 Square Mile Area. This conclusion remains the same in this

amendment. The Service also concurred with the Corps' determination regarding wood storks since disturbance would be minimized by the Corps' agreement 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" (Service 2004). The Corps agreed to implement the primary and secondary zone restrictions for the Tamiami West and East colonies; however, new information surfaced regarding the location of a previously unidentified wood stork colony (East-2) within the project area (Figure 2).

On February 25, 2010, the Service provided an amendment to the Biological Opinion which delineated the appropriate primary and secondary zone boundaries for the Tamiami East-2 colony and provided guidance on the type of construction activities allowed within the zones. Following a year of construction activities governed by these restrictions (the 2010 nesting season), it has become evident that construction of the central portion of the 1-mile bridge (area directly north of the Tamiami East-2 colony) cannot be completed unless work is allowed in this section during the nesting season. In the Corps' letter dated October 15, 2010, the effects determination for the wood stork is changed to a "may affect, and is likely to adversely affect" due to the potential for harm of nesting wood storks in the Tamiami East-2 colony. This amendment reviews current information regarding the East-2 colony and provides incidental take for storks in this colony harmed or harassed due to construction activities immediately north of the colony. All zones and restrictions previously identified for the Tamiami West and Tamiami East colonies are still valid and should be adhered to by the Corps and their construction contractors.

STATUS OF THE SPECIES AND CRITICAL HABITAT RANGEWIDE

Wood Stork

Federal Status

The wood stork was listed under the Act as endangered on February 28, 1984 (49 FR 7332). Critical habitat has not been designated for the wood stork.

Species Description

The wood stork is a large, long-legged wading bird, with a head to tail length of 85 to 115 centimeters (cm) (33 to 45 inches) and a wingspan of 150 to 165 cm (59 to 65 inches) (Coulter et al. 1999). The plumage is white, except for iridescent black primary and secondary wing feathers and a short black tail. Wood storks fly with their neck and legs extended. On adults, the rough scaly skin of the head and neck is unfeathered and blackish in color, the legs are dark, and the feet are dull pink. The bill color is also blackish. During courtship and the early nesting season, adults have pale salmon coloring under the wings, fluffy undertail coverts that are longer than the tail, and their toes are bright pink. Immature wood storks, up to the age of about 3 years, have yellowish or straw-colored bills and varying amounts of dusky feathering on the head and neck (Coulter et al. 1999).

Status and Distribution

The wood stork is found from northern Argentina, eastern Peru and western Ecuador north to Central America, Mexico, Cuba, Hispaniola, and the southeastern United States (AOU 1983). Only the population segment that breeds in the southeastern United States is listed as endangered. In the United States, wood storks were historically known to nest in all coastal states from Texas to South Carolina (Wayne 1910; Bent 1926; Howell 1932; Oberholser 1938; Dusi and Dusi 1968; Cone and Hall 1970; Oberholser and Kincaid 1974). Dahl (1990) estimates these states lost about 38 million acres, or 45.6 percent, of their historic wetlands between the 1780s and the 1980s. However, it is important to note wetlands and wetland losses are not evenly distributed in the landscape. Hefner et al. (1994) estimated 55 percent of the 2.3 million acres of the wetlands lost in the southeastern United States between the mid-1970s and mid-1980s were located in the Gulf-Atlantic Coastal Flats. These wetlands were strongly preferred by wood storks as nesting habitat. Currently, wood stork nesting is known to occur in Florida, Georgia, South Carolina, and North Carolina. Breeding colonies of wood storks are currently documented in all southern Florida counties, except for Okeechobee County. Additional expansion of the breeding range of wood storks in the southeastern United States may continue in coming years, both to the north and possibly to the west along the Gulf Coast (Service 2007a).

The decline that led to listing in the United States population of the wood storks is thought to be related to one or more of the following factors: (1) reduction in the number of available nesting sites; (2) lack of protection at nesting sites; and (3) loss of an adequate food base during the nesting season (Ogden and Nesbitt 1979). Ogden and Nesbitt (1979) indicate a reduction in nesting sites is not the cause in the population decline, because the number of nesting sites used from year-to-year is relatively stable. They suggest loss of an adequate food base is a cause of wood stork declines. Ogden and Nesbitt (1979) also suggest that changes in remaining wetland systems in Florida, including drainage and impoundment, may be a larger concern for wood storks than loss of foraging habitat.

The primary causes of the wood stork population decline in the United States are loss of wetland habitats and loss of wetland function resulting in reduced prey availability. Almost any shallow wetland depression where fish become concentrated, through either local reproduction or receding water levels, may be used as feeding habitat by the wood stork during some portion of the year, but only a small portion of the available wetlands support foraging conditions (high prey density and favorable vegetation structure) that storks need to maintain growing nestlings. Browder et al. (1976) and Browder (1978) documented the distribution and the total acreage of wetland types occurring south of Lake Okeechobee, Florida, for the period from 1900 through 1973. We combined their data for habitat types known to be important foraging habitat for wood storks (cypress domes and strands, wet prairies, scrub cypress, freshwater marshes and sloughs, and sawgrass marshes) and found these south Florida wetland habitat types have been reduced by about 35 percent since 1900.

The alteration of wetlands and the manipulation of wetland hydroperiods to suit human needs have also reduced the amount of habitat available to wood storks. The decrease in wood storks nesting on Cape Sable was related to the construction of the drainage canals during the 1920s

(Kushlan and Frohring 1986). Water level manipulation may decrease food production if the water levels and length of inundation do not match the breeding requirements of forage fish. Dry-downs of wetlands may selectively reduce the abundance of the larger forage fish species that wood storks tend to utilize, while still supporting smaller prey fish. Water level manipulation can also facilitate raccoon predation of wood stork nests when water is kept too low (alligators deter raccoon predation when water levels are high). Artificially high water levels may retard nest tree regeneration since many wetland tree species require periodic droughts to establish seedlings.

During the 1970s and 1980s, wood storks have also been observed to shift their nest sites to artificial impoundments or islands created by dredging activities (Ogden 1991). The percentage of nests in artificial habitats in central and north Florida increased from about 10 percent of all nesting pairs during 1959-1960 to 60-82 percent during 1976-1986 (Ogden 1991). Nest trees in these artificially impounded sites often include exotic species such as Brazilian pepper (*Schinus terebinthifolius)* or Australian pine (*Casuarina equisetifolia*). Ogden (1996) has suggested the use of these artificial wetlands indicates wood storks are not finding suitable conditions within natural nesting habitat or they are finding better conditions at the artificial wetlands. The long-term effect of these nesting areas on wood stork populations is unclear.

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

The role of chemical contamination in the decline of the wood stork is unclear. Pesticide levels high enough to cause eggshell thinning have been reported in wood storks, but decreased production has not yet been linked to chemical contamination (Ohlendorf et al. 1978; Fleming et al. 1982). Burger et al. (1993) studied heavy metal and selenium levels in wood storks from Florida and Costa Rica. Adult birds generally exhibited higher levels of contaminants than young birds. The authors attribute this to bioaccumulation in the adults who may be picking up contaminants at the colony nesting site and while foraging at other locations during the non-breeding season. There were higher levels of mercury in young birds from Florida than young birds or adults from Costa Rica. Young birds from Florida also exhibited higher levels of cadmium and lead than young birds from Costa Rica. The authors recommended the lead levels in Florida be monitored. Burger et al. (1993) drew no conclusions about the potential health effects to wood storks.

Prey and Foraging

Wood storks feed almost entirely on fish between 1 to 10 in (2.54 to 25.4 cm) in total length (Kahl 1964; Ogden et al. 1976; Coulter 1987). Depkin et al. (1992) studied the diets of wood storks at nesting colonies in east-central Georgia, and observed that fish constitute 92 percent of all individual prey items and 93 percent of the diet biomass. The availability of fish to the wood stork may be more a function of the productivity of each wetland rather than the immigration of fish from other adjacent wetlands. Carlson and Duever (1979) noted in their study that long distance movement of fish into deeper habitats is not a regular occurrence in the Big Cypress

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

The diet of wood storks may also include crustaceans, amphibians, reptiles, mammals, birds, and arthropods. Depkin et al. (1992) found crayfish to represent 1 percent of the prey item biomass and 1.9 percent of the prey items in the wood stork's diet. Bryan and Gariboldi (1998) also noted a similar frequency of occurrence of crayfish in diet of wood storks, and Lauritsen (2007) observed wood storks foraging on crayfish at the Corkscrew Swamp Sanctuary. Other studies of the wood stork provide little information regarding the consumption of invertebrates (Ogden et al 1976; Coulter et al. 1999; Carlson and Duever 1979; Turner et al. 1999; Trexler et al. 2002). Ogden et al. (1976) summarized information from Kahl's publications (1962, 1964) on stomach contents of wood storks sampled in south Florida and southwest Florida and noted that all individuals examined contained only fish. Ogden et al. (1976) study also noted that the prey consumed were fish, although the average density of prawns was 2.5 times the density of the most abundant fish.

To catch prey items, wood storks generally employ a specialized feeding method called tactilocation, or grope feeding. This type of feeding consists of wading through the water with the beak immersed and open about 7 to 8 cm (2.5 to 3.5 inches) in width. When the wood stork encounters prey within its bill, the mandibles snap shut capturing the prey item, the head is raised, and the food is swallowed (Kahl 1964). Wood storks have also been reported to forage visually under some conditions (Kushlan 1979). In addition, wood storks have been observed to stir the water with their feet in an attempt to startle hiding prey (Rand 1956; Kahl 1964; Kushlan 1979). This foraging method allows them to forage effectively in turbid waters, at night, and under other conditions when other wading birds that employ visual foraging may not be able to forage successfully. Wood storks forage in a wide variety of wetland types. Wetland habitat types used for foraging include freshwater marshes, ponds, hardwood and cypress swamps, narrow tidal creeks or shallow tidal pools, and artificial wetlands such as stock ponds, shallow and seasonally flooded roadside or agricultural ditches, and managed impoundments (Coulter and Bryan 1993; Coulter et al. 1999). Optimal foraging habitat consists of shallow-water wetlands (2 to 16 in [5 to 40 cm] in depth) that are sparsely vegetated (Ogden et al. 1978; Browder 1984; Coulter 1987; Coulter and Bryan 1993).

Hydrological patterns of wetlands in south Florida affect wood stork foraging. The annual hydrological pattern of wetland systems consists of water levels rising and peaking during the wet season (June to November) when the majority of the yearly total precipitation occurs, and gradually receding during the dry season (December to May). Shallow water levels within wetlands concentrate prey items (*i.e.*, fish) as they dry out and this is of particular importance during the wood stork nesting season (Kahl 1964). Therefore, a wetland site in south Florida may only provide suitable foraging conditions during part of the year when the water level has

receded sufficiently to allow access and concentrate prey items. Consequently, during the nesting season there is a general progression in the suitability of wetlands for foraging based on their hydroperiods, with short hydroperiod wetlands used early in the season, mid-range hydroperiod wetlands used during the middle of the nesting season, and long hydroperiod wetlands used during the later part of the nesting season (Kahl 1964; Gawlik 2002).

Several other factors affect the suitability of foraging habitats for wood storks. Suitable foraging habitats must provide a sufficient density and biomass of forage fish or other prey species, and have vegetation characteristics that allow storks to locate and capture prey. Wetlands that contain deep water may not be accessible to wood storks for foraging. Conversely, wetlands with too little water may not provide adequate habitat for fish or other prey species. Longer hydroperiod wetlands are generally observed to support more fish and larger fish than shorter hydroperiod wetlands (Loftus and Ecklund 1994; Jordan et al. 1997 and 1998; Turner et al. 1999; Trexler et al. 2002). In addition, nutrient enrichment (primarily phosphorus) within the oligotrophic Everglades wetlands generally results in increased density and biomass of fish in potential stork foraging sites (Rehage and Trexler 2006). Distances from dry-season refugia, such as canals, alligator holes, and similar long hydroperiod sites, may also affect fish density and biomass in southern Florida. However, across the highly modified landscape of southern Florida, fish availability varies with respect to hydrologic gradients and nutrient availability gradients and it becomes very difficult to predict fish density. The foraging habitat for most wood stork colonies within southern Florida includes a wide variety of hydroperiod classes, nutrient conditions, and spatial variability.

Dense submerged and emergent vegetation may reduce foraging suitability by preventing storks from moving through the habitat and interfering with prey detection (Coulter and Bryan 1993). Wood storks tend to select foraging areas that have an open canopy, but occasionally use sites with 50 to 100 percent canopy closure (Coulter and Bryan 1993; O'Hare and Dalrymple 1997; Coulter et al. 1999). Densely forested wetlands may preclude storks from foraging (Coulter and Bryan 1993). However, the presence of minor to moderate amounts of submerged and emergent vegetation does not seem to detrimentally affect stork foraging and may be important to maintaining fish populations. Submergent and emergent vegetation cover at foraging sites at a Georgia nesting colony averaged 26 and 29 percent, respectively, but ranged from 0 to 100 percent (Coulter and Bryan 1993). These cover values did not differ significantly from random wetland sites.

During nesting, foraging areas must be sufficiently close to the colony to allow wood storks to efficiently capture prey and deliver prey to nestlings. In Georgia, wood storks generally forage in wetlands within 50 km (31 miles) of the colony site (Bryan and Coulter 1987), but forage most frequently within 20 km (12 miles) of the colony (Coulter and Bryan 1993). Herring (2007) noted similar foraging patterns for wood storks in south Florida with most frequent foraging within 10.29 km (6.4 miles). Maintaining this wide range of feeding site options ensures sufficient wetlands of all sizes and varying hydroperiods are available to support wood storks during shifts in seasonal and annual rainfall and surface water patterns. Storks forage the greatest distances from the colony at the beginning of the nesting season, before eggs are laid, and near the end of the season when the young are large. Wood storks feed nearest the colony

during incubation (Browder 1984; Mitchell 1999). In south Florida, wood storks generally use wet prairie ponds early in the dry season and shift to slough ponds later in the dry season following receding water levels (Browder 1984).

Gawlik (2002) characterized wood storks foraging in the Everglades as "searchers" that employ a foraging strategy of seeking out areas of high-density prey and optimal (shallow) water depths, and abandoning foraging sites when prey density begins to decrease below a particular efficiency threshold. The wood storks' choice of foraging sites in the Everglades was significantly related to both prey density and water depth (Gawlik 2002). Based on this strategy, wood stork foraging opportunities are more constrained than many other wading bird species (Gawlik 2002).

Nesting and Reproduction

Wood stork nesting habitat consists of a variety of wooded habitat types including mangroves, cypress (as tall as 30.5 meters [100 ft]), and various other live or dead shrubs or trees located in standing water (swamps) or on islands surrounded by relatively broad expanses of open water (Palmer 1962; Rodgers et al. 1987; Ogden 1991; Coulter et al. 1999). Wood storks nest colonially, often in conjunction with other wading bird species, and generally occupy the large-diameter trees at a colony site (Rodgers et al. 1996). The same colony site will be used for many years as long as the colony is undisturbed and sufficient feeding habitat remains in surrounding wetlands. However, not all storks nesting in a colony will return to the same site in subsequent years (Kushlan and Frohring 1986). Natural wetland nesting sites may be abandoned if surface water is removed from beneath the trees during the nesting season (Rodgers et al. 1996). In response to this type of change to nest site hydrology, wood storks may abandon that site and establish a breeding colony in managed or impounded wetlands (Ogden 1991). Wood storks that abandon a colony early in the nesting season due to unsuitable hydrological conditions may re-nest in other nearby areas (Borkhataria et al. 2004; Crozier and Cook 2004). Between breeding seasons or while foraging wood storks may roost in trees over dry ground, on levees, or on large patches of open ground. Wood storks may also roost within wetlands while foraging far from nest sites and outside of the breeding season (Gawlik 2002). The majority of wood stork nesting generally occurs within a core of established rookeries that are used annually. However, each year a few new nesting colonies may be established or abandoned (Meyer and Frederick 2004). Abandoned nesting colonies may remain inactive permanently (Meyer and Frederick 2004). The establishment or abandonment of colony sites is likely related to the environmental conditions at the site (*e.g.*, prey availability, water levels, etc.) that make site conducive to successful nesting (Meyer and Frederick 2004).

Breeding wood storks are believed to form new pair bonds every breeding season. Wood storks have been documented to breed as young as 3 to 4 years of age. A single clutch of two to five (average three) eggs is laid per breeding season, but a second clutch may be laid if a nest failure occurs early in the breeding season (Coulter et al. 1999). Eggs are laid as early as October in south Florida and as late as June in north Florida (Rodgers 1990). Yearly variation in clutch size has been observed and may be related to habitat conditions at the time of laying. The incubation period for the wood stork egg is about 30 days. Egg laying, and subsequently hatching, is

staggered resulting in the nestlings varying in size (Coulter et al. 1999). The younger and smaller nestlings are first to die when food is scarce.

The young fledge in about 8 weeks, but will stay at the nest for 3 to 4 more weeks to be fed. Adults feed the young by regurgitating whole fish into the bottom of the nest about 3 to 10 times per day. Feedings are more frequent when the birds are young (Coulter et al. 1999), and less frequent when wood storks are forced to fly great distances to locate food (Bryan et al. 1995). The total nesting period, from courtship and nest building through independence of young, lasts about 100 to 120 days (Coulter et al. 1999). Nest initiation may be asynchronous within the colony. Adults and independent young may continue to forage around the colony site for a relatively short period following the completion of breeding.

Considerable variation in annual wood stork production may occur in response to local habitat conditions and food availability (Holt 1929; Kahl 1964; Ogden et al. 1978; Clark 1978; Ehrhart 1979; Hopkins and Humphries 1983; Rodgers and Schwikert 1997). Rodgers and Schwikert (1997) documented breeding production of 21 north and central Florida wood stork colonies from 1981 through 1985, and observed an average of 1.29 fledglings per nest and 0.42 fledglings per egg, and survivorship probability from egg laying to fledgling of 42 percent. More recent studies (Rodgers et al. 2008; Bryan and Robinette 2008; Winn et al. 2008; Murphy and Coker 2008) have documented production rates similar to rates observed from the 1970s to the 1990s. Rodgers et al. (2008) reported a combined production rate for 21 north and central Florida colonies from 2003 to 2005 of 1.19$\pm$ 0.09 fledglings per nest attempt (n=4,855 nests). Bryan and Robinette (2008) reported rates of 2.3 and 1.6 fledged young per nesting attempt for South Carolina and Georgia in 2004 and 2005. Murphy and Coker (2008) reported, since listing, South Carolina colonies averaged 2.08 young per successful nest (range 1.72 to 2.73). The Palm Beach County (PBC) Solid Waste Authority colony (Morrison 2008) documented 0.86-fledglings per nesting attempt (2003 to 2008) with annual rates ranging from 0.25 to 1.49.

During nesting wood storks are dependent on consistent foraging opportunities with the greatest energy demands occurring during the middle of the nestling period (*i.e.,* when nestlings are 23 to 45 days old) (Kahl 1964). The average wood stork family requires 201 kg (443 pounds [lbs]) of fish during the breeding season, with 50 percent of the nestling stork's food requirement occurring during the middle third of the nestling period (Kahl 1964). As discussed, receding water levels are necessary in south Florida to concentrate suitable densities of forage fish for wood storks (Kahl 1964; Kushlan et al. 1975).

Short hydroperiod wetlands in south Florida are an important source of forage for wood storks during pre-nesting activities (Flemming et al. 1994; Ceilley and Bortone 2000) and immediately following hatching. As discussed, short hydroperiod wetlands are accessible to wood storks due to their lower water levels. Based on Kahl's (1964) estimate that 201 kg of forage are required for successful nesting, about 50 kg are needed to meet the foraging needs of the adults and nestlings in the first third of the nesting cycle. Large acreages of short hydroperiod wetlands are required to meet this need because short hydroperiod wetlands are known to produce fewer fish and lower fish biomass per unit area than long hydroperiod wetlands. Loftus and Eklund (1994) estimated 50 fish per square meter for long hydroperiod wetlands and 10 fish per square meter for

short hydroperiod wetlands in the Everglades. The disproportionate reduction (85 percent) of this wetland type due to development and over drainage has been proposed as a major cause of late colony formation and survivorship reduction in early nestling survival rates (Fleming et al. 1994).

Following the completion of the nesting season, both adult and fledgling wood storks generally begin to disperse away from the nesting colony. Fledglings have relatively high mortality rates within the first 6 months following fledging, most likely because of their lack of experience, including the selection of poor foraging locations (Hylton et al. 2006). Post-fledging survival also appears to be variable among years, probably reflecting the environmental variability that affects storks and their ability to forage (Hylton et al. 2006).

In southern Florida, both adult and juvenile storks consistently disperse northward following fledging in what has been described as a mass exodus (Kahl 1964). Storks in central Florida also appear to move northward following the completion of breeding, but generally do not move as far (Coulter et al. 1999). Many of the juvenile storks from southern Florida move far beyond Florida into Georgia, Alabama, Mississippi, and South Carolina (Coulter et al. 1999; Borkhataria et al. 2004; Borkhataria et al. 2006). Some flocks of juvenile storks have also been reported to move well beyond the breeding range of storks in the months following fledging (Kahl 1964). This post-breeding northward movement appears consistent across years.

Adult and juvenile storks return southward in the late fall and early winter months. Borkhataria et al. (2006) reported that nearly all radio-tagged wood storks in the southeastern United States moved into Florida near the beginning of the dry season, including all subadult storks that fledged from Florida and Georgia colonies. Adult storks that breed in Georgia remained in Florida until March, and then moved back to northern breeding colonies (Borkhataria et al. 2006). Overall, about 75 percent of all locations of radio-tagged wood storks occurred within Florida (Borkhataria et al. 2006). Range wide occurrence of wood storks in December, recorded during the 1995 to 2008 Audubon Society Christmas Bird Counts for the Southeast United States (Audubon 2008) suggests that the majority of the southeastern United States wood stork population occurs in central and southern Florida. Relative abundance of storks in this region was 10 to 100 times higher than in northern Florida and Georgia (Service 2007a). As a result of these general population-level movement patterns during the earlier period of the stork breeding season in southern Florida, the wetlands upon which nesting storks depend are also being heavily used by a significant portion of the southeastern United States wood stork population, including storks that breed in Georgia and the Carolinas, and subadult storks from throughout the stork's range. In addition, these same wetlands support a wide variety of other wading bird species (Gawlik 2002).

Population Dynamics

The United States breeding population of wood storks declined from an estimated 20,000 pairs in the 1930s to about 10,000 pairs by 1960 and a low of 2,500 pairs during a severe drought conditions in 1978 (49 FR 7332). The total number of nesting pairs in 1995 was 7,853 with 11 percent in South Carolina, 19 percent in Georgia, and 70 percent in Florida (Service 1997).

However, nesting data from 1981 to 2006 suggest that the wood stork population in the southeastern United States appears to be increasing (Figure 7). Population totals indicate that the stork population has reached its highest level since it was listed as endangered in 1984. More than 11,000 wood stork pairs nested within their breeding range in the southeastern United States in 2006 (Service 2007). The nesting and colony data (Figure 7) show increases in both the number of nests and the number of colonies, with the greatest increases in both nests and colonies in Georgia, South Carolina, and North Carolina. Recent data also show a decrease in the average size of colonies (Frederick and Meyer 2008). The Florida nesting population appears to fluctuate yearly and vary around a 3-year running average of 5,040 nests and 49 colonies annually (data through 2006). Total population and nest data are not available for 2007 and 2008 nesting years as all Florida colonies are not monitored from year to year (Bill Brooks, Service, 2009). All south Florida colonies have been continuously monitored since listing and south Florida nesting data show a significant drop in nesting pairs from 2,710 (2006) to 770 (2007), and 704 (2008) (Cook and Herring 2007; Cook and Kobza 2008). Researchers attribute this drop to the severe drought conditions present in south Florida during the nesting periods.

However, wood stork numbers appeared to increase in 2009. During 2009, Corkscrew Rookery produced 1,120 nests and 2,570 nestlings (Audubon 2009). Similar rebounds in nest production were recorded for other south Florida rookeries as well, with probably the largest number of nest starts since 2004 (Cook and Kobza 2009). Approximately 3,000 nest starts were estimated within colonies throughout the WCAs (District 2009). Data reported by Cook and Kobza (2009) noted approximately 6,452 nests in south Florida during the 2009 breeding season. Reports of breeding during 2009 from rookeries in north Florida and Georgia also noted record numbers of wood stork nests (Georgia Department of Natural Resources [GDNR] 2009; Bill Brooks, Service 2009).

A review of the historic data show that, since the 1960s, the wood stork population declined in southern Florida and increased in northern Florida, Georgia, and South Carolina (Ogden et al. 1987). The number of nesting pairs in the Everglades and Big Cypress ecosystems (southern Florida) declined from 8,500 pairs in 1961 to 969 pairs in 1995. During the same period, nesting pairs in Georgia increased from 4 to 1,501 and nesting pairs in South Carolina increased from 11 to 829 (Service 1997). The number of nesting pairs in northern and central Florida doubled between 1976 and 1986 (Ogden 1991). Although Ogden (1991) attributed this to an increase in the availability of altered wetland and artificial wetland nesting sites, the regional increase coincided with the northward shift of the wood stork breeding population center and the overall population decline in the southeastern United States.

Between 1958 and 1985, the wood stork breeding population center shifted north from Lake Okeechobee to Polk County, a distance of about 132 km (82 miles) (Ogden et al. 1987). The 1976 breeding season was the last year when more pairs nested in south Florida than in central and north Florida. Production is generally higher in central-north Florida than south Florida. Whereas the number of colonies in south Florida has remained relatively stable, the number of colonies in central and north Florida region continues to increase (Ogden et al. 1987). The increase in central-north Florida is associated with an increase in colony numbers and not colony

size. Colonies in the north are smaller than colonies in the south. Historically, colonies in the south were associated with extensive wetlands and food was abundant. The implication is that food resources may be limiting colony sizes in central-north Florida (Ogden et al. 1987). Ogden et al. (1987) suggested the population shift is the result of deteriorating feeding conditions in south Florida and better nesting success rates in central and north Florida that compound population growth in that area.

Wood stork nesting data for the southeast United States indicate that the wood stork nesting has reached its highest level since it was listed as endangered in 1984 (Service 2007a). In 2006, an estimated 11,232 wood stork pairs nested within their breeding range in the southeastern United States. Wood stork nesting was again recorded in North Carolina in 2006, 2007, and 2008 after it was first documented there in 2005. This suggests the northward expansion of wood stork nesting may be continuing. New colonies have been documented in recent years (2007 and 2008) including several in Florida and some colonies have become inactive. New colonies were also recorded in 2008 in Georgia and South Carolina (Bill Brooks, Service 2009). The total number of colonies has peaked at over 80 in 2006 (Service 2007a), which is the highest to date in any year. From 2001 through 2006, the number of colonies and nesting wood storks in Florida appears to fluctuate yearly and varies around a 3-year running average of 49 colonies and 5,040 nests annually (Service 2007a).

Wood stork nesting effort within the southeastern United States appears to be increasing. A total of 4,300 nesting pairs were documeted in 2007 and 5,900 nesting pairs were documented in 2009. Rangewide nesting data for 2009 is not currently available, but large numbers of wood storks were observed in North Florida (Bill Brooks, Service 2009) and Georgia rookeries during 2009 (GDNR 2009). Wood stork nesting within south Florida rookeries decreased significantly during 2007 (Cook and Herring 2007) and 2008 (Cook and Kobza 2008), most likely due to severe drought conditions experienced by the region. However, large numbers of wood storks nest were also observed to nest in south Florida rookeries during 2009 (Cook and Kobza 2009; District 2009; Bill Brooks, SERVICE 2009).

Analysis of the Species Likely to be Affected

The primary cause of wood stork population decline in the United States is loss of wetland habitats or loss of wetland function resulting in reduced prey availability. The alteration of wetlands and the manipulation of wetland hydroperiods to suit human needs have also reduced the amount of habitat available to wood storks and affected the prey base availability. The altered hydrology of the central and south Florida wetland systems has also fostered the invasion of these systems by the exotic plant species melaleuca (*Melaleuca quinquenervia*). This plant species produces a dense understory and closed canopy, limiting the suitability of these wetland systems to foraging by wood storks, although sufficient prey base may be present in the wetlands. Increasing human population has resulted in increasing impacts on native habitat and flora and fauna. Continuing threats to wood storks include habitat loss, habitat fragmentation, and human disturbance.

Critical habitat has not been designated for the wood stork; therefore, none would be affected.

Florida Panther

Federal Status

The Florida panther is the last subspecies of *Puma* (also known as mountain lion, cougar, panther, or catamount) still surviving in the eastern United States. Historically occurring throughout the southeastern United States (Young and Goldman 1946), today the panther is restricted to less than 5 percent of its historic range 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 Florida panthers had been restricted to peninsular Florida (Bangs 1899). By the late 1920s to mid 1930s, it was thought by many the Florida panther had been completely extirpated (Tinsley 1970). In 1935, Dave Newell, a Florida sportsman, hired Vince and Ernest Lee, Arizona houndsmen, to hunt for panthers in Florida. They killed eight in the Big Cypress Swamp (Newell 1935). Every survey conducted since then has confirmed that a breeding panther population occurs in southern Florida south of the Caloosahatchee River, and no survey since then has been able to confirm a panther population outside of southern Florida.

Attempts to eradicate panthers and a decline in panther prey (primarily white-tailed deer [*Odocoileus virginianus*]) resulted in a panther population threatened with extinction. Prior to 1949, panthers could be killed in Florida at any time of the year. In 1950, the Florida Game and Freshwater Fish Commission (now FWC) declared the panther a regulated game species due to concerns over declining numbers. The FWC removed panthers from the game animal list in 1958 and gave them complete legal protection. On March 11, 1967, the Service listed the panther as endangered (32 FR 4001) throughout its historic range, and these animals received Federal protection under the passage of the Act. In addition, the Florida Panther Act (Florida Statute 372.671), a 1978 Florida State law, made killing a panther a felony. The Florida panther is listed as endangered by the States of Florida, Georgia, Louisiana, and Mississippi.

Since the panther was designated as an endangered species prior to enactment of the Act, there was no formal listing package identifying threats to the species as currently required by section 4(a)(1) of the Act. However, the Florida Panther Recovery Plan, third revision, addressed the five factor threats analysis (Service 2006e, 2008a). Critical habitat has not been designated for the panther.

Taxonomy

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

Felis floridana had been used previously for a bobcat (*Lynx rufus*). The taxonomic classification of the *Felis concolor* group was revised and described by Nelson and Goldman (1929) and Young and Goldman (1946). These authors differentiated 30 subspecies using geographic and morphometric (measurement of forms) criteria and reassigned the Florida panther to 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*. The taxonomic classification of the puma is now considered to be *Puma concolor* (Wozencraft 1993), making the accepted name for the Florida panther *P. c. coryi*.

Culver et al. (2000) examined genetic diversity within and among the described subspecies of *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 (Service 2008a). The Florida panther remains listed as a subspecies and continues to receive protection pursuant to the Act.

Species Description

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

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

Three external characters – a right angle crook at the terminal end of the tail, a whorl of hair or cowlick in the middle of the back, and irregular, white flecking on the head, nape, and shoulders – not found in combination in other subspecies of *Puma* (Belden 1986), were commonly observed in Florida panthers through the mid-1990s. The kinked tail and cowlicks were considered manifestations of inbreeding (Seal 1994); whereas the white flecking was thought to be a result of scarring from tick bites (Maehr 1992; Wilkins et al. 1997). Four other abnormalities prevalent in the panther population prior to the mid-1990s were cryptorchidism

(one or two undescended testicles), low sperm quality, atrial septal defects (the opening between two atria in the heart fails to close normally during fetal development), and immune deficiencies; and these were 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 (Cunningham 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). Field surveys and more than 90,000 locations of radio-collared panthers recorded between 1981 and 2010 clearly define the panther's current breeding range. Reproduction is known only in the Big Cypress Swamp and Everglades physiographic region in Collier, Lee, Hendry, Miami-Dade, and Monroe Counties, south of the Caloosahatchee River (Belden et al. 1991). Although the breeding segment of the panther population occurs only in south Florida, panthers have been documented north of the Caloosahatchee River over 125 times since February 1972. This has been confirmed through field signs (*e.g.*, tracks, urine markers, scats), camera-trap photographs, seven highway mortalities, four radio-collared animals, two captured animals (one of which was radio-collared), and one skeleton. From 1972 through 2004, panthers have been confirmed in 11 counties (Flagler, Glades, Highlands, Hillsborough, Indian River, Okeechobee, Orange, Osceola, Polk, Sarasota, 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 panthers limited range and low densities may make the population count derived from track searches more accurate than in Utah. During 2 month-long investigations – one late in 1972 and

early 1973 and another in 1974 – funded by the World Wildlife Fund to determine if panthers still existed in Florida, McBride searched for signs of panthers in portions of south Florida. In 1972, McBride authenticated a road-killed male panther in Glades County and a female captured and released from a bobcat trap in Collier County (McBride 2005). In 1973, McBride captured one female in Glades County (Nowak and McBride 1974). Based on this preliminary evidence, Nowak and McBride (1974) estimated the "population from the Lake Okeechobee area southward to be about 20 or 30 individuals." In 1974, McBride found evidence of only two additional panthers in the Fakahatchee Strand and suggested that "there could be as few as 10 individual 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).

Using a population genetics approach, Culver et al. (2008) estimated that to reduce the microsatellite variation to that seen in the Florida panther, a very small bottleneck size of approximately 2 animals for several generations and a small effective population size in other generations would be necessary. Using demographic data from Yellowstone pumas, Culver et al. (2008) estimated the ratio of effective to census population size to be 0.315. Using this ratio, they determined that the census population size in the Florida panthers necessary to explain the loss of microsatellite variation was approximately 41 for the non-bottleneck generations and 6.2 for the two bottleneck generations.

More recently, McBride et al. (2008) and McBride (2010) reported minimum population counts (*i.e.*, number known alive) based on physical evidence (*e.g.*, tracks, urine markers, panther treed with hounds, trail-camera photos). They counted adult and subadult panthers but not kittens at the den. Three rules were used to distinguish individuals: (1) gender was determined by track size or stride length; (2) time (freshness) was determined by known events within the past 24 hours, such as wind or rain; and (3) distance between individual track sets. These rules were used as an exclusionary tool to avoid over-counting (McBride et al. 2008). The number of panthers detected and verified by physical evidence from 1981 to 1994 fluctuated between a high of 30 and a low of 19 adult and juvenile panthers, with the lowest point occurring in 1991 following the removal of 7 juveniles and 3 kittens to initiate a captive breeding program (McBride et al. 2008). In 1995, eight female pumas from Texas were released to address suspected deleterious effects of inbreeding. From 1996 to 2003, the panther population was increasing at a rate of 14 percent per year with 26.6 kittens being produced annually (Johnson et al. 2010). The effective population size (N_e) rose from 9.6 to 32.1, and N_e /N was 0.314 (Johnson et al. 2010). The population has tripled since 1995 (McBride et al. 2008, Johnson et al. 2010), reaching a high of 117 by 2007 (mortalities not subtracted) (McBride et al. 2008). The count for 2009 (mortalities not subtracted) was 113 (McBride 2010). The deterministic annual growth rate (λ) for pre-1995 panthers was 0.952 ± 0.026 (SE), suggestive of a shrinking population (Hostetler et al. 2009). The λ for the overall population now is 1.052 ± 0.023 suggestive of a growing population (Hostetler et al. 2009).

Maehr et al. (1991) provides an estimate of population density of 1 panther/27,520 acres (11,137 hectares [ha]) based on 17 concurrently radio-collared and 4 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 to 1990 to achieve a population estimate of 46 adult panthers for southwest Florida (excluding ENP, eastern Big Cypress National Preserve [BICY], and Glades and Highlands Counties). Beier et al. (2003), however, argued that this estimate of density, although "reasonably rigorous," could not be extrapolated to other areas because it was not known whether densities were comparable in those areas. Kautz et al. (2006) provided a density estimate of 1 panther/31,923 acres (12,919 ha) by dividing the panther count at that time (67) by the area within the Primary Zone. However, panther densities are variable across the landscape. Using an average of the 2007 to 2009 panther counts in the eight survey units of McBride et al. (2008) and Kautz et al. (2006) Primary Zone land within these survey units, density estimates range from a low of 1 panther/81,479 acres (32,974 ha) to a high of 1 panther/7,850 acres (3,177 ha).

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. 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).

Panther dens are usually located closer to upland hardwoods, pinelands, and mixed wet forests and farther from freshwater marsh-wet prairie (Benson et al. 2008). Most den sites are located in dense saw palmetto (*Serenoa repens*), shrubs, or vines (Maehr 1990; Shindle et al. 2003, Benson et al. 2008). Den sites are used for 6 to 8 weeks by female panthers and their litters from birth to weaning (Benson et al. 2008). 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: Benson et al. (2009) analyzed survival and cause-specific mortality of subadult and adult Florida panthers. They found that sex and age influenced panther survival, as females survived better than males, and older adults (≥10 years) survived poorly

compared with younger adults. Genetic ancestry strongly influenced annual survival of subadults and adults after introgression, as F_1 generation admixed panthers survived longer than pre-introgression panthers and non-F_1 admixed individuals (Benson et al. 2009).

Mortality records for uncollared panthers have been kept since February 13, 1972, and for radio-collared panthers since February 10, 1981. Through June 24, 2010, 280 mortalities have been documented (FWC 2010). Of the 280 total mortalities, 127 were radio-collared panthers that have died since 1981 (FWC 2010). Intraspecific aggression was the leading cause of mortality for radio-collared panthers, and was more common for males than females (Benson et al. 2009). Older-adult males had significantly higher and sub-adult males had marginally higher mortality due to intraspecific aggression than prime-adult males (Benson et al. 2009). Most intraspecific aggression occurs between male panthers; but, aggressive encounters between males and females have occurred, resulting in the death of the female. Defense of kittens and\or a kill is suspected in half (5 of 10) of the known instances through 2003 (Shindle et al. 2003).

Following intraspecific aggression, the greatest causes of mortality for radio-collared Florida panthers was from unknown causes, vehicles, and other (Benson et al. 2009). From February 13, 1972, through June 30, 2010, 152 radio-collared and uncollared Florida panthers were hit by vehicles (FWC 2010). Eight of the collisions were not fatal. The number of panther/vehicle collisions per year tracks very closely the annual panther count (McBride et al. 2008).

Female panthers are considered adult residents if they are older than 18 months, have established home ranges and bred (Maehr et al. 1991). Land et al. (2004) reported that 23 of 24 female panthers first captured as kittens survived to become residents and 18 (78.3 percent) produced litters; 1 female was too young to determine residency. Male panthers are considered adult residents if they are older than 3 years and have established a home range that overlaps with females. Thirty-one male panthers were captured as kittens and 12 (38.7 percent) of these cats survived to become residents (Jansen et al. 2005; FWC 2005). "Successful male recruitment appears to depend on the death or home range shift of a resident adult male" (Maehr et al. 1991). Turnover in the breeding population is low with documented mortality in radio-collared panthers being greatest in subadult and non-resident males (Maehr et al. 1991; Shindle et al. 2003). Den sites of female panthers have been visited since 1992 and the kittens tagged with passive integrated transponder chips. Annual survival of these kittens has been determined to be 0.328 ± 0.072 (SE) (Hostetler et al. 2009). There was no evidence that survival rate differed between male and female kittens or was influenced by litter size. Hostetler et al. (2009) found that kitten survival generally increased with degree of admixture with introduced Texas pumas and decreased with panther abundance. Kitten survival is lowest during the first 3 months of their lives (Hostetler et al. 2009).

Dispersal: Panther dispersal begins after a juvenile becomes independent from its mother and continues until it establishes a home range. Dispersal distances are greater for males (n = 18) than females (n = 9) (42.5 miles [68.4 km] verses 12.6 miles [20.3 km], respectively) and the maximum dispersal distance recorded for a young male was 139.2 miles (224.1 km) over a 7-month period followed by a secondary dispersal of 145 miles (233 km) (Maehr et al. 2002a). Males disperse an average distance of 25 miles (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 meters]), channelized river, probably is not a significant barrier to panther movements, but the combination of the river, State Road (SR) 80, and land uses along the river seems to have restricted panther dispersal northward (Maehr et al. 2002a). Documented physical evidence of at least 15 other uncollared male panthers have been confirmed north of the river since 1972, but no female panthers nor reproduction have been documented in this area since 1973 (Belden and McBride 2005).

Home Range Dynamics and Movements: Panthers require large areas to meet their needs. Numerous factors influence panther home range size, including: habitat quality, prey density, and landscape configuration (Belden 1988; Comiskey et al. 2002). Home range sizes of six radio-collared panthers monitored between 1985 and 1990 averaged 128,000 acres (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, 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 BICY (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. 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 miles (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 prey species are white-tailed deer and feral hog (*Sus scrofa*) (Maehr et al. 1990b; Dalrymple and Bass 1996). Generally, feral hogs constitute the greatest biomass consumed by panthers north of the Alligator Alley section of Interstate 75 (I-75), while white-tailed deer are the greatest biomass consumed to the south (Maehr et al. 1990b). Secondary prey species includes raccoons (*Procyon lotor*), nine-banded armadillos (*Dasypus novemcinctus*), marsh rabbits (*Sylvilagus palustris*) (Maehr et al. 1990b) and American alligators (*Alligator mississippiensis*) (Dalrymple and Bass 1996). No seasonal variation in diet has been detected. Maehr et al. (1990b) rarely observed domestic livestock in scats or kills of the Florida panther, although cattle were readily available in the study area.

Little information on the feeding frequency of the Florida panther is available. However, the feeding frequency of the Puma is likely similar to the feeding frequency of the Florida panther. Ackerman et al. (1986) reported that a resident adult male puma generally consumes one deer-sized prey every 8 to 11 days. Moreover, a female puma will consume one deer-sized prey item every 14 to 17 days for a resident female and one deer-sized prey item every 3.3 days for a female with three 13-month-old kittens.

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 since testing began in 1978. However, between November 2002 and February 2003, two panthers tested FeLV antigen positive (Cunningham 2005; Cunningham et al. 2008). The following year, three more cases were diagnosed (Brown et al. 2008). All infected panthers had overlapping home ranges in the Okaloacoochee Slough ecosystem. Three of the panthers died due to suspected FeLV-related diseases (opportunistic bacterial infections and anemia) and the two others died from intraspecific aggression. Testing of serum samples collected from 1990 to 2005 for antibodies (indicating exposure) to FeLV indicated increasing exposure to FeLV beginning in the late 1990s and concentrated north of I-75. There was apparently minimal exposure to FeLV during this period south of I-75. Positive antibody titers in different areas at different times may indicate that multiple introductions of the virus into the panther population may have occurred. These smaller epizootics were apparently self-limiting and did not result in any known mortalities. Positive antibody titers, in the absence of an active infection (antigen positive), indicate panthers can be exposed and overcome the infection (Cunningham 2005). Genetic analysis of the panther FeLV determined that the source of this outbreak was a cross-species transmission from a domestic cat (Brown et al. 2008). Management of the disease includes vaccination (Cunningham et al. 2008) as well as removal of infected panthers to captivity for quarantine and supportive care. As of June 1, 2005, about one-third of the population had received at least one vaccination against FeLV (Cunningham et al. 2008). No new positive cases have been diagnosed since July 2004; however, the potential for reintroduction of the virus remains (Cunningham et al. 2008).

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

Feline immunodeficiency virus (FIV) is a retrovirus of felids that is endemic in the panther population. About 28 percent of Florida panthers were positive for antibodies to the puma lentivirus strain of FIV (Olmstead et al. 1992); however, the prevalence may be increasing. Between November 2004 and April 2005, 13 of 17 (76 percent) panthers tested were positive (M.Cunningham, FWC, unpublished data). 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. 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 West Nile virus), 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; Foster et al. 2006). 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 and neonates may be more susceptible to the toxic effects of mercury (Berglund and Berlin 1969). Consistently high hair mercury values in ENP and FPNWR and the finding of elevated values in some portions of BICY 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 to 60,703 km^2) would be needed to support an effective population size of 50 individuals (equating to an actual adult population of 100 to 200 panthers [Ballou et al. 1989]). However, to provide for long-term persistence based on an effective population size of 500 individuals (equating to 1,000 to 2,000 adult panthers [Ballou et al. 1989]), could require as much as 156,251 to 234,376 mi^2 (404,687 to 607,031 km^2). This latter acreage corresponds to roughly 60 to 70 percent of the Florida panthers' historical range. Although it is uncertain, whether this much land is needed for panther recovery, it does provide some qualitative insight into the importance of habitat conservation across large landscapes for achieving a viable panther population (Noss and Cooperrider 1994).

Between 1981 and 2010 more than 90,000 locations were collected from more than 180 radio-collared panthers. Belden et al. (1988); Maehr et al. (1991); Maehr and Cox (1995); Maehr (1997); Kerkoff et al. (2000); Comiskey et al. (2002); Cox et al. (2006); Kautz et al. (2006) provide information on habitat use based on various subsets of these data. Since almost all locations from radio collars have been collected during daytime hours (generally 0700 to 1100) using very high frequency (VHF) aerial telemetry, and because panthers are most active during nocturnal and crepuscular periods (Maehr et al. 1990a), daytime telemetry data may be insufficient to describe habitat use patterns of nocturnal animals (Beyer and Haufler 1994; Comiskey et al. 2002; Beier et al. 2003; Dickson et al. 2005; Beier et al. 2006). However, Land et al. (2008), investigated habitat selection of 12 panthers in the northern portion of the breeding range using Global Positioning System (GPS) telemetry data collected during nocturnal and diurnal periods as well as VHF telemetry data collected only during diurnal periods and found that analysis of both types of telemetry data yielded similar results.

A landscape-level strategy for the conservation of the panther population in south Florida was developed using a Florida panther potential habitat model based on the following criteria: (1) forest patches greater than 4.95 acres (2 ha); (2) non-urban cover types within 656 ft (200 meters) of forest patches; and (3) exclusion of lands within 984 ft (300 meters) 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 (LCP)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) (Figures 5 and 6). The Primary Zone is currently occupied and supports the breeding population of panthers. The Secondary Zone could support resident panthers with sufficient restoration. Although panthers move through the Dispersal Zone, it is not currently occupied by resident panthers.

These zones vary in size, ownership, and land cover composition. The Primary Zone is 2,270,711 acres (918,928 ha) in size, 73 percent of which is publicly owned, and includes

portions of the BICY, 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. 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 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 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 (WMA), 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, 2009). Major

highways and urban or agricultural development isolate these habitat patches, and they are rapidly being lost to the same development that threatens southern Florida (Belden and McBride 2005).

Panther Habitat Use: Radio-collar data and ground tracking indicate that panthers use the mosaic of habitats available to them as resting and denning sites, hunting grounds, and travel routes. The majority of panther telemetry locations (Belden 1986; Belden et al. 1988; Maehr 1990; Maehr et al. 1991; Maehr 1992; Smith and Bass 1994; Kerkhoff et al. 2000; Comiskey et al. 2002, Cox et al. 2006, Kautz et al. 2006, Land et al. 2008) and natal den sites (Benson et al. 2008) were within or close to forested cover types, particularly cypress swamp, pinelands, hardwood swamp, and upland hardwood forests. Global Positioning System data has shown that panthers (n = 12) use all habitats contained within their home ranges by selecting for forested habitat types and using all others in proportion to availability (Land et al. 2008).

Kautz et al. (2006) found that the smallest class of forest patches (*i.e.*, 9 to 26 acres [3.6 to 10.4 ha]) were the highest ranked forest patch sizes within panther home ranges. The diverse woody flora of forest edges probably provides cover suitable for stalking and ambushing prey (Belden et al. 1988; Cox et al. 2006). Also, dense understory vegetation comprised of saw palmetto provides some of the most important resting and denning cover for panthers (Maehr 1990; Benson et al. 2008). Shindle et al. (2003) estimated that 73 percent of panther dens were in saw palmetto thickets.

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 BICY, based on Harlow (1959) deer density estimates of 1 per 210 acres (85 ha) in pine forest, 1 per 299 acres (121 ha) in swamps, 1 per 1,280 acres (518 ha) in prairie, 1 per 250 acres (101 ha) in marshes, and 1 per 111 acres (45 ha) in hammocks. Schortemeyer et al (1991) estimated deer densities at 1 per 49 to 247 acres (20 to100 ha) in three management units of BICY based on track counts and aerial surveys. Labisky et al. (1995) reported 1 per 9 acres (20 ha) in southeastern BICY. Using track counts alone, McCown (1994) estimated 1 per 183 to 225 acres (74 to 91 ha) on the FPNWR and 1 per 133 to 200 acres (54 to 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). However, the importance of these habitat types to panthers is dependent upon the availability of stalking and ambush cover.

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 landscape corridors for wide-ranging predators should be half the width of an average home range size. Following Harrison's (1992) suggestion, corridor widths for Florida panthers would range 6.1 to 10.9 miles (9.8 to17.6 km) depending on whether the target animal was an adult female or a transient male. Beier (1995) suggested that corridor widths for transient male puma in California could be as small as 30 percent of the average home range size of an adult. For Florida panthers, this would translate to a corridor width of 5.5 miles (8.8 km). Without supporting empirical evidence, Noss (1992) suggests that regional corridors connecting larger hubs of habitat should be at least 1.0 mile (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 mile (0.8 km) should be more than 328 ft (100 meters) wide, and corridors extending 0.6 to 4 miles (1 to 7 km) should be more than 1,312 ft (400 meters) wide. The Dispersal Zone encompasses 44 mi^2 (113 km^2) with a mean width of 3.4 miles (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 final third revision of the Florida Panther Recovery Plan (Service 2008a) 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 (Table 1, Figure 8), continued action is needed to obtain additions to and inholdings for public lands, assure linkages are maintained, restore degraded and fragmented habitat, and obtain the support of private landowners for maintaining property in a manner that is compatible with panther use. Conservation lands used by panthers are held and managed by a variety of entities including the Service, NPS, Seminole Tribes of Florida, Miccosukee Tribe of Indians of Florida, FWC, Florida Department of Environmental Protection (DEP), Florida Division of Forestry (FDOF), Water Management Districts, non-governmental organizations, counties, and private landowners.

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

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

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

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

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

5. 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).

6. In 1985, acquisition of Picayune Strand State Forest and WMA began with the complex Golden Gate Estates (GGE) subdivision buyouts and now comprises over 76,160 acres (30,821 ha). The Southern GGE 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.

7. In 1989, FPNWR was established and now protects 26,240 acres (10,619 ha).

8. In 1989, 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).

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

10. 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 FDOF.

11. 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.

12. 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.

13. 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 (Kautz 2006). 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.

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. 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 (ORV) 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 BICY) is significantly less during the hunting season. Schortemeyer et al. (1991) examined the effects of deer hunting on panthers at BICY between 1983 and 1990. They concluded that, based on telemetry data, panthers may be altering their use patterns because 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 (BICY) 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).

Roads and Highways

Roads and highways facilitate the movement of people and goods by cars and trucks, and may adversely affect the Florida panther. The construction of new roads and the widening of existing roads can result in the direct loss of wildlife habitat (Fornan et al. 2003). Moreover, disturbance resulting from motorized vehicles may cause panthers to avoid busy roads. Maher (1990) reported that female panthers are less likely to cross busy highways. Consequently, roads may act as barriers affecting panther movement and fragmenting panther habitat. Panthers can also be injured or killed due to collisions with motorized vehicles when attempting to cross highways, and the potential for collisions increases as traffic increases. Adverse effects resulting from roads and highways represent a potential threat to the existing panther population.

Collisions with motor vehicles on highways appear to be a significant source of mortality for the Florida panther. As discussed above, the FWC documented 144 vehicle-related panther mortalities and 9 vehicle-related panther injuries from 1972 to the present on highways in south Florida. In portions of the panther's range the rate of panther vehicle-related mortalities may be increasing. Smith et al. (2006) found that vehicle-related panther mortalities in Collier County have increased by a factor of four from 2000 to the present compared to previous decades. This increase in panther mortality is likely related to the increase in traffic from Collier County's burgeoning population growth. Unfortunately, the effect of vehicle-related mortality on the existing panther population is largely unknown.

Wildlife underpasses, or crossings, can be constructed within highway corridors to reduce the potential for panther injuries and mortalities resulting from vehicle collisions. Underpasses allow panthers and other wildlife to safely cross under busy roadways, and maintain connectivity and gene flow within the panther population. Underpasses usually consist of a open-span bridge, prefabricated concrete box, or culvert (Fornan et al. 2003). Effective crossing structures are large enough to allow the passage of panthers and include adequate wing fencing to funnel panthers to the crossing site. Crossings should be designed so that panthers have an unobstructed view of habitat on the opposite side of the underpass (Foster and Humphrey, 1995). The status of lands adjacent to the crossing site should also be considered when determining the location of a crossing. Unprotected private lands adjacent to the crossing could be developed and render the crossing unviable. Accordingly, lands adjacent to crossings should be acquired or placed under a

conservation easement or other protective covenant to ensure the crossing will function in perpetuity.

A number of wildlife crossings with associated fencing have already been constructed within major roadways in southwest Florida to benefit the panther and other wildlife species. In the 1991, the Florida Department of Transportation (FDOT) constructed 28 wildlife crossings within I-75 corridor from U.S. Highway 27 to just west of Everglades Boulevard. A total of five vehicle-related panther mortalities were documented within this corridor prior to construction of the crossings. Following construction of the crossings a total of four vehicle-related panther mortality (all in 2009) were recorded in the corridor from 1991 to the present. For three of these mortalities, it appears that the panther had entered the I-75 right-of-way through the gaps in the fence at existing roadway intersections (*i.e.*, SR 29, Snake Road).

The FDOT has also constructed six wildlife crossings on SR 29 between Oil Well Road and US 41. Crossings A, B, C, and D are located north of I-75 and Crossings E and F are located south of I-75. Crossings A and B were constructed in 2007, Crossings C and D were constructed in 1995, Crossing E was constructed in 1997, and Crossing F was constructed in 1999. Prior to construction of the SR 29 Crossings, a total of 10 vehicle-related panther mortalities were recorded near the locations of Crossings A and B from 1980 through 2004, and 2 vehicle-related panther mortalities were recorded near the location of Crossings C and D from 1979 through 1990. Vehicle-related panther mortalities have not been recorded in the vicinity of Crossings A, B, C, or D following their installation. A total of 2 vehicle–related panther mortalities were documented within 3.5 miles of the location of Crossing E prior to construction, and vehicle-related panther mortalities were not observed within 2.5 miles of the location of Crossing F prior to construction. Following construction of Crossings E and F, a total of four vehicle-related panther mortalities have been reported within 3 miles of Crossing E, and two vehicle-related panther mortality has been documented within 1 mile of Crossing F. The observed increase in the number of vehicle-related panther mortalities following the construction of Crossings E and F may be related to the increase in the panther population within recent years.

The wildlife crossings described above represent a commendable effort by the FDOT to reduce panther deaths resulting from collisions with vehicles, however more crossings are needed within the major roadways of south Florida to significantly reduce this threat to the panther and other wildlife species (Smith et al. 2006). Accordingly, recent studies have been conducted to identify locations for wildlife crossings in south Florida. Swanson et al. (2005) used a LCP modeling approach to identify the most likely travel routes for panthers among six major use areas in southwest Florida. LCP modeling takes into consideration elements in the landscape that permit or impede panther movement when traveling. Swanson et al. (2005) identified 20 key highway segments where LCPs intersected improved roadways. Smith et al. (2006) studied the movements of the Florida panther, the Florida black bear, and other wildlife species along SR 29, County Road (CR) 846 and CR 858 in Collier County, Florida. Data analyzed in the study were obtained from roadkill and track surveys, infra-red camera monitoring stations, existing data provided by the FWC (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. County governments are also working with the Service to construct needed crossings for the panther. Collier County has committed to construct two wildlife crossings and associated fencing in association with the Oil Well Road widening project. These crossings will be located within the Oil Well Road (CR 858) corridor at 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 August 2003, concluded consultation on 41 projects involving the panther and habitat preservation (Table 1). The minimum expected result of these projects is impacts to 71,308 acres and the preservation of 14,179 acres of panther habitat. Of the 71,308 acres of impacts, 38,932 acres are due to agricultural conversion and 32,376 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 through the date of this Biological Opinion, the Service concluded consultations on 90 projects affecting 25,549 acres with preservation of 27,319 acres (Table 1). Following our refugia design assessment approach, the projects affected 12,825 acres in the Primary Zone, 7,507 acres in the Secondary Zone, and 4,516 acres in the Other Zone. Compensation provided included 24,574 acres in the Primary Zone, 272 acres in the Secondary Zone, 652 acres in the Dispersal Zone, and 1,646 acres in the Other Zone. The project-affected lands were primarily agricultural fields consisting of row crops and citrus groves and natural lands with varying degrees of exotic vegetation. Functional habitat value of these lands to the Florida panther, following our Panther Habitat Assessment methodology provided a PHU loss from development of 109,588 primary equivalent PHUs, with a corresponding PHU preservation and enhancement complement of 216,302 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).

Shaffer (1981) originally defined a viable population as follows, "a minimum viable population for any given species in any given habitat is the smallest isolated population having a 99 percent chance of remaining extant for 1,000 years despite the foreseeable effects of demographic, environmental and genetic stochasticity, and natural catastrophes." However, the goal of 95 percent probability of persistence for 100 years is the standard recommended by population biologists and is used in management strategies and conservation planning, particularly for situations where it is difficult to accurately predict 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 to 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 41 females represent the number of individual panthers documented in surveys by McBride (2001, 2002). While the 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 percent chance of breeding in a given year," and therefore only half of the 41 females were modeled as breeding each year. The primary reason the model (Root, 2004) assumed a 50 percent chance of breeding in a given year is that kittens stay with their mother from 15 to 24 months prior to dispersal, however, this assumption accounts for the likelihood some of the 41 females would not breed in a given year, including subadult status of some individuals. Fourth, the Service recognizes the McBride data is not intended to provide a total population estimate. Although the Service believes population estimates derived through field surveys are close to the actual population number, it is likely some individuals in the current panther population have not been documented. Finally, the Service notes 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 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 41 females (82 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 one 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 41 females (82 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 would still be subject to genetic problems.

The Service also believes the model runs show lands in the Primary Zone are important to the survival and recovery of the Florida panther and 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 landscape level program that through regulatory reviews and coordinated conservation efforts with landowners and resource management partners provides a mechanism to achieve this population threshold.

Model Violations: The actual likelihood of population declines and extinctions may be different than the guidelines and models suggest, depending upon the number of and severity of assumptions violated. The Service realizes habitat loss is occurring at an estimated 0.8 percent loss of habitat per year. 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 FeLV in the panther population at Okaloacoochee Slough as a potential catastrophe. The FWC is carefully monitoring the situation and it appears to be under control at this time due to a successful vaccination program. However, if the outbreak spreads into the population, the Service will consider this as a catastrophe and factor this into our decisions.

We acknowledge uncertainties exist, assumptions can be violated, and catastrophes can occur. The Service and 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 Objective

Although the Service supports Kautz et al.'s (2006) guideline 4 "that a population greater than 240 panthers have a high probability of persistence for 100 years and are demographically stable and large enough to retain 90 percent of original genetic diversity," we believe that for the southwest Florida population, Kautz et al.'s (2006) guideline 3 is a more appropriate threshold.

The support for this guideline is that there is an insufficient acreage of non-urban lands, based on Kautz et al.'s (2006) average density value of 31,923 acres per panther, available in southwest Florida south of the Caloosahatchee River for a panther population of this size. However, based on Kautz et al.'s (2006) average density value, sufficient lands are available for a population between 80 and 100 panthers. Although this size population does not meet the recovery goals in the Service's Florida Panther Recovery Plan (Service 2006e, 2008a), a population of this size, based on Kautz et al. (2006) evaluation, would provide a population that is likely stable but would still be subject to genetic problems and would meet the Service's Florida Panther Recovery Plan (Service 2006e, 2008a) objective (1), which is to 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.

The Service proposes to achieve this landscape scale effort 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. The acreages of lands necessary to achieve this landscape scale effort, based on Kautz et al. (a) average density of 31,923 acres (12,919 ha) per panther is 2,553,840 acres (1,033,520 ha) for 80 panthers or 3,192,300 acres (1,291,900 ha) for 100 panthers.

The principle regulatory mechanism that allows the Service to work directly with private landowners during review of development and land alteration projects is section 10 of the Act. The Service coordinates with Federal agencies pursuant to section 7 of the Act. In August 2000, the Service, to assist the Corps in assessing project effects to the Florida panther in accordance with their 7a(1) responsibilities under the Act, developed the Florida panther interim Standard Local Operating Procedures for Endangered Species (SLOPES) (Service 2000)(update in 2007) (Service 2007b). The document is available on the Corps, web site at: http://www.saj.usace.army.mil/regulatory/what/species/panther.htm

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 includes a consultation area map that identifies an action area where the Service believes 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 clarified the boundaries of the Map to better reflect areas where Florida panthers predominate (Figure 6) and refer to these areas cumulatively as the Panther Focus Area (Service 2007b). As part of this review, we also made revisions in coordination with the Corps to components in the SLOPES documents

that address actions that can be taken by the Service, Corps, and project applicants that may benefit panthers and minimize effects from proposed actions (Service 2007b).

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. These zones are defined as follows:

Primary Zone: The area that 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: These lands are contiguous with the Primary Zone and although they 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: A known corridor between the Panther Focus Area south of the Caloosahatchee River and the Panther Focus Area north of the Caloosahatchee River that may facilitate future panther expansion north of the Caloosahatchee River (Kautz et al. 2006). 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 documented using this zone.

Primary Dispersal/Expansion Area: This 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 population thresholds 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 meters) of forest patches; and (3) exclusion of lands within 984 ft (300 meters) of urban areas. The potential habitat map was reviewed in relation to telemetry data, recent satellite imagery (where available), and panther home range polygons. Boundaries were drawn around lands defined as the Primary Zone (Figures 5 and 6), 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 (Figures 5 and 6), 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 LCP 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. Those dispersal routes connecting lands between the Panther Focus Area south of the Caloosahatchee River and the Panther Focus Area north of the Caloosahatchee River, which may facilitate future panther expansion north of the Caloosahatchee River, were defined as the Dispersal Zone (Figures 5 and 6) (Kautz et al. 2006). 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 one panther per 31,923 acres (12,919 ha). In the following discussions of the number of panthers 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 landscape scale effort 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 midpoint (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. This equivalency factor is needed, since Secondary Zone lands are of less value than Primary Zone lands to the panther, to assure that additional acreage (special consideration) is required 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 2), 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 affect 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 categories 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, 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. (2006) panther core lands and represent the lands within the Service's 2000 consultation area boundary south of the Caloosahatchee River as shown in Figure 6. These lands (core lands and other zone lands) together are referred to by the Service as the Panther Core Area (labeled on Figure 6 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 strategy 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 strategy 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 7). 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. Dispersal Zone lands are considered equivalent to Primary Zone lands with a 1 to 1 value.

At-risk lands in the Other Zone total 819,995 acres. Actions on some of the Other Zone lands, such as actions in areas that have already been urbanized, will in most situations not have an impact on panthers or their habitat. We are considering that within the Other Zone lands, these types of actions will account for 20 percent of the available lands and that actions on the remaining 80 percent of available lands may have an impact on panthers and could affect our southwest Florida panther population strategy. We will monitor this consideration carefully as we review proposed actions within the Other Zone. To estimate the acres of Primary Zone

equivalent lands the 819,995 acres of Other Zone lands represent, we applied the 80 percent factor and the 33 percent factor to the available acres, which equate to 216,479 acres of Primary Zone equivalent lands (819,995 times 0.8 equals 655,996 times 0.33 equals 216,479).

These equivalent values, 0.33 and 0.69, for Other and Secondary Zones, respectively, and 1 to 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 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 (Tables 2 and 5), 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 (see Tables 2 and 8). Currently 2,073,865 acres of Primary Zone equivalent lands 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. To meet the protected and managed lands threshold 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 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 chose a 5-year time frame because we believe that a time period less (2 to 3 years) would not show a changing trend in habitat alterations and a period longer (7 to 10 years) would not allow the Service sufficient time to adjust for a changing trend. The Service intends to monitor this habitat loss and may periodically adjust our habitat methodology to reflect this change.

Based on an analysis of wetland permits issued for single-family residential projects in Northern GGE by DEP (167 over a 30-month period [DEP permit data- 2006 to 2008) and corresponding Collier County single-family residential building permits (267 permits [Collier County permit data – 2006 to 2008]) issued over the same time period (167/296=0.56), we conservatively assumed based on the joint Corps/DEP wetland application submittal process and the Corps consultation process with the Service in accordance with the Act that we would have the opportunity to review these wetland permits and provide species impact reviews. Based on these assumptions, we estimated that about 41,496 acres would be developed without Federal review over a 5-year period (14,820*5*0.56=41,496), or an average of 8,299 acres per year. As a result, we adjusted the base value from 1.98 to 2.23.

We also realize habitat losses from individual single-family residential developments will collectively compromise the Service's landscape scale effort 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 affect 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 about another 12,950 acres over a 5-year period (2,590 acres per year or about 0.14 percent of the at risk lands), or an average of 2,590 acres per year would be developed through this avenue. This estimate for individual single-family development is based on the yearly average level of development combined in Northern GGE and Lehigh Acres in Lee and Collier Counties. To account for this loss, we further adjusted the base value from 2.23 to 2.48.

There is also 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. For assessment purposes, since our habitat methodology does not provide a mechanism to address this type of effect directly, we are providing a habitat surrogate of 500 acres per year of habitat loss for these types of projects, with a not to exceed value of 2,500 acres over the 5-year period. 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 Act and to achieve the Service's landscape scale effort for the Florida panther.

The Service uses a very conservative density of panthers per area of habitat to calculate the compensation ratio for impacts south of the Caloosahatchee River. Specifically, the Service relied on the low estimate in the range presented in Kautz et al. (2006) to reach its factor of 2.5. This low estimate density value was calculated by dividing the documented number of panthers in 2000, or 62 panthers, by an estimate of the habitat in the Primary Zone that was most consistently occupied by panthers from 1981 to 2000. As previously mentioned, it is clear the panther population south of the river has increased notably since 2000, in 2001 = 78 panthers; in 2002 = 80; in 2003 = 87; in 2004 = 78; in 2005 = 82; in 2006 = 97; in 2007 = 117; and 2008=104. In 2007 more panthers were documented in south Florida than have been documented since current verified estimates have been collected. Furthermore, none of the panthers recorded south of the Caloosahatchee River lives exclusively outside of the Primary Zone, although some do venture outside of it on occasion (McBride et al. 2008).

The average population size south of the Calooshatchee River over the past 7 years is 86. If we were to use this number instead of 62 to calculate the compensation ratio and to use the entire acreage of the Primary Zone as the denominator, the revised compensation ratio requirement would be 0.32 acres protected for every acre developed. Furthermore, if we even excluded the "Other Zone" altogether from the analysis, the ratio would be 1.01, still lower than the Service's current ratio. We believe this conservative approach is warranted because of the inherent importance of habitat protection to panther conservation.

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 7 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 Tables 3 and 6. 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.

As of January 2005, the Service has been using a panther habitat suitability ranking system based in part on methods in publications by Swainson et al. (2005) and Kautz et al. (2006) and adjusted by the Service to consolidate similar types of habitats and to include Comprehensive Everglades Restoration Plan water treatment and retention areas located in the panther's range (Table 4). Since the implementation of this ranking system, the Service has received two additional, published habitat assessment studies (Cox et al. [2006] and Land et al. [2008]) that further assess habitat usage by the Florida panther. As it is the Service's policy to incorporate the most current peer-reviewed science into our assessment and review of project effects on the Florida panther, we have revised the current habitat suitability ranking system.

To revise these values, the Service, in coordination with FWC, examined the habitat ranking values in the two new papers referenced above and Kautz et al. (2006) publication and developed a spreadsheet. The spreadsheet was developed to: (1) compare the results of each of these published analyses; and (2) provide a habitat ranking system for each of the assessments. On the first page of the spreadsheet, labeled "Panther Habitat Selection Analysis - Habitat Papers Comparison," we summarized the types of analyses performed as to whether it was second order (selection of a home range with a large study area) or third order (selection of habitats within a home range). For each of these analyses, we then listed the habitat types reported in each paper and their order of selection by panthers (Table 4). We used the Cost Surface Scores and the Rank Differences from the Kautz et al. (2006) analyses as the selection order and for a measure of statistical differences among the habitat types. Selected habitat types are represented as bold black numbers and avoided habitats are bold red numbers. Habitats that were neither selected nor avoided are shown as normal font black numbers. Ranks with the same letter are not different from each other. Results from the Cox et al. (2006) and Land et al. (2008) papers using Euclidean analyses are shown in a similar fashion.

On the second page of the spreadsheet, labeled "Summary of Ranking Values," we ranked the habitat types on a scale from 0 to 10 according the results from each study and professional judgment (Table 5). We used our original ranking for the Kautz et al. analyses (with the ranking scale reversed such that the best habitat received a "10" and the lowest quality habitat was "0").

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

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

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

1. Barren/Disturbed: Barren/Disturbed lands may include many temporary changes to land use, such as crop rotation and prescribed fires that likely have little impact on the value to panthers. Areas disturbed by human impact on a longer-term basis (*e.g.*, parking of equipment and material storage areas) have chronic effects on panthers that we judge decrease the value of these lands for panthers. Barren/Disturbed lands include disturbed lands (Florida Land Use and Cover Classification System [FLUCCS] 740) and spoil areas (FLUCCS 733). Based on the above reasons, we assigned barren/disturbed land a value of 3.

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

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

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

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

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

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

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

   However, this neutral effect assessment is only applicable to land conversions from nonnative habitats to STAs. For those projects that remove natural habitats, the Service considers STA functional values to mimic the value of the natural system the STA is designed to achieve. As an example, a STA design that results in a dense monotypic stand of cattails would be appropriately evaluated following the exotic/nuisance species profile. Similarly, a system designed to provide a diverse mosaic of wetland communities and hydroperiods would be evaluated following the wet prairie/marsh profile. Another system

design that incorporates internal and external berms could include an edge benefit evaluation identifying the berms and adjacent littoral shelves and their benefit to the Florida panther and panther prey species, and follow the values provided for improved pasture for the berms and or wet prairie/marsh values for the littoral shelves. An individual project assessment of pre and post habitat impacts will identify whether the project as designed results in loss of functional value or provides benefit to the Florida panther and panther prey species.

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

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

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

Therefore, for assessment purposes, if a project is proposing restoration of non-native habitats (*e.g.*, pasture, row crops, groves, etc) to native habitats, we believe that a restoration lift to a value of 7 is appropriate. The functional value of 7 corresponds to that value found in the literature where panthers begin to select for that habitat attribute (Table 6). We also believe that a full functional lift credit for these restorations is appropriate as the time lag from restoration to full functional value is estimated to be relatively short (less than 5 years) for non-forested systems. However, the calculation of forested restoration values remains the same as in the previous methodology, which is one-half the difference between pre- and post-restoration.

In conclusion, we believe that appropriate adjustments to our original PHU values are warranted based on the most current peer-reviewed science and our category specific discussions above. Therefore, we have incorporated the above referenced values into our revised habitat assessment matrix and these values are the current basis for habitat evaluations and the recommended compensation values to minimize project effects to the Florida panther (Table 6).

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 hydric 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 885 PHUs ((90 acres of pine flatwoods x 9.5 [the habitat suitability value for pine flatwoods] = 855 PHUs) + (10 acres of exotic vegetation x 3 [the habitat suitability value for exotics] = 30 PHUs) = 885 PHUs). The value of 885 PHUs is then multiplied by the 2.5 (the base ratio) and 0.69 (the landscape multiplier) resulting in a value of 1,527 PHUs for the project site. In this example, the acquisition of lands in the Primary Zone containing at least 1,527 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 large areas exhibiting a diversity of habitat types to survive. Dispersing subadult males range 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.

Past and ongoing joint Federal and State actions affecting wood stork habitat in the action area included the operation of the Central and South Florida Project (C&SF), the CERP, and consultations with the Corps under nationwide, general and individual project specific permits. The C&SF Project provided the South Florida ecosystem with flood control, regional water supply, prevention of saltwater intrusion, preservation of fish and wildlife, recreation, and navigation. In fulfilling these objectives since the mid-1960s, the C&SF Project has had unintended adverse effects on the natural environment that constitutes the Everglades and south Florida ecosystem. The C&SF Project was operational before the Act was authorized; therefore, no consultation was conducted for this Federal action.

In 2000, Congress authorized the CERP to restore, preserve, and protect the South Florida ecosystem while providing for other water-related needs of the region. CERP consists of structural and operational modifications to the C&SF Project and will be implemented over a 35-year period. Together, these modified components are expected to deliver benefits to improve the ecological functioning of over 2.4 million acres of the South Florida ecosystem, improve urban and agricultural water supply, improve deliveries to coastal estuaries, and improve regional water quality conditions, while maintaining the existing levels of flood protection.

As approved by Congress, CERP contains 68 major components that anticipate the creation of approximately 217,000 acres of reservoirs and wetland-based water treatment areas, wastewater reuse plants, seepage management, and the removal of levees and canals in natural areas. These components vastly increase storage and water supply for the natural system, as well as for urban and agricultural needs, while continuing to fulfill the original objectives of the existing C&SF Project. CERP will restore more natural flows of water (including sheetflow), improve water quality, and establish more natural hydroperiods in the South Florida ecosystem. Improvements to fish and wildlife habitat are expected to occur as a result of the restoration of hydrologic conditions as well as promote the recovery of native flora and fauna, including threatened and endangered species. The CERP or pre-CERP projects that may affect wood stork and/or Florida panther habitat in the action area, for which consultation has been completed, include:

<u>2000 Modified Water Deliveries-8.5 Square Mile Area (SMA) Project</u>: The proposed action is the restoration of flows and hydropatterns to NESRS in ENP while providing flood mitigation to the residents and landowners in the adjacent 8.5 SMA through the construction of a flood

protection levee and drainage system. The Service concurred with the Corps' determination of "may affect, but is not likely to adversely affect" for the wood stork (Service 1999a).

2001 Broward County Water Preserve Areas (WPA): The Broward County WPA Project is a CERP project consisting of the following components: (1) the 3A/3B Seepage Management Areas, (2) the C-1 1 Impoundment and (3) the C-9 Impoundment. The proposed actions associated with this multi-component project are the operation of water control structures and the construction of above ground impoundments to: (1) reduce seepage from WCA 3A and 3B and improve hydropatterns within the WCAs; (2) capture untreated runoff currently back pumped from the western C-1 1 basin into WCA 3A; and (3) pump excess storm runoff from the western C-9 basin into the impoundment and reduce loss of excess runoff to tide. The Service concurred with the Corps' determination of "may affect, but is not likely to adversely affect" for the wood stork (Service 2001).

2006 Interim Operational Plan: The proposed action is the continuation of the IOP and operations of the IOP structures and impoundments in the C&SF Project. Representing a Reasonable and Prudent Alternative under the Service's 1999 jeopardy BO, the IOP was developed to avoid jeopardy to the Cape Sable seaside sparrow while meeting other needs and constraints of the region including restoration of flows to ENP and maintenance of flood control in adjacent urban areas. The Service concluded that IOP, as proposed, is not likely to jeopardize the continued existence of the wood stork. Incidental take for the wood stork in the form of harm, was exempted as a result of reductions in foraging habitat suitability as predicted by hydrologic modeling (Service 2006b).

2010 Everglades Restoration Transition Plan (Phase 1): The proposed action is the modification of the IOP to incorporate more flexibility in regulating water levels in WCA-3, located in Broward and Dade Counties, Florida. The Service concluded that incidental take in the form of harm would occur from reductions in foraging habitat suitability, may result in injury or death of a limited number of wood storks (eggs or nestlings) each year based on slight changes to foraging habitat suitability, as predicted by hydrologic modeling, that is expected to occur under ERTP-1 or the interim IOP period operations (Service 2010c).

The Service has also consulted with and provided its biological opinion to the National Park Service on the Final General Management Plan (GMP)/EIS – Addition Lands for Big Cypress National Preserve. The Service concluded that implementation of the preferred alternative of the GMP will result in increased human use of the Addition Lands. Studies on the behavior of panthers in the vicinity of recreational off-road vehicle use and hunting have noted alterations in behavior that trend with hunting season and human use. However, these alterations in behavior have not been correlated with any change in reproductive success or survival in Florida panthers, thus the Service concluded that the preferred alternative would not jeopardize the continued existence of the Florida panther. Incidental take in the form of harassment was anticipated as a result of the project on the Addition Lands within the primary trail buffer area (16,808 ac associated with the 180 m buffer of the proposed trail system).

The District, in partnership with Miami-Dade and Broward Counties, is also undertaking restoration projects concurrent with CERP. These projects primarily include exotic species removal and hydrological restoration of impacted wetlands. According to the District, during the past several years, these programs through mechanical, chemical, and biological treatments have restored or improved habitat quality to systems throughout the region. Two recent projects are the Broward Water Preserve Area enhancements (BWPA) and the Rocky Glades/L31 Preserve Area enhancements (RGPA). The BWPA is an 8,313-acre preservation area bordering the adjacent WCAs. Restoration actions being undertaken in these lands are primarily exotic species removal. The RGPA is 5,922-acre restoration area also bordering the adjacent WPAs. Restoration actions in these lands included exotic species eradication, construction of tieback levees, backfilling borrow canals, and construction of several pump stations to improve area hydrology (SFWMD 2006).

Also in coordination with Miami-Dade and Broward Counties, the District is providing restoration of lands within the Pennsuco Wetlands above and beyond those proposed by the applicants associated with the pending action. Approximately 5,417 acres of District lands are included in this program with exotic species removal as the primary restoration benefit (District 2006). A similar program is in place for lands within the 8.5 SMA, an area of about 6,427 acres, of which the District currently owns about 541 acres (SFWMD 2006).

2009 Phase 1 Rock Mining in the LBMA: The proposed action would impact about 7,308 acres of wetlands (Service Biological Opinion - 7,351), while preserving and enhancing about 4,590 acres of wetlands. The Service determined in their Biological Opinion that the project would adversely affect the wood stork and exempted incidental take for the wood stork based upon the loss of 7,351 acres of wetlands and the estimated loss of 58 nests (75 nestlings) over the 20-year life of the alternative associated with losses specific to individual hydroperiods. The Service's Phase 1 Biological Opinion evaluated impacts to 7,351 acres, which includes about 43 acres of habitat in Kendall Properties and Miami-Dade Aviation that may not be jurisdictional Federal wetlands. The Service concluded in the Biological Opinion that the proposed action will not jeopardize the survival and recovery of the wood stork (Service 2010d).

Climate change

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

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

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

Whittle et al. (unpublished data 2008) applied several prominent climate change models to panther habitat in southwest Florida. Their review indicated a climate change-induced sea level rise of 1 meter (3 feet) will reduce southwest Florida panther habitat by 29 percent, at 3 meters (9.8 feet) by 62 percent, and at 5 meters (16.4 feet) by 90 percent. The consequences would be particularly dire for the panther which has no other populations outside of low-lying south Florida. Their cost surface analyses identified likely migration routes that would link the south Florida panther population to suitable habitat to the north. However, without rapid conservation actions that establish a population to the north, they predict that the Florida panther may go extinct in the wild due to climate change effects.

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

It should be noted that Titus and Narayanan's (1995) worst-case scenario was premised on a 1 percent chance that global warming would raise sea level that high. However, most climate change researchers agree with the findings in the IPCC Report (2007) which estimates a 90 percent probability of 7 to 23 inches of sea level rise by 2100. Scientific evidence that has emerged since the publication of the IPCC Report (2007) indicates an increase in the speed and scale of the changes affecting the global climate. Important aspects of climate change seem to have been underestimated and the resulting impacts are being felt sooner. For example, early signs of change suggest that the less than 1.0°C (1.8°F) of global warming that the world has

experienced to date may have already triggered the first tipping point of the Earth's climate system – the disappearance of summer Arctic sea ice. This process could open the gates to rapid and abrupt climate change, rather than the gradual changes that have been currently forecasted.

STATUS OF THE SPECIES WITHIN THE ACTION AREA

Wood Stork

As stated previously, the Service has defined the action area for the wood stork as the project footprint and all lands within the overlapping CFAs (Figure 3) of all active wood stork nesting colonies. The action area encompasses about 1,628 square-miles (1,041,674 acres) of Broward, Collier, Miami-Dade and Monroe Counties, Florida (Figure 3). The proposed action may have direct and indirect effects on the ability of wood storks to breed, feed, and find shelter within the action area.

A complete census of the wood storks currently occurring within the action area has not been conducted. However, surveys of wading birds, including the wood stork, have been conducted in south Florida (South Florida Wading Bird Report [SFWBR] 2009). Data on wood stork nesting collected from 1985 through 2009 indicate the population of wood storks is increasing within south Florida. Wood stork nest production in 2009 was the greatest observed since the predrainage period with an estimated 6,452 wood stork nests in south Florida (SFWBR 2009). The high production observed in 2009 was likely due to improved nesting and foraging conditions resulting from the lack of dry season rainfall (SFWBR 2009).

The project corridor is located immediately north of 2 annually active wood stork nesting colonies. The Tamiami Trail East colony is located approximately 1000 ft south of the project footprint at Latitude 25.757616, Longitude -80.508016. The Tamiami Trail West colony (FWC i.d. #620313) is located approximately 300 ft south of the project footprint at Latitude 25.760000, Longitude -80.545000 (Figure 2, inset). A third "ephemeral" colony, discussed below, was identified and unofficially named Tamiami East-2 during construction of the 1-mile bridge segment initiated by the Corps in 2009. The project corridor is located within the primary (all lands within 500 feet and up to 1,500 ft from the colony boundary) and secondary (all lands extending outward 1,000 ft to 2,000 ft from the primary management zone boundary) management zone of the Tamiami Trail West colony, and the primary management zone of the Tamiami Trail East colony. These management zones (Service 1990) have been proposed by the Service as a guide to avoid activities that are detrimental to a wood stork colony and to minimize disturbance to the colony. In addition, the Tamiami Trail East-2 colony (80˚31′33.267″W 25˚45′36.599″N) was analyzed in the Service letter dated February 25, 2010, and primary and secondary protection zones were delineated therein.

Aerial wood stork nest surveys have been conducted annually at these colonies by ENP and the SFWMD and the Service has obtained the nesting data for the years 2005 through 2009 for these colonies. Data for the Tamiami Trail East colony indicate that 10 wood stork nests were observed in 2002, and nesting did not occur from 2005 through 2008. The number of nests observed in the Tamiami Trail West colony from 2005 through 2009, were: 900 to 1,000 in

2009, 0 in 2008, 75 in 2007, 400 in 2006 and 0 in 2005. Applying the mean number of nestlings produced by a wood stork nest (1.21 nestlings per nest reported by Rodgers and Schwikert (1997)) to the 2009 nest data for each colony results in the production of 12.1 nestlings for the Tamiami Trail East colony and 1,089 to 1,210 nestlings for the Tamiami Trail West colony.

Wood stork nesting was observed at two other nest colonies in the action area during 2009. The Grossman Ridge West nest colony, located approximately 10.6 miles southwest of the project site (Latitude 25.636266, Longitude -80.652766) produced 60 nests. An additional 7 nests were constructed at the 3B Mud East nest colony, located approximately 2.3 miles northeast of the project site (Latitude 25.798000, Longitude -80.494000), but all of these nests failed to produce young.

Status of Tamiami East-2 Colony

The Tamiami East-2 colony occupies an area of willow and pond apple shrub associated with culvert discharge south underneath the Trail into the seasonally flooded North East Shark River Slough (NESRS) of ENP. This habitat is similar to, but smaller in size than those areas just east and west where the Tamiami East and West wood stork colonies are located. Wood storks are more likely to return to the same nesting site year after year than other wading birds (Frederick and Ogden 1997). Some colonies are known to be continuously active (Coulter et al. 1999) while others are active for only a year or two. If hydrologic conditions are suitable, storks and other wading birds can begin nesting in these areas as early as October but usually start around January. A nesting cycle usually takes roughly 15-17 weeks after which fledged birds are feeding independently. The nesting season in south Florida can last until May or June.

As reported by Frederick and Tsai in the South Florida Wading Bird Report (Cook and Kobza 2009), wood stork nest numbers were exceptionally high in 2009 with a 14.5 fold increase over the previous 5-year average and 4-fold increase above the 10-year average. In fact, wood stork numbers were the highest recorded since 1975. Nest starts experienced a greater than 75 percent chance of fledging at least one young, and successful nests produced over 2.6 young each. Relatively high water levels in 2008 favored ample production of fish and aquatic macroinvertebrates. The abundance of prey in conjunction with a long and continuous period of drying (September 2008 through May 2009) contributed to the high nest success in 2009. In addition, the high numbers may be attributed to the number of young birds produced during the exceptional 2006 season that had just reached breeding age or from storks outside the region that were attracted by the favorable conditions.

The Tamiami East-2 colony has been active since 2009 when approximately 15 wood stork nests were reported in the South Florida Wading Bird Report (Cook and Kobza 2009). Wood storks were also identified within this colony by the Corps' contractor in February 2010, as a result of ongoing environmental monitoring during construction activities associated with the 1-mile bridge. Upon identification, construction was suspended and the Corps and Service consulted on new primary and secondary zones (see Service 2010a). On March 4, 2010, personnel from ENP confirmed that nests within East-2, as well as nesters in other nearby colonies had all abandoned their nesting attempts. Wood storks did not return to Tamiami Trail East-2 during the remainder

of the 2010 nesting season, though precautions and requirements established by the Corps and Service were maintained and the colony was monitored closely in the event the birds re-nested. Table 12 below lists nesting activity, over the past decade, in the three Tamiami wood stork colonies south of the project area. For a more detailed account of the status of the wood stork in south Florida please refer to the Service's Biological Opinion for the Tamiami Trail Modifications: Next Steps project (Service 2010b).

Factors affecting species environment within the action area

The primary factor which will affect storks within the action area of the proposed project is harassment to nesting wood storks from construction related activities associated with bridge building. While other factors like forage abundance and forage habitat suitability are often analyzed the proposed project is not expected to negatively affect these attributes.

Florida Panther

As stated previously, for the purposes of this consultation, the action area includes the project footprint and surrounding lands frequently visited by panthers (Figure 4). 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 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 collared, 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 McBride (Shindle et al. 2003) shows that between July 2002 and June 2003, three-collared panthers, two-uncollared females, and two-uncollared males had home ranges in or home ranges that overlapped or were immediately adjacent to the same survey unit as the Premier Airport Park Project. In addition, eight other panthers that used this same

survey unit previously died during this time period (Shindle et al. 2003). This unit, designated as Unit 7, includes the Okaloacoochee WMA and adjacent private lands.

Within the 25-mile radius action area, based on telemetry data as of August 2010, at least 7 known radio-collared panthers have overlapping home ranges with the project area. These panthers are FP 61 (female), FP 88 (female), FP 94 (female), FP 95 (female), FP 124 (female), FP 125 (male), and FP 142 (female). It is unknown at this time whether these panthers are still alive. The closest documented telemetry location of a radio-collared panther is about 2 miles east of the project site. This telemetry point was recorded on September 22, 2004. In addition, McBride (2003) notes previous use of the action area by other panthers prior to their mortality. Four of these panthers were likely dispersing sub-adult males or sub-adult females without established territories.

Historically, there have been a total of 4 radio-collared male panthers recorded within 5 miles of the project site on 120 occasions based on telemetry data from June 7, 1987 through June 29, 2009 (Figure 9; Table 10). This translates to an average of about 9.17 occurrences per year or 0.76 occurrences per month since the first telemetry point was recorded within 5 miles of the site. All four of these panthers are known to have died prior to the date of this document (Table 11). Uncollared panthers are presumed to occur and cannot be confirmed or ruled out because there is documented use of the area by collared panthers so it would be impossible to determine whether any physical evidence came from collared panthers or uncollared panthers. The status and activities of non-collared Florida panthers within the action area are unknown. Based on the above information and because the site contains habitat types used by panthers and their prey, and the project vicinity has been used historically by panthers as indicated by telemetry locations, the Service believes the project site may be occasionally used by other non-collared panthers.

There have been 5 documented panther-vehicle collisions within the 25-mile action area (see Table 11 and Figure 10). The panther-vehicle collision closest to the project site occurred on US 41 (Tamiami Trail) about 2 miles east of the project site in 2004. The panther was an uncollared male.

Other activities within the action area have also benefited panthers. The land acquisition programs of Federal, State, and County resource agencies have preserved high quality panther habitat. Moreover, the management of public lands, including prescribed fire and eradication of exotic vegetation in the Everglades and Francis S. Taylor WMA including WCA-3A and 3B, BICY, ENP, and other conservation areas, is intended to improve habitat for panther prey species, which benefits panthers within these areas.

Factors affecting species environment within the action area

Factors that affect the species environment (positively and negatively) within the action area include, but are not limited to, the presence and construction of highways and urban development, 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.

Wildlife Value and Habitat Quality

As discussed previously in the status of the species, the Service believes the existing habitat conditions present on a site and the feeding value that a site provides to the Florida panther and panther prey species are important parameters in assessing the importance of the project site to the Florida panther and other wildlife species. In order to assess this importance, the Service typically reviews wildlife surveys and plant species compositions as part of the applicant's biological assessment prepared for the project.

Wildlife Value: Wildlife surveys specific to this project have not been conducted, however information exists from other surveys conducted in this area. The wetlands located within and adjacent to the project site are known to provide habitat for a diverse array of wildlife species including: American alligator, wood stork, great blue heron (*Ardea herodias*), little blue heron (*Egretta caerulea*), white ibis (*Eudocimus albus*), and a variety of other mammals, birds, reptiles, amphibians, fish, and invertebrates. Track surveys to quantify deer and feral hog tracks within and near the project site were not conducted by the applicant. However, white-tailed deer and feral hogs (*Sus scrofa*) have been observed in the project vicinity historically.

Habitat Quality: The 148.96-acre project site contains 100.5 acres of habitat types that provide habitat for the Florida panther. These lands consist of wetlands and disturbed upland areas associated with the roadway and various developed sites such as airboat concessions and Miccossukee camps. White-tailed deer densities and other panther prey species are influenced by the quality of the foraging habitat present in the project area. About 33 percent of the project site (48.46 acres) contains existing paved roadway and surface waters unsuitable as habitat for panthers and their prey. The proposed off-site mitigation at the PSRP site will provide high-quality permanent foraging areas to regional deer populations and other panther prey species.

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 Modified Water Deliveries, Tamiami Trail project.

Table 9 illustrates the PHU calculations for the Tamiami Trail Modifications project with impacts to 16.4 acres of panther habitat within the Primary Zone. The 16.4 acres expected to experience impacts currently provides 90 PHUs in the Primary Zone. After the project the same acreage is

expected to provide 61 PHU's or a difference of 29 PHU's. The 29 Primary Zone PHUs are multiplied by the 2.5 Base Ratio and a landscape multiplier of 1 for a product of 72.5 PHUs. The proposed habitat compensation site is within the Modified Water Deliveries 8.5 Square Mile Area (SMA) project site located in western Dade County, Florida. The 8.5 SMA is a pre-CERP component that will restore more than 2,280 acres of land to near pre-development condition. Once the construction of this project is complete it will contain an estimated 2,280 Primary Zone acres comprised mostly of restored short hydroperiod marl prairies. This site lies within Everglades National Park which is a large publicly-managed natural area set aside for the benefit of a wide variety fish and wildlife resources including the panther. The Corps proposes to use a small portion (10 acres) of the approximately 2,280 acres of panther habitat that are being restored by the State of Florida and the Federal government as part of the Modified Water Delivery project. Therefore, the Service believes the impacts associated with the habitat lost by the proposed project will be offset by the restoration at the 8.5 SMA project site.

The lands proposed for the current project are on the eastern edge of the panther's range. The lands proposed for restoration are in the Primary Zone, adjacent to other natural lands, and are 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. Further, the future CERP projects made possible by this project will enhance thousands of acres of wetlands that will improve overall habitat in the Everglades ecosystem, including areas in the eastern portion of the panther's range.

EFFECTS OF THE ACTION

Wood Stork

The primary effect of the proposed action on the Tamiami East-2 wood stork colony will be harassment due to construction activities. The center point (80˚31′33.267″W 25˚45′36.599″N) of this colony lies 200 feet [61 meters (m)] south of culvert #3 (ENP designated #57) on the Tamiami Trail where the 1-mile bridge will be constructed. The type of construction activities that the Corps' contractor anticipates during the nesting season can be seen in Table 13 below. Although the effect of the proposed action on nesting wood storks was not evaluated by the Corps it can be reasonably expected that disturbance could occur. Nesting storks show some variation in the levels of human activity they will tolerate near a colony. In general, nesting storks are more tolerant of low levels of human activity near a colony when nests are high in trees than when they are low, and when nests contain partially or completely feathered young than during the period between nest construction and the early nestling period (adults still brooding). When adult storks are forced to leave their nests, eggs or downy young may die quickly (e.g., in less than 20 minutes) when exposed to direct sun or rain (Ogden 1990).

Studies of storks and other wading birds have shown a varied response to disturbance dependent on bird activity and habitat type. Foraging and roosting wading birds, including Wood Storks, in narrow tidal creeks reacted to boats at lesser distances than birds in more open areas, shoreline trees and flats (Bratton 1990). Passing distances of 15 to 40 m resulted in most birds flushing, whereas a passing distance of 60 m elicited little flushing. Similarly, Rodgers and Smith (1997)

examined the reaction of foraging and loafing wading birds to four types of disturbance: walking, ATV, car, and boat. A buffer zone of about 100 m was recommended to minimize disturbance effects on most species of wading birds. A bicyclist with a light riding a trail beside the Priest Landing stork roost (at 2230 hours; personal observation, John Robinette, Service – Savannah Coastal Refuges) resulted in the flushing of all storks, suggesting that storks may be especially sensitive to nocturnal disturbance.

Rodgers and Smith (1995) examined the reaction of nesting wading birds relative to three types of disturbance: walking, canoe, motorized boat. A buffer zone of about 100 m was recommended to minimize disturbance to most species of wading birds. Wood Storks had the shortest flushing distance (18.5 m) for walking disturbance.

While most of the construction activities scheduled during the nesting season are not anticipated to disturb nesting storks, a few such as pile driving and placement of fill will certainly create noise disturbances that will most likely affect nesting storks. The highest recorded background decibel levels on site, as measured by the contractor at 150-ft distance, were 100 decibels (dB). This was usually as a result of motorcycle(s) traffic. Compared to on site measurements of some construction activities (excluding pile driving, Sweeper – Truck 93.3 dB, Roller 107.9 dB) and simulated operation of heavy equipment conducted by General Asphalt (Roller 98.5 dB, Dump truck 91.1 dB), it appears that most construction activities will produce noise levels similar or lower than the background levels. These results are preliminary measurements and it should be understood that many variables will affect the actual noise level that reaches the wood storks on any given day. We suggest that the Corps contractor continue to monitor decibel levels during various phases of construction and use any means possible to reduce the amount of noise produced by the pile driver (e.g., sound dampening shroud).

Given the infrequent use of the Tamiami East-2 colony and the continued protection of the Tamiami East and West wading bird colonies, the Service does not believe the loss of nesting attempts (should they occur) will affect the continued existence of the species in the action area. The Service suggests the Corps contractor begin with a level of construction activity before the nesting season begins and maintain this level throughout the nesting season. If birds initiate nesting with construction activities present they are less likely to abandon if that level of activity is maintained throughout the nesting season.

Species Response to the Proposed Action

The proposed action is located within several hundred feet of the Tamiami Trail West wood stork nesting colony, the Tamiami Trail East wood stork nesting colony and the Tamiami East-2 wood stork nesting colony. The project will relocate the existing Tamiami Trail (US 41) roadway about 50 to 100 ft closer to wood storks at the two nesting colonies. The proposed action will result in disturbance from construction activities and roadway operation (*i.e.*, motor vehicles) occurring closer to wood storks at the existing nest colonies. The increased disturbance could cause wood storks to abandon the nest colonies. The project also increases the probability for wood stork mortality from motor vehicle collisions with wood storks flying in and out of the colonies. However, nesting wood storks at these colonies are already subject to noise and

disturbance from motor vehicle traffic and human activity on the existing Tamiami Trail (US 41). Should this level of disturbance suddenly increase (e.g., introduction of pile driving) at critical times within the nesting cycle then some or all of the nests could be abandoned. The Service believes that wood storks at the nesting colonies will likely acclimate to the disturbance resulting from construction of the bridge, barring an introduction of elevated disturbance levels, and not abandon the nesting colonies.

Florida Panther

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 6) 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 6). 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 6), 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 6) and represent the lands within the Service's 2000 consultation area boundary south of the Caloosahatchee River as shown in Figure 6. 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 6 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 9 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, 2006d). 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 (Alternative 6D), 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. 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 10); 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 that are reasonably certain to occur in the action area considered in this Biological Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Wood Stork

For evaluation purposes, the Service is considering the action area for the wood stork to include the CFAs of all five nesting colonies as they encompass the project area (Figure 3). According to available information, from October 2004 through March 2006 (a period of 18 months), the Corps issued non-jurisdictional wetland determinations (for isolated wetlands) for 22 non-related rock mining projects in the action area outside of the direct footprint of the proposed Tamiami Trail project for a total of 119 acres. This equates to an average of almost 7 acres per month which when projected across the 44-month construction period for the current action would equal 308 acres that could potentially be filled without Corps regulatory review. The Corps' determinations for these projects were issued per guidance provided as a result of the Supreme Court decision, Solid Waste Agency of Northern Cook County vs. U.S. Army Corps of Engineers, 53 1 U.S. 1 59 (2001)(SWANCC) and will not require a Clean Water Act (CWA) section 404 wetland permit.

The Tamiami West CFA (approximately 457,300 acres) has 407,500 wetland acres located on public lands and are generally considered secure from alteration, 41,200 acres are in private ownership and subject to future section 7 consultations while the remaining 8,700 wetland acres are in private ownership outside the project foot print, but within the action area. The 3B Mud East CFA (approximately 396,700 acres) has 345,100 wetland acres located on public lands, 41,300 wetland acres are in private ownership and subject to future section 7 consultations while the remaining 10,300 wetland acres are in private ownership outside the project foot print, but within the action area. The Grossman Ridge CFA (approximately 562,100 acres) has 517,200 wetland acres located on public lands, 4,300 wetland acres are in private ownership and subject to future section 7 consultations while the remaining 4,600 wetland acres are in private ownership outside the project footprint, but within the action area.

Approximately 23,600 wetland acres of possible wood stork foraging habitat is within private ownership outside the project foot print, but within the action area. In south Florida, approximately 10 to 20 percent of the requests submitted to the Corps for wetland jurisdictional review on private lands are determined to be isolated wetlands and, thus, not subject to the Corps permitting requirements (Service 2006). To provide a reasonable estimate of the number of wetland acres likely to be outside of the Corps' jurisdiction, we conservatively assumed that 20 percent of the 23,600 privately-owned wetland acres within the action area might be isolated. Therefore, we estimate approximately 4,720 acres of wetlands may be developed without Federal review during the 44-month period of the proposed action. This acreage estimate represents the potential loss of wetlands due to future non-Federal actions.

To estimate the effects to wood stork production from the loss of these wetlands, we applied the wood stork foraging assessment method introduced in the programmatic consultation on the Lake Belt Mining Area (41420-2008-F-0921) dated January 11, 2010. Based on field inspections by the Corps and the Service of jurisdictional and non-jurisdictional wetlands on the project site and within the action area, the Service is considering these wetlands as a Class 2 (short) hydroperiod vegetated by exotic species densities between 50 and 75 percent. Using the All Bird competition factor of 32.5 percent, the Class 2 hydroperiod biomass (fish and crayfish)

of 0.62 g/m2, and an exotic density foraging factor of 0.37, we determined that the 4,720 wetland acres would provide an estimated loss of almost 1,424 kg of wood stork foraging biomass (4720*4047*0.62*0.37*0.325/1000=1,424) for the 44-month construction period.

Florida Panther

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 BICY 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.

Conclusion

Wood Stork

The Service believes that the proposed action may adversely affect the endangered wood stork. The Corps' proposed mitigation, which includes the hydrologic restoration and creation of wetland habitats in the project area, as a result of this project, will minimize adverse effects from the proposed action.

Recent population estimates indicate the stork population has reached its highest level since it was listed as endangered in 1984. About 11,232 nesting pairs nested within their breeding range in the southeastern United States in 2006. Several new colonies were located in 2006, including several in Florida. The number of colonies also continues to rise, and over 80 nesting colonies were reported in 2006 throughout the southeastern United States (Service 2007), which is the highest to date in any 1 year. In 2009, wood storks produced approximately 6,452 nests in south Florida alone (Cook and Kobza 2009).

In addition, the Tamiami Trail project, once completed, is expected to enhance habitat for wood storks and other wildlife. Hydrologic restoration of NESRS and eastern ENP is essential to the recovery of wading bird populations such as the wood stork, white ibis, great egrets and tricolor herons (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 which would improve the quality and quantity of forage fish that support wood stork nesting colonies in both their current and historic locations.

After reviewing the status of the wood stork, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the wood stork.

No critical habitat has been designated for this species; therefore, none will be affected.

Florida Panther

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

Sections 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns such as breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns, which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are nondiscretionary, and must be undertaken by the Corps so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require the applicant 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 protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, the Corps shall report the progress of the action and its impact on the species to the Service as specified in the incidental take statement.

AMOUNT OR EXTENT OF TAKE

Wood Stork

The Service anticipates incidental take of wood storks in the form of harm or harassment due to construction activities associated with the proposed action directly north of the Tamiami East-2 colony. Recent observations of nesting activity within this colony indicate that as many as 15 nesting attempts could take place in years when the Tamiami West and other nearby colonies reach high occupancy levels. The loss of these nests during the next two years of construction of the 1-mile bridge would be unavoidable and considered incidental. This level of take will be exceeded if more than 15 nests [approximately 45 eggs based on an average clutch size of 3 which would result in 19 fledglings based on 0.42 fledglings per egg (Rodgers and Schwikert 1997)] in any given year are lost due to construction disturbance associated with the proposed action.

Florida Panther

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.

The primary methods of determining the presence of panthers on a given area is through radio telemetry and by detecting physical evidence. The use of radio telemetry is limited to areas suitable to capturing panthers (less than a third of the panther population is radio collared at any one time), and, due to their large home ranges (resident males have a man home range of 160,639 acres [65,009 ha] and females 97,920 acres [39,627 ha]) and the fact that they occur at low densities (1 to 8 per 100 mi^2), counting the exact number of panthers responsible for creating physical evidence can be problematic. The annual population count reflects the total number of panthers confirmed by physical evidence during the one calendar year (McBride et al. 2008). This count serves as an indication of the population trend rather than an actual count since in any one 12-month period some of the panthers recorded will die, kittens previously documented at the den may become dependent-aged juveniles, and uncollared subadults, particularly males, may disperse into other areas.

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

Wood Stork

In the accompanying Biological Opinion, the Service determined this level of anticipated take is not likely to result in jeopardy to the species. The Service anticipates incidental take of wood storks in the form of harassment from construction related disturbances to up to 15 nests in the Tamiami East-2 wood stork nesting colony. Therefore, based on the evaluations provided above for the proposed action; direct, indirect, and cumulative effects in the action area; the status of the species; and the ecological lift resulting from construction and operation of the project, the Service believes that the proposed action will not jeopardize the survival and recovery of the wood stork.

Florida Panther

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 as of June 2008.

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 following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of wood storks. 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.

1. The Corps or their contractors should continue to abide by the management zones and other conservation recommendations set forth in previous Biological Opinions and amendments to protect the Tamiami East and West wood stork colonies (Service 2006b, 2008b, 2010a, 2010b).

2. The Corps must continue ongoing monitoring efforts to ensure that no more than 15 nests are disturbed within the Tamiami East-2 colony during a single nesting season. Should the Corps' contractor encounter more than 15 nests then construction activities should cease and previously defined management zones and recommendations implemented. Corps and Service staff should then reinitiate consultation to determine the best course of action.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures, described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

1. The Corps or their contractor should continue to monitor and report bird activity to the Service, ENP and FWC personnel. This includes monitoring of equipment noise levels and any observed effects these levels have on the behavior of wood storks in the area.

2. 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;

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

4. 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;

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

Upon locating a dead, injured, or sick specimen of any threatened or endangered species, initial notification must be made to the nearest Service Law Enforcement Office (U.S. Fish and Wildlife Service; 9549 Koger Boulevard, Suite 111; St. Petersburg, Florida 33702; 727-570-5398). Secondary notification should be made to the Florida Fish and Wildlife Conservation Commission; South Region, 3900 Drane Field Road, Lakeland, Florida, 338 11-1299; 1-800-282-8002. Care should be taken in handling sick or injured specimens to ensure effective treatment and care or in the handling of dead specimens to preserve biological material in the best possible state for later analysis as to the cause of death. In conjunction with the care of sick or injured specimens 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.

The Service will not refer the incidental take of any migratory bird or bald eagle for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 USC Section 703-712), or the Bald and Golden Eagle Protection Act of 1940, as amended (16 USC Section 668-668d), if such take is in compliance with the terms and conditions specified herein.

Reinitiation Notice

This concludes formal consultation on the Tamiami Trail portion of the Modified Water Deliveries to Everglades National Park Project. As provided in 50 CFR Section 402. 16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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, extension 280.

Sincerely yours,

Paul Souza
Field Supervisor
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Table 1. List of development projects affecting Florida panther habitat consulted on the by the Service from March 1984 through October 2010 and acres of habitat impacted and preserved.

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, BICY (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, BICY (NERCO - Clements Energy, Inc.)	Collier	3	0	0	0
02/23/88	4-1-88-055	unknown	NPS, BICY (Shell Western E&P, Inc.)	Collier Miami-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, BICY [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
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, BICY (Calumet Florida, Inc. seismic testing)	Collier Miami-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

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)
12/08/99	4-1-98-F-517	199607574 (IP-MN)	Kaufmann Holdings, Inc. (Cypress Creek Farms)	Collier	239	0	24	24
04/17/00	4-1-98-F-428	199507483 (IP-AM)	Miromar Development, Inc. (Miromar Lakes)	Lee	1,323	0	194	194
06/09/00	4-1-99-F-553	199900619 (IP-SB)	Vineyards Development Corp. (Naples Reserve GC)	Collier	833	0	320	320
02/21/01	4-1-00-F-135	199803037 (IP-SR)	Wortzel & Landl, Co-Trustees (Corkscrew Ranch)	Lee	106	0	0	0
04/17/01	4-1-00-F-584	200001436 (IP-MN)	WCI Communities, Inc. (Sun City - Ft. Myers)	Lee	1,183	0	408	408
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
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

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)
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
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
10/25/06	41420-2006-F-0442	20047046	Koreshan Boulevard Extension	Lee	14	0	31	31

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)
10/26/06	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
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 41420-2008-F-0112	200106580	Parklands Collier	Collier	487	157	434	591
06/25/08	41420-2007-FA-1577 41420-2008-F-0435	Not known at time of issuance	Modified Water Delivery; Tamiami Trail 1-mi. bridge	Miami-Dade	16.4	7.1	10	10

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)
02/7/2008	41420-2007-FA-1120 41420-2007-I-0862	1993-0862	Poinciana Parkway	Polk	187	0	236	236
01/30/2008	41420-2008-FA-0009 41420-2008-I-003	2007-4884	I-75 from Corkscrew Road to Daniels Parkway	Lee	7	0	12	12
01/22/2008	41420-2008-FA-0021 41420-2008-I-005	2007-4503	I-75 from Collier County Line to South of Corkscrew Rd	Lee	7	0	44	44
6/26/2008	41420-2007-FA-1150 41420-2007-F-1144	2007-2175	Immokalee Master Plan	Collier	506	0	1,015	1,015
7/02/2008	41420-2007-FA-0592 41420-2007-F-0491	2005-7439	Kaicasa	Collier	72	0	183	183
07/14/2008	41420-2008-I-0508	2005-6488	Amerimed Medical Center	Collier	19	0	14	14
04/28/2008	41420-2008-I-0313	2007-6414	Immokalee Rd Substation	Collier	1	0	1	1
07/14/2008	41420-2008-I-0509	2007-4314	Gridley Medical Building	Collier	4	0	2	2
07/23/2008	41420-2006-FA-0165 41420-2006-F-0846	2004-182	Premier Airport Park	Lee	180	0	211	211
09/04/2008	41420-2008-FA-0415 41420-2008-I-0211	1984-4913	Colonial Boulevard Widening	Lee	35	0	39	39
09/25/08	41420-2008-FA-0702 41420-2008-I-0806	1988-1061	Alligator Alley Commercial Center	Collier	41	0	18	18
12/17/2008	41420-2006-FA-0023 41420-2008-F -0018	1999-4926	Sembler Partnership McMullen Parcel	Collier	40	0	49	49
01/13/09	41420-2007-FA-1111 41420-2007-I-1083	2007-1264	Big Corkscrew Island Fire Control & Rescue	Collier	5	2	5	7
01/30/02 02/12/09	4-1-98-F-372 41420-2006-F-0267	199402492 (IP-ML)	Florida Rock Industries, Inc. (Fort Myers Mine #2)	Lee	2,913	1,959	0	1,960
02/24/2009	41420-2006-FA-0548 41420-2006-F-1011	2006-7018	Oil Well Road Widening	Collier	329	0	356	356
06/10/2009	41420-2008-FA-0804 41420-2008-I-0253	Not applicable	Greenfrog Electrical Substation	Miami-Dade	3	0	12	12
09/**?**/2010	41420-2010-FA-0265 41420-2010-F-0164	SAJ-2010-00191 (IP-JPF)	SR 80 from CR 833 to US 27 Widening	Hendry	40	0	41	41
10/08/2010	41420-2010-CPA-0388 41420-2010-F-0164	Not known at time of issuance	Tamiami Trail Modifications: Next Steps Project	Miami-Dade	101	0	143	143
				Total:	96,151	12,583	29,373	41,955

Table 2. Land protected for conservation within the Florida panther core area.

	Acres	Primary Equivalent Factor	Primary Equivalent Acres
Primary	1,659,65	1.00	1,659,657
Dispersal		1.00	0
Secondary	308,62	0.69	212,950
Other	609,87	0.33	201,258
TOTAL	2,578,15	**TOTAL**	2,073,865

Table 3. Original panther habitat unit values for use in assessing habitat value to the Florida panther.

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

Table 4. Comparison of panther habitat selection analyses.

Panther Habitat Selection Analyses – Habitat Papers Comparison													
Habitats	Kautz compositional second order	rank	Kautz Euclidean second order	rank	Habitats	Cox Euclidean second order	rank	Cox Euclidean third order	rank	Habitats	Land VHF Euclidean third order	rank	Land GPS Euclidean third order	rank
Hardwood swamp	**1**	A	**3**	A	Coniferous forest	**1**	A	**1**	A	Upland forest	**1**	A	**1**	A
Pineland	**2**	A	**2**	AB	pineland					pine/hardwood				
Cypress swamp	3	AB	**1**	BC	Hardwood forest	**3**	C	**2**	A	hardwood hammock				
Upland forest	**1**	B	**4**	CD	hardwood hammock					pinelands				
Dry prairie	5	B	5	DE	mixed pine/hardwood					tropical hammock				
Shrub and brush	4	C	7	EF	palm/oak					palm/hardwood				
Xeric scrub	3	CD	**9**	F	tropical hammock					Wetland forest	**2**	A	**2**	AB
Marsh	5	CD	**9**	F	Forested wetland	**2**	B	**3**	A	cypress swamp				
Unimproved pasture	**7**	DE	7	G	cypress swamp					cypress/pine/palm				
Barren	6	E	**9**	G	mixed forest					mixed swamp				
Improved pasture	**9**	EF	6	G	shrub swamp					hardwood swamp				
Urban	8	F	8	G	hardwood swamp					Dry prairie/grass	3	B	3	BC
Cropland	**9**	F	8	H	other wet forest					grassland				
Citrus	**10**	G	8	H	Dry prairie/grass	**4**	C	4	B	unimproved pasture				
Coastal wetlands	**11**	G	8	H	dry prairie					improved pasture				
Open water	**10**	H	**10**	I	grassland					Marsh/shrub	6	B	4	C
Exotic plants					Open wetland	7	E	**7**	C	marsh/wet prairie				
STA					marsh and wet prairie					sawgrass				
Reservoir					sawgrass					cattail				
					cattail					shrub swamp				
					Agricultural	**5**	D	5	B	Other	4	B	5	C
second order - selection of home range with entire study area					improved pasture					open water				
third order - selection of habitats within home range					citrus					shrub/brush				
Bold (black) - habitat used more than availability (selection)					row crop					barren				
Bold (red) - habitat used less than availability (avoidance)					other agriculture					high impact urban				
rank - habitats with same letters did not differ in preference					Urban/barren	**6**	E	6	B	low impact urban				
					bare soil					extractive				
					high-impact urban					Agriculture	5	B	6	C
					low-impact urban					citrus				
					extractive					row crop				
										other agriculture				

Table 5. Summary of ranking values.

Habitats	Kautz compositional second order	Kautz Euclidean second order	Cox Euclidean second order	Cox Euclidean third order	Land VHF Euclidean third order	Land GPS Euclidean third order	Average
Hardwood swamp	10	7	9	10	10	9	9.2
Pineland	9	8	10	10	10	10	9.5
Cypress swamp	8	9	9	10	10	9	9.2
Upland forest	10	6	8	10	10	10	9.0
Dry prairie	6	5	8	6	6	7	6.3
Shrub and brush	7	3	no data	no data	6	6	5.5
Xeric scrub	8	1	no data	no data	no data	no data	4.5
Marsh	6	1	6	3	6	6	4.7
Unimproved pasture	4	3	8	6	6	7	5.7
Barren	5	1	7	6	6	6	5.2
Improved pasture	2	4	7	6	6	6	5.2
Urban	3	2	7	6	6	6	5.0
Cropland	2	2	7	6	6	6	4.8
Citrus	1	2	7	6	6	6	4.7
Coastal wetlands	0	2	no data	no data	no data	no data	1.0
Open water	1	0	no data	no data	6	6	3.3
Exotic plants							
STA							
Reservoir							

habitat selection	7,8,9,10
neither selected nor avoided	4,5,6
habitat avoidance	0,1,2,3

Table 6. Revised panther habitat unit values for use in assessing habitat value to the Florida panther.

Land Cover Type	Value	Land Cover Type	Value	Land Cover Type	Value
Reservoirs	*	Xeric scrub	4.5	Dry prairie	6.3
STAs	**	Orchards/groves	4.7	Upland Hardwood Forest	9.0
Urban	0	Marsh/ wet prairie	4.7	Cypress swamp	9.2
Water	0	Cropland	4.8	Hardwood swamp	9.2
Barren/Disturbed lands	3	Improved pasture	5.2	Hardwood-Pine	9.3
Coastal wetlands	3	Shrub swamp/brush	5.5	Upland-Hydric Pine forest	9.5
Exotic/nuisance plants	3	Unimproved pasture	5.7		

*PHU values for reservoirs are evaluated based on open water for the main water areas and the appropriate categories for berms and other non-water sections. Refer to page 39 for the accompanying text for guiding criteria for these systems.

**PHU values for stormwater treatment areas vary depending on design criteria, mode of operation, location in native or non-native habitats, and other landscape features. Refer to page 38 for the accompanying text for guiding criteria for these systems.

Table 7. 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 8. Undeveloped privately owned land within Florida panther core area.

Zones	Acres	Primary Equivalent Factor	Primary Equivalent Acres
Primary	610,935	1.00	610,935
Dispersal	27,883	1.00	27,883
Secondary	503,481	0.69	347,402
Other	655,996*	0.33	216,479
TOTAL	1,962,294	**TOTAL**	1,202,699

*About 819,995 acres are at-risk in the other zone with about 80 percent with resource value. Total acres of at-risk privately owned lands are 1,962,294 acres.

Table 9. 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.

Table 10. Radio-collared panthers recorded within 5 miles of the west of Tamiami Trail Modifications project.

Panther	Count	Sex	Years	Death Cause - Year
FP20	1	M	1987	Heart Defect - 1988
FP28	1	M	1989	Intraspecific Agression - 1992
FP84	18	M	2000	Unknown - 2000
FP130	130	M	2004	Vehicle - 2007

Table 11. Panther-Vehicle Collisions within the Tamiami Trail Modifications project action area as of September 2010.

ID	Distance from Project	Roadway	Year	Sex	Result
FP-21	23.0 Miles South	Palm Drive,1 Mile East of U.S. Highway	1988	F	INJURY
UCFP62	16.7 Miles West	U.S. Highway 41 near 40-Mile Bend	2004	F	DEATH
UCFP71	22.3 Miles West	U.S. Highway 41 Just East of 11 Mile Road	2005	M	DEATH
UCFP96	24.0 Miles South	U.S. Highway 41 ½ Mile South of Intersection with Card Sound Road	2007	F	DEATH
UCFP101	7.8 Miles East	U.S. Highway 41 1 Mile East of Krome Avenue	2007	M	DEATH

Table 12. The table shows the number of wood stork nests from 2002 to 2009 at three colonies located along the Tamiami Trail as reported by Dr. Peter Frederick and Ross Tsai (SFWMD 2009).

Colony	2002	2003	2004	2005	2006	2007	2008	2009
Tamiami East	0	0	0	0	0	0	0	35
Tamiami East-2	0	0	0	0	0	0	0	15
Tamiami West	350-400*	350-400*	50	200*	400	75-242	0	1,300

* Some nests successfully fledged young; where a range was reported, the average was used to calculate the total number of nests.

Table 13. Types of construction activities that will occur during construction of the Tamiami Trail 1-mile bridge beginning on November 1, 2010 through completion of the project. These activities may occur during wood stork nesting season and have the potential to disrupt the East-2 wood stork colony.

Activity	**Dates anticipated**
Pile drilling	Nov. 2010 to Sept. 2011
Pile driving	Nov. 2010 to Sept. 2011
Grouting	Nov. 2010 to Sept. 2011
Forming	Nov. 2010 to Sept. 2011
Tying Rebar	Dec. 2010 to Jan. 2012
Pouring concrete	Dec. 2010 to Jan. 2012
Placing beams	Dec. 2010 to Jan. 2012
Groove deck	Jan. 2012 to Feb. 2012
Road striping	Jan. 2012 to Feb. 2012
RPM installation	Jan. 2012 to May 2012
Shoulder strip installation	Jan. 2012 to May 2012
Excavation	Nov. 2010 to Oct. 2011
Placement of fill	Nov. 2010 to Oct. 2011
Installation of guardrails	Jan. 2011 to Dec. 2011
Drainage pipe	Feb. 2011 to Jan. 2012
Utility work	Feb. 2011 to Jan. 2012
Bridge section installation	Jan. 2011 to Dec. 2011
Clearing and grubbing	Nov. 2010 to Jun. 2012
Demolition	Mar. 2012 to Jun. 2012
Installation and repair silt fence	Nov. 2010 to Jul. 2012
Water quality sampling	Nov. 2010 to Jun. 2012
Airboat usage	Nov. 2010 to Jun. 2012

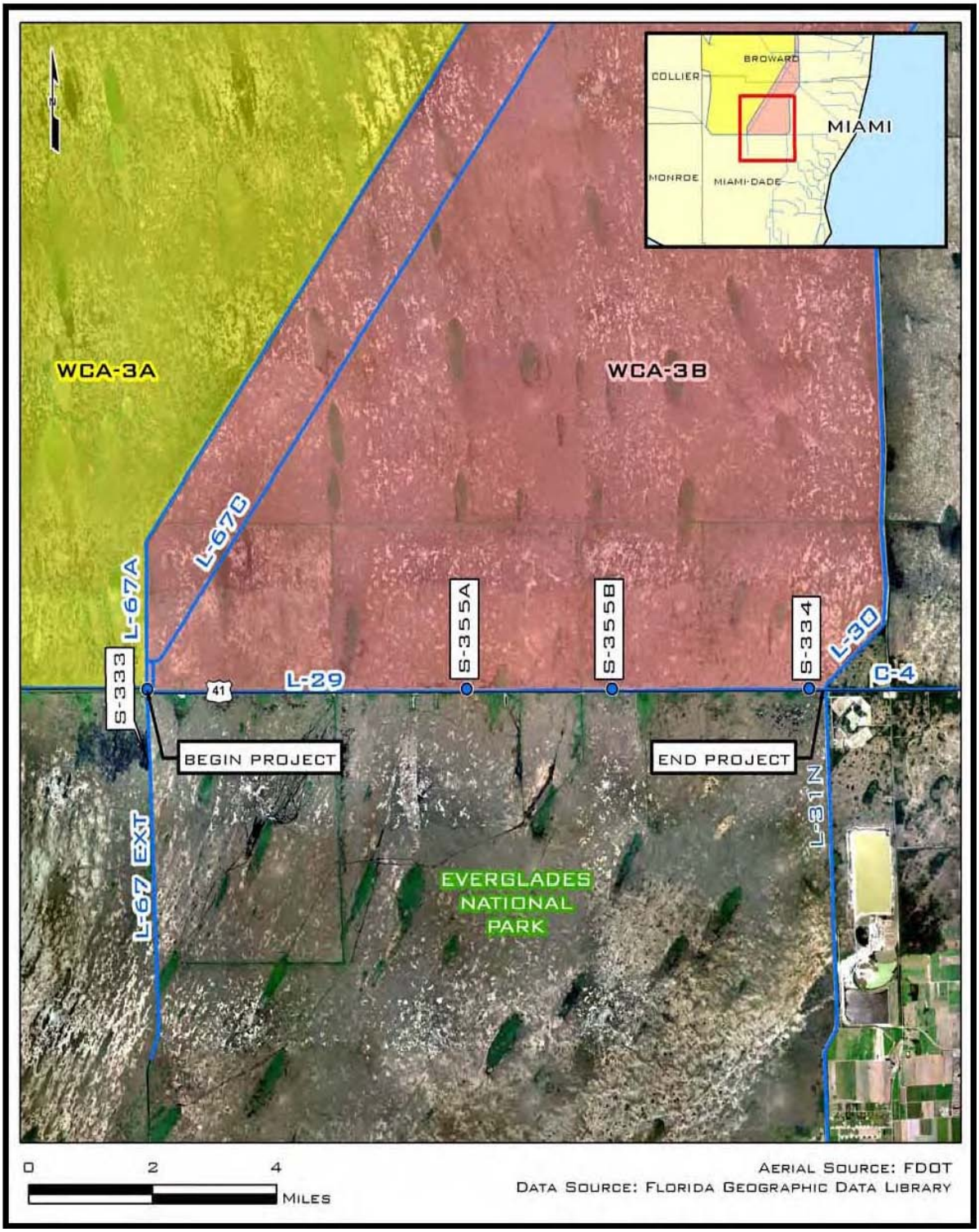

Figure 1. Location map of Tamiami Trail Modifications project in Miami-Dade County, Florida (ENP 2010).

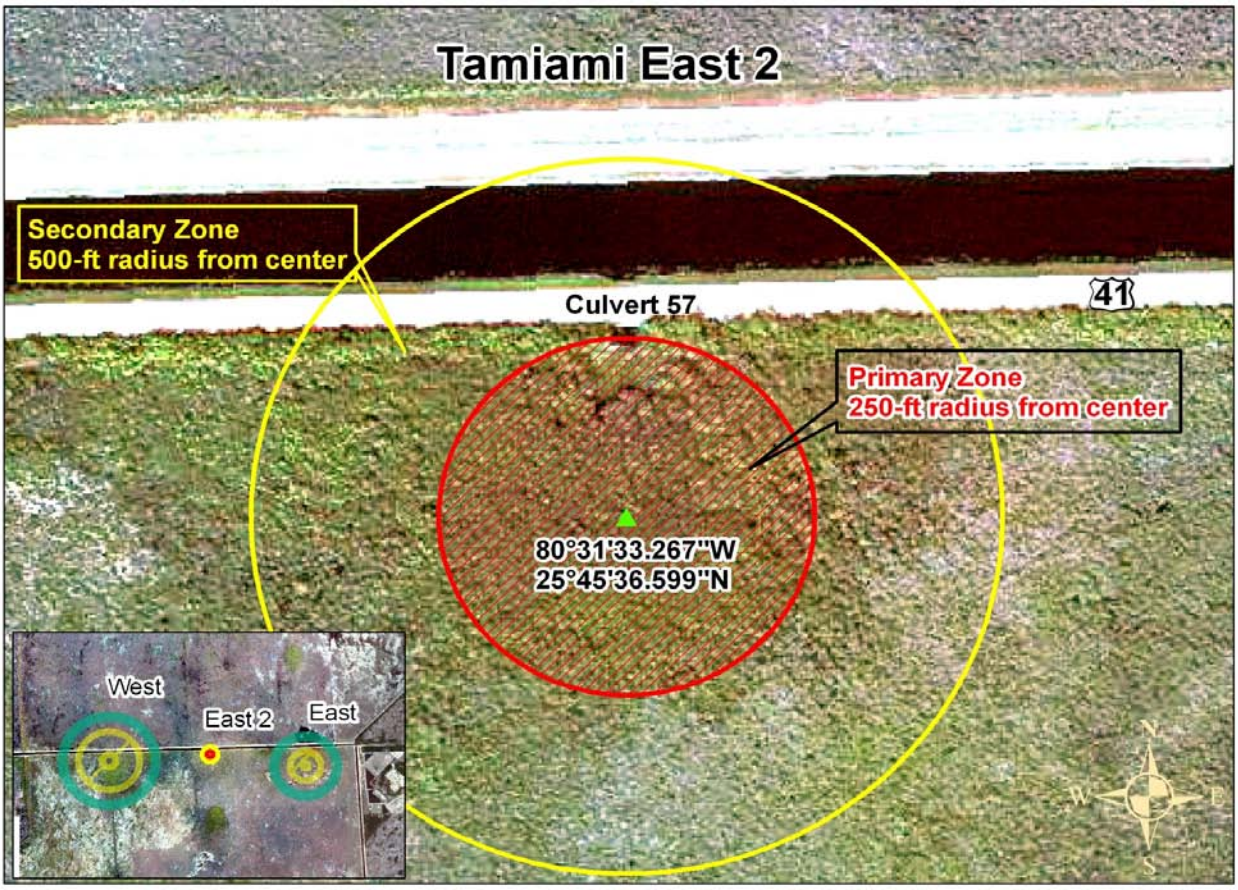

Figure 2. Aerial photograph depicting the center point, primary, and secondary zones of the Tamiami East-2 wood stork colony. The secondary zone perimeter (yellow line) intersects the Trail (US Highway 41) at 80°31'28.722"W 25°45'39.373"N on the east side and 80°31'37.91"W 25°45'39.407"N on the west side which equals 840 linear feet of construction area within this zone.

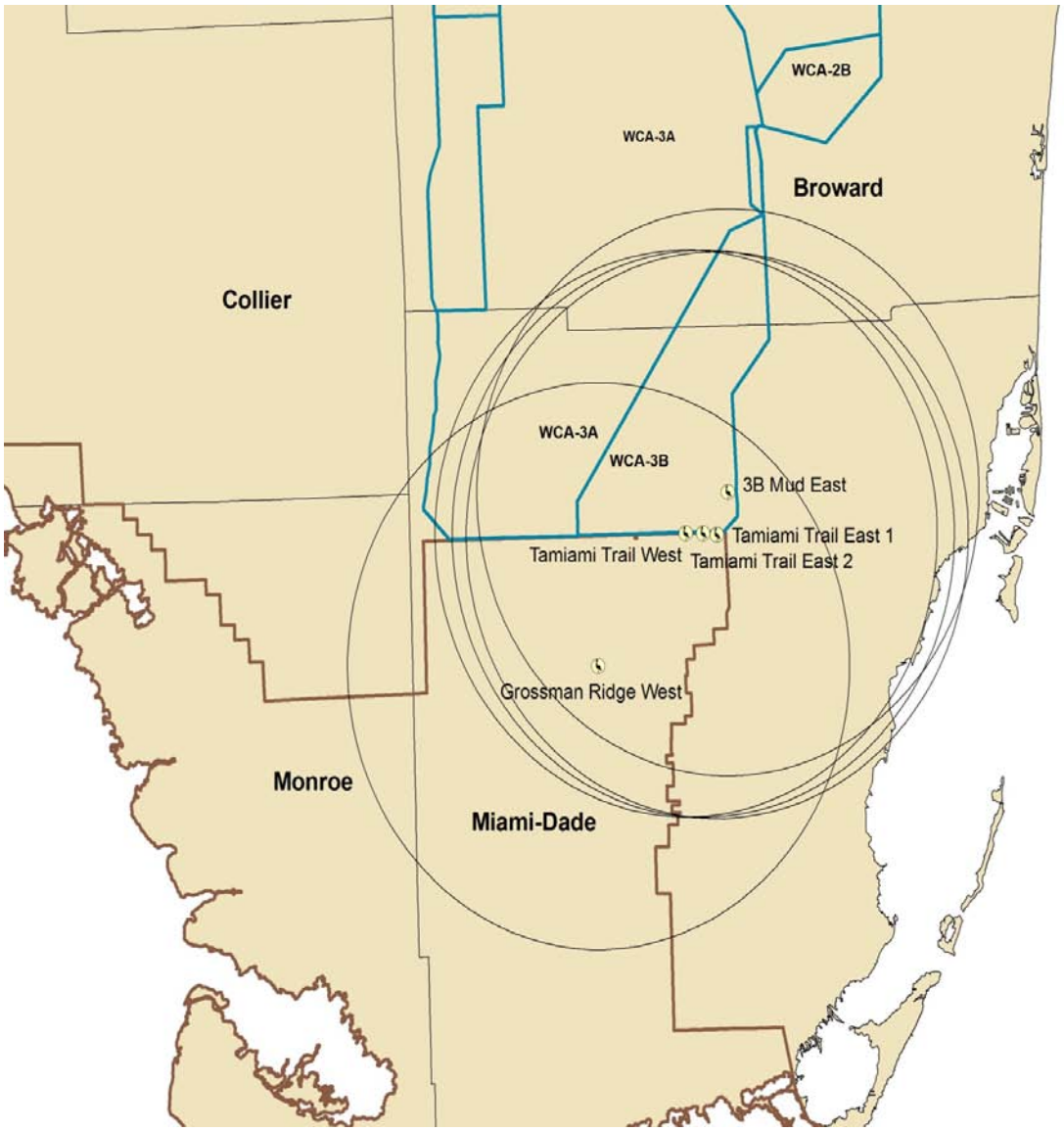

Figure 3. Map of wood stork action area and Tamami Trail East-1, East-2 and West nest colonies for the wood stork.

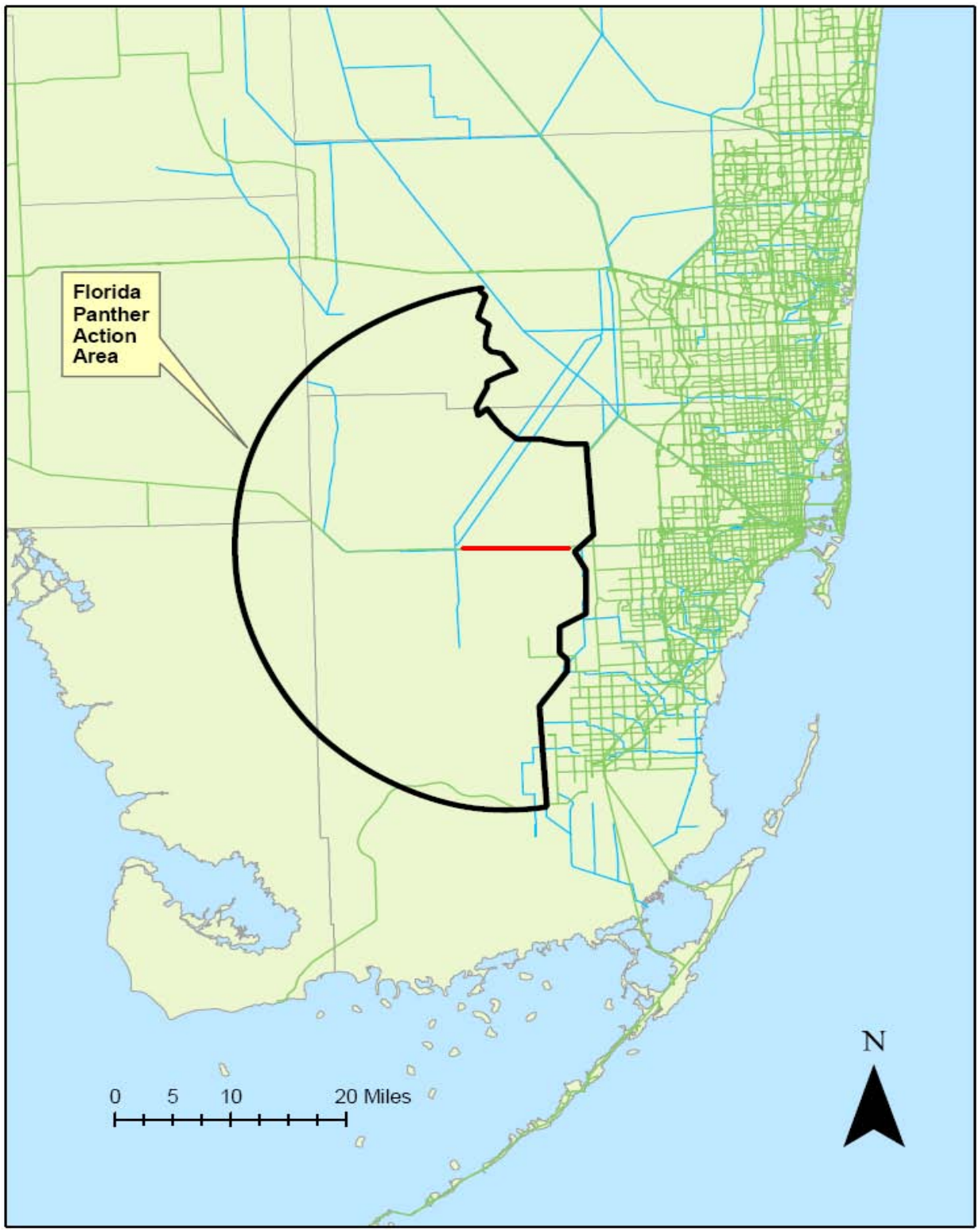

Figure 4. Map of Florida panther action area in Miami-Dade, Broward, and Collier Counties for the Tamiami Trail Modification project (project site indicated by red line).

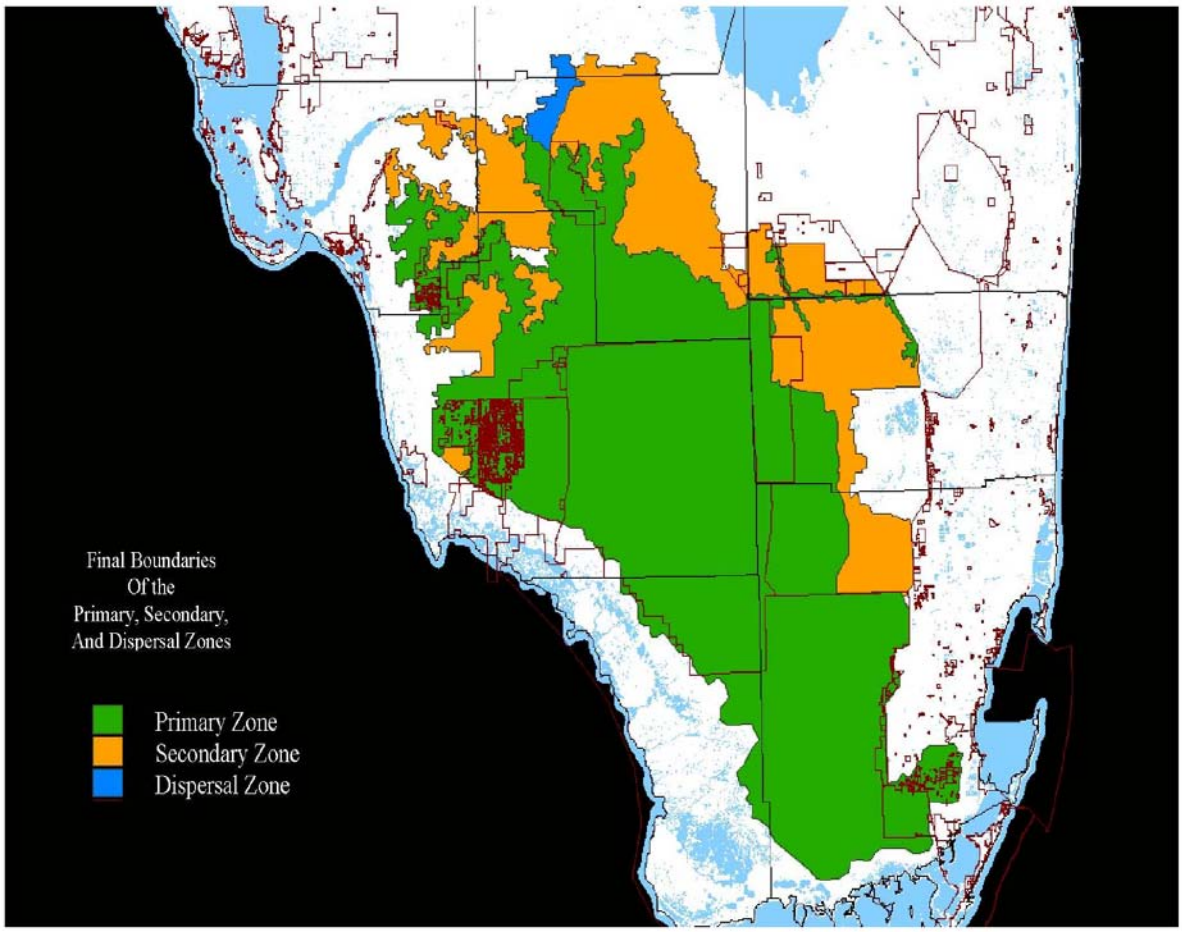

Figure 5. Primary, Secondary, and Dispersal Zones from Kautz et al. (2006).

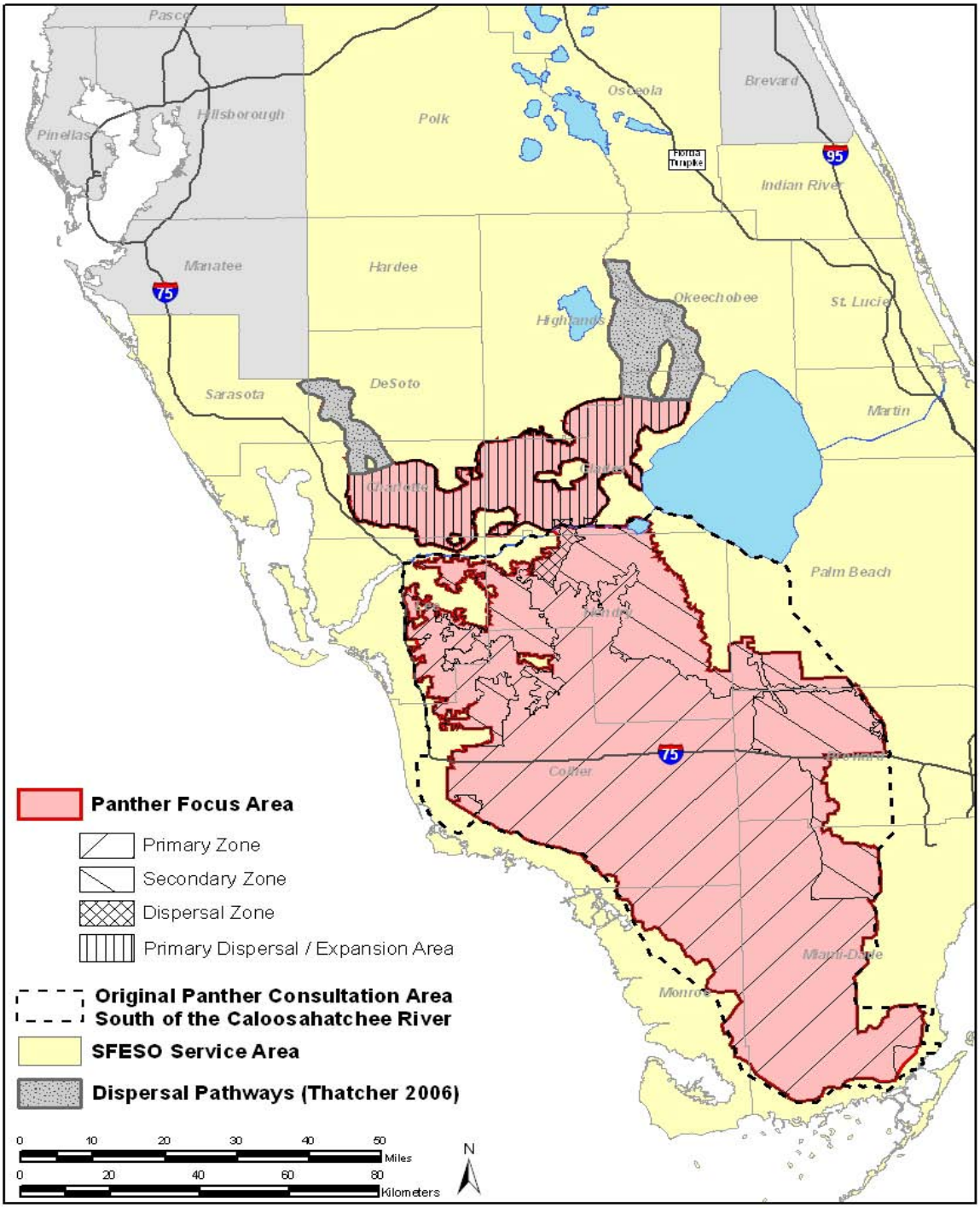

Figure 6. Florida panther focus area and original panther consultation area.

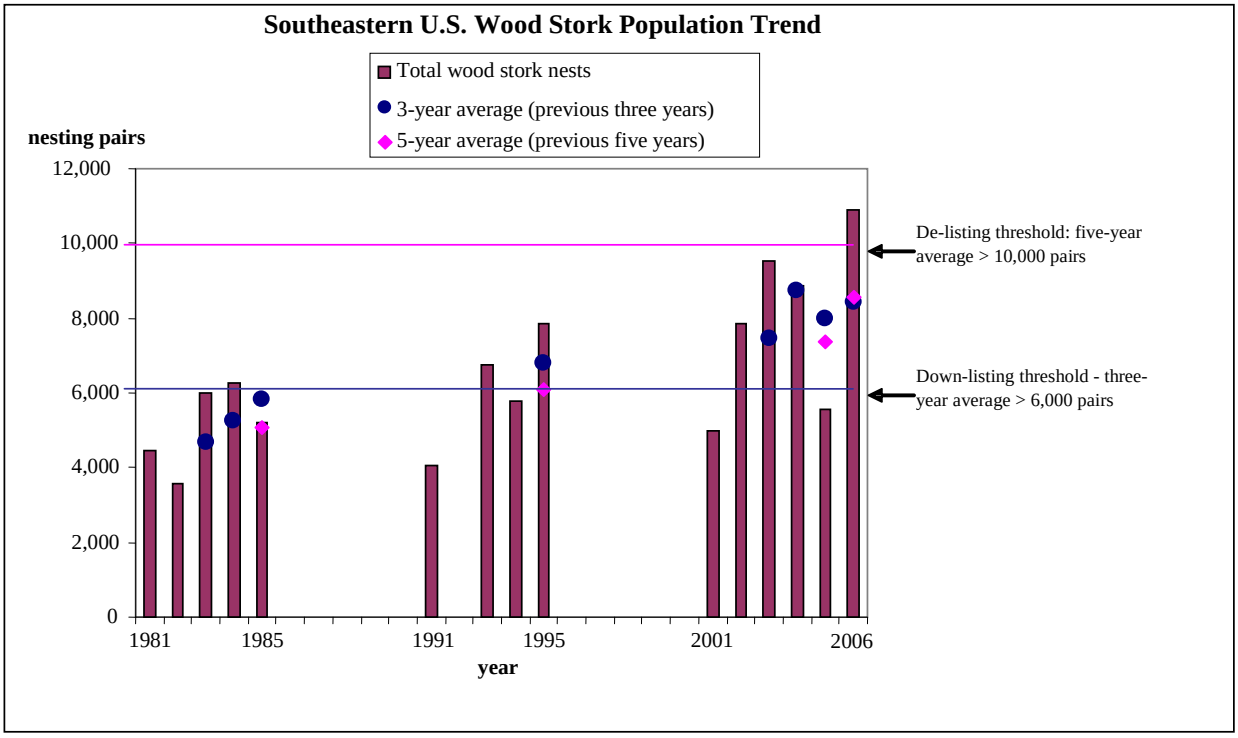

Figure 7. Total wood stork nesting in the Southeastern United States in relation to recovery criteria.

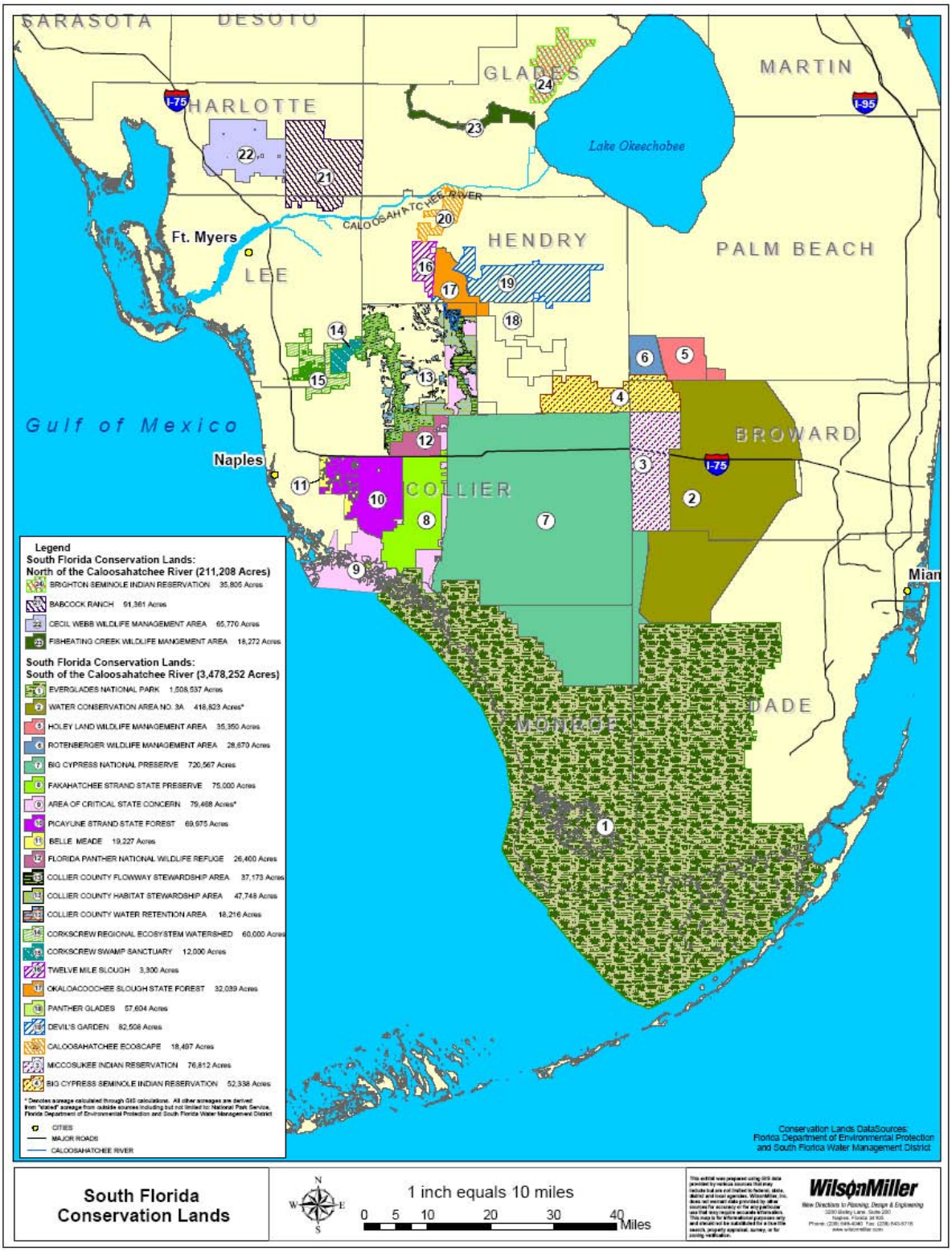

Figure 8. Southwest Florida conservation lands.

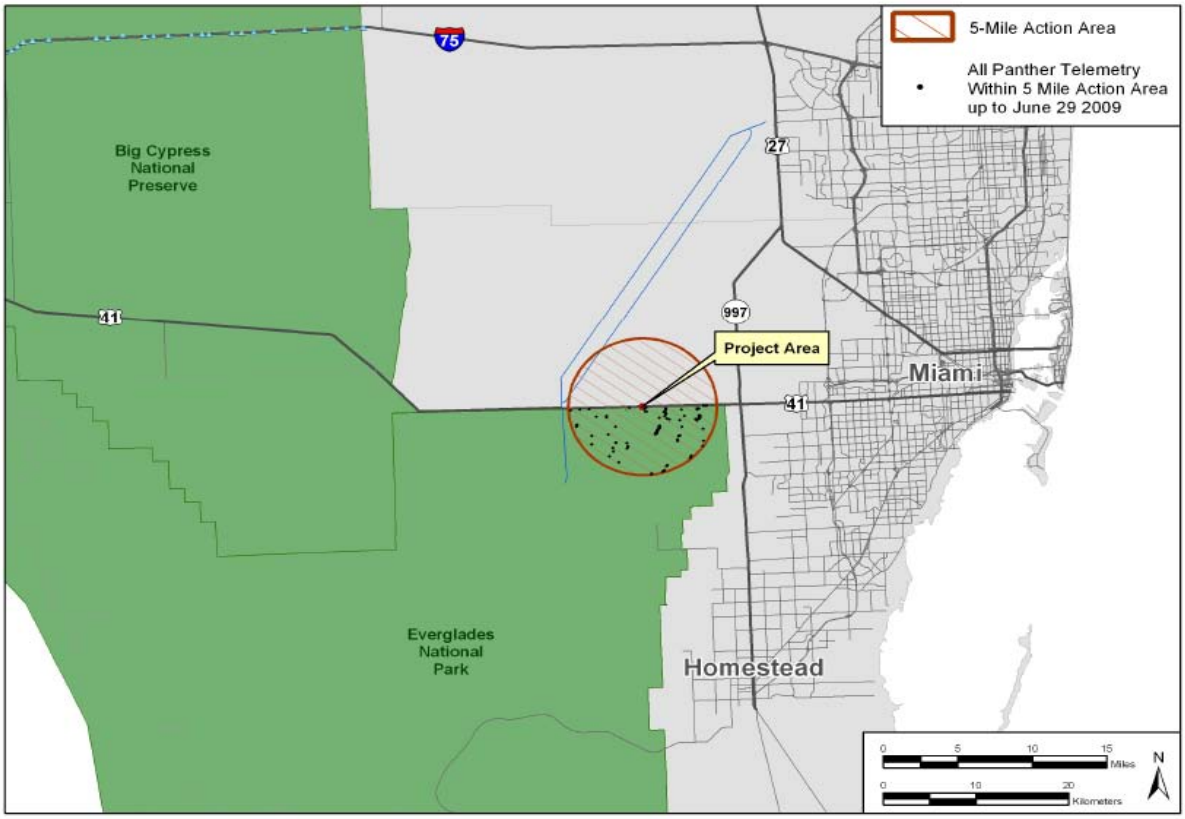

Figure 9. Map indicating Florida panther telemetry points within 5 miles of the Tamiami Trail Modifications project site.

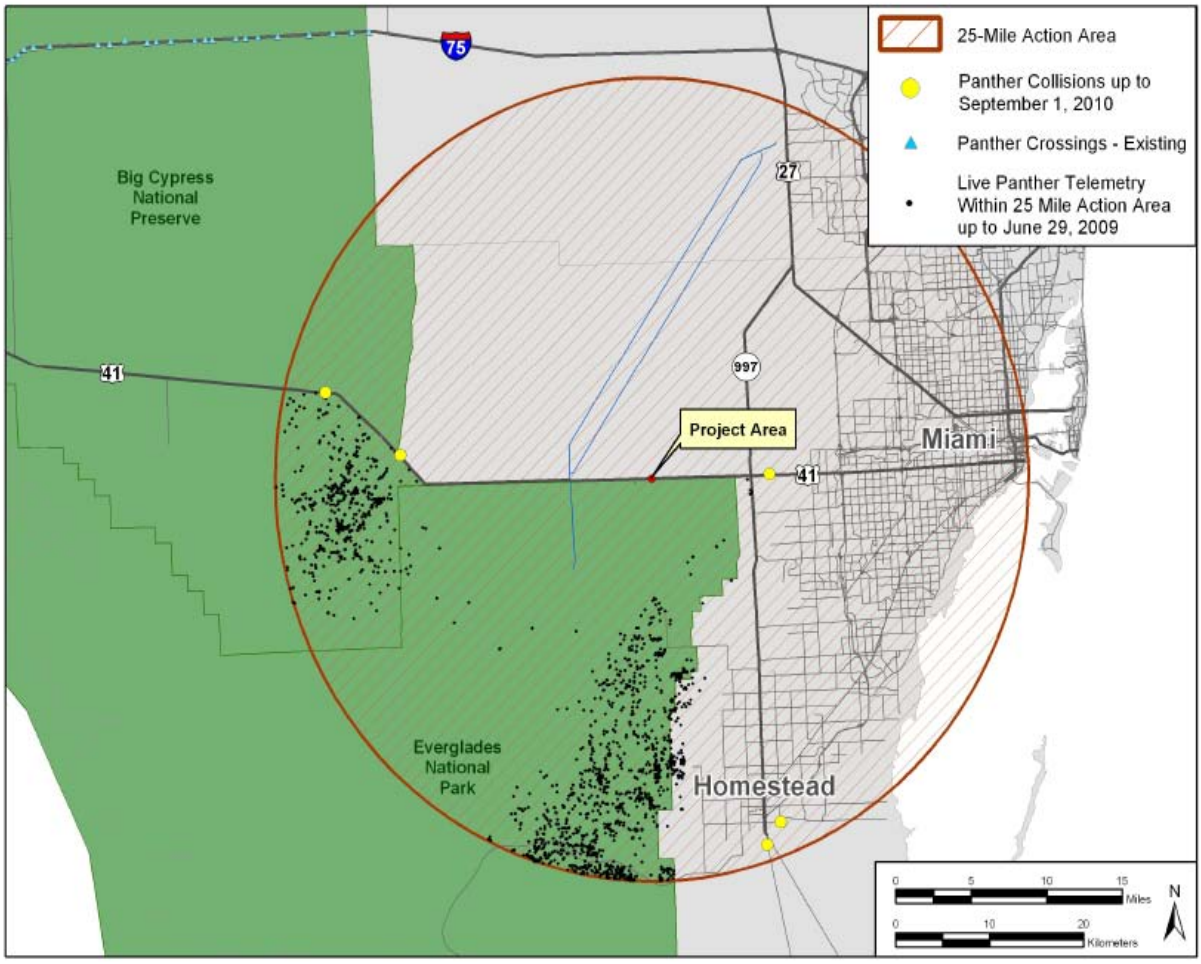

Figure 10. Locations of Florida panther/vehicle collisions within Florida panther action area of the Tamiami Trail Modifications project site.