United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960
August 13, 2012

Memorandum

To: Pedro Ramos, Superintendent, Big Cypress National Preserve

From: Larry Williams, Field Supervisor, South Florida Ecological Services Office

Subject: Off Road Vehicle (ORV) Trail Heads and U.S. Highway 41 Turn Lanes Project,
Service Federal Activity Code: 2012-CPA-0140;
Service Consultation Code: 2012-I-0139

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion for the construction of ORV trail heads and turn lanes on U.S. Highway 41 in the Big Cypress National Preserve (BCNP) and its effects on the endangered Florida panther (panther; *Puma concolor coryi*) in accordance with section 7 of the Endangered Species Act of 1973, as amended in 1998 (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). The project sites are located in the BCNP, Collier County and Monroe County, Florida (Figure 1).

This Biological Opinion is based on information provided in the National Park Service's (NPS) letter to the Service and Environmental Assessment dated June 4, 2012; meetings, telephone conversations, emails, and other sources of information. A complete administrative record of this consultation is on file at the Service's South Florida Ecological Services Office (SFESO), Vero Beach, Florida.

Consultation History

On June 7, 2012, the Service received a letter and Environmental Assessment from the NPS regarding construction of ORV trail heads and turn lanes on U.S. Highway 41 within the BCNP. The NPS determined the project would "not affect" the threatened eastern indigo snake (*Drymarchon corais couperi*), threatened American crocodile (*Crocodylus acutus*), endangered wood stork (*Mycteria americana*), and endangered West Indian manatee (*Trichechus manatus*). The NPS also determined that the project "may affect, but is not likely to adversely affect" the panther.

On June 28, 2012, Service biologists conducted a site inspection of the proposed ORV trail heads and U.S. Highway 41 turn lanes in the BCNP.

In an email to the NPS dated July 3, 2012, the Service informed the NPS we could not concur with their determinations that the ORV trail heads and U.S. Highway 41 turn lanes project would "not affect" the wood stork, and "may affect, but is not likely to adversely affect" the Florida panther. The Service recommended the NPS change their determination for the wood stork from

"no effect" to "may affect, not likely to adversely affect." The Service also recommended the NPS change their determination for the Florida panther from "may affect, not likely to adversely affect" to "may affect, likely to adversely affect," and request initiation of formal consultation.

On July 11, 2012, and July 20, 2012, staff from the Service and the NPS met via conference call to discuss the project.

As of July 29, 2012, we received all the information necessary for initiation of formal consultation on the Florida panther for this project as required in the regulations governing interagency consultations (50 CFR § 402.14). The Service is providing this Biological Opinion in conclusion of formal consultation.

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

The NPS proposes to improve trail heads in the BCNP to enhance access for ORV and other recreational users. Improvements are proposed at the following locations: Skillet Strand North, Skillet Strand South, Monroe Station, Sig Walker, Paces' Dike, and Boundary Line. Improvements include the construction of lime rock or asphalt entry ways, parking areas, and stormwater ponds, and the installation of wheel stops, vault toilets, refuse containers, information boards, signs, gates, and back country permit stations. Each trail head site will be landscaped with sod and native plants. To improve traffic safety on U.S. Highway 41, turn lanes will be constructed at Burns Road, the Oasis Visitor Center, the Skillet Strand North and South trail heads, Monroe Station South, and Turner River Road. The project sites are located in the BCNP (Figure 1). The project will impact 14 acres (ac) of wetlands. To compensate for impacts to wetlands, the NPS has proposed to obtain credits from a Service-approved mitigation bank that provides wood stork foraging biomass.

Adverse effect to the Florida panther and proposed compensation

The project sites will impact 17.5 ac of land within the "Primary" zone (Kautz et al. 2006) of the Service's "Focus Area" (as defined on page 4; Figures 2 and 3) for the endangered Florida panther. The project footprints within the Primary Zone are comprised of 3.5 ac of pine forest, 4.9 ac of cypress swamp, 5.3 ac of wet prairie, 0.3 ac of surface waters, and 3.5 ac of urban lands. The Service finds the 17.5-ac project site provides about 13.7 ac of habitat types suitable for panther feeding and dispersal. Therefore, the project will result in the loss of about 13.7 ac (rounded to 14 ac) of panther habitat. The Service has determined the 14 ac of panther habitat to be impacted provide a total of 103.24 Panther Habitat Units (PHUs) (see Appendix A and Table 6).

The NPS has proposed to minimize the adverse effects of the loss of panther habitat resulting from the project by acquiring 258 PHUs from a Service-approved conservation or mitigation bank. The proposed compensation plan provides habitat preservation and restoration near the project area, and is consistent with goal 1.1.1.2.3 in the Panther Recovery Plan (Service 2008) recommending that habitat preservation and restoration be provided, especially within the Primary Zone, in situations where land use intensification cannot be avoided. The applicant has proposed equivalent habitat protection and restoration, to compensate for both the function and value of the lost habitat.

Action area

The action area is defined as all areas to be directly or indirectly affected by the Federal action and not merely the immediate area involved in the action. Therefore, the Service considers the action area for this project as all lands within the footprints of the proposed ORV trail heads and U.S. Highway 41 turn lanes, and all lands located in the Service's panther Focus Area (Focus Area) within 25 miles of the boundary of these footprints (Figure 4). The 25-mile buffer around the project footprint is based on mean dispersal distances of 37.3 kilometers (km) (23.2 miles) (Maehr et al. 2002a), and 40.1 km (24.9 miles) (Comiskey et al. 2002) reported for subadult male panthers. The 25-mile buffer distance encompasses the dispersal distance of both male and female panthers because male panther dispersal distances are known to exceed those reported for female panthers (Maehr et al. 2002a; Comiskey et al. 2002). The size of the action area for this consultation is consistent with action areas defined in our recent biological opinions for the panther, and it encompasses the wide ranging movements of subadult panthers and the large home territories of adult panthers.

The Focus Area denotes areas in Florida where development projects could potentially affect the panther (Figure 2) and is based on the scientific information on panther habitat usage provided in Kautz et al. (2006) and Thatcher et al. (2006). The Focus Area includes lands in Charlotte, Glades, Hendry, Lee, Collier, Palm Beach, Broward, Miami-Dade, and Monroe Counties, as well as the southern portion of Highlands County (Figure 2). Developed urban coastal areas in eastern Palm Beach, Broward, and Miami-Dade Counties, and in western Charlotte, Lee, and Collier Counties were excluded because they contain little or no panther habitat, and it is unlikely panthers would use such areas. Additional details regarding the Panther Focus Area zones (*e.g.*, Primary, Secondary, etc.) can be found in the *Habitat Characteristics/Ecosystem* and *South Florida Panther Population Goal* headings, below. Areas outside of the Panther Focus Area, but within the original Consultation Area (Figure 2), are collectively known as the "Other Zone."

STATUS OF THE SPECIES AND CRITICAL HABITAT RANGEWIDE

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 [m]) from their nose to the tip of their tail and may exceed 161 pounds (lbs) (73 kg) in weight; but, typically adult males average around 116 lbs (52.6 kg) and stand about 24 to 28 inches (in) (60 to 70 centimeters [cm]) at the shoulder (Roelke 1990). Female panthers are smaller with an average weight of 75 lbs (34 kg) and length of 6 ft (1.8 m) (Roelke 1990). 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 characteristics – a right angle crook at the terminal end of the tail, a whorl of hair or cowlick in the middle of the back, and irregular, white flecking on the head, nape, and shoulders – not found in combination in other subspecies of *Puma* (Belden 1986), were commonly observed in 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 2005a). As of January 27, 2003, none of the eight female Texas panthers introduced in 1995 remain in the wild.

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 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 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 accepted the results of Culver et al. (2000) and the proposed change in taxonomy is not resolved at this time (Service 2008). The Florida panther remains listed as a subspecies, and continues to receive protection pursuant to the Act.

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 confirmed a breeding panther population occurs in southern Florida south of the Caloosahatchee River, and no survey since then has been able to confirm a reproducing panther population outside of southern Florida.

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 Florida Fish and Wildlife Conservation Commission [FWC]) declared the panther a regulated game species due to concerns over declining numbers. The FWC removed panthers from the game animal list in 1958 and gave them complete legal protection. On March 11, 1967, the Service listed the panther as endangered (32 FR 4001) throughout its historic range, and these animals received Federal protection under the passage of the Act. In 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. Because 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 2008). Critical habitat has not been designated for the panther.

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 to 60 percent of births occurring between March and June (Jansen et al. 2005; Lotz et al. 2005). The greatest number of births occurs in May and June (Jansen et al. 2005; Lotz et al. 2005). 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 to 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 to 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 March 3, 2012, 317 mortalities have been documented. Of the 317 total mortalities, 161 were radio-collared panthers that died since 1981 (FWC 2010a). Intraspecific aggression was the leading cause of mortality for radio-collared panthers, and was more common for males than females (Benson et al. 2009). Older-adult males had significantly higher and subadult males had marginally higher mortality due to intraspecific aggression than 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 19, 2012, 172 Florida panthers (radio-collared and uncollared) were hit by vehicles (FWC 2010a). These collisions resulted in 164 panther fatalities and 8 non-fatal injuries. The number of panther/vehicle collisions per year is positively correlated with the annual panther count (McBride et al. 2008).

Female panthers are considered adult residents if they are older than 18 months, have established home ranges and bred (Maehr et al. 1991). Land et al. (2004) reported 23 of 24 female panthers first captured as kittens survived to become residents and 18 (78.3 percent) produced litters;

1 female was too young to determine residency. Male panthers are considered adult residents if they are older than 3 years and have established a home range that overlaps with females. Thirty-one (31) male panthers were captured as kittens and 12 (38.7 percent) of these cats survived to become residents (Jansen et al. 2005; FWC 2005). "Successful male recruitment may depend on the death or home range shift of a resident adult male" (Maehr et al. 1991). Turnover in the breeding population is low with documented mortality in radio-collared panthers being greatest in subadult and non-resident males (Maehr et al. 1991; Shindle et al. 2003).

Den sites of female panthers have been visited since 1992 and the kittens tagged with passive integrated transponder chips. Annual survival of these kittens has been determined to be 0.328 ± 0.072 (SE) (Hostetler et al. 2009). There was no evidence that survival rate differed between male and female kittens or was influenced by litter size. Hostetler et al. (2009) found kitten survival generally increased with degree of admixture with introduced Texas pumas and decreased with panther abundance. Kitten survival is lowest during the first 3 months of their lives (Hostetler et al. 2009).

Dispersal

Panther dispersal begins after a juvenile becomes independent from its mother and continues until it establishes a home range. Dispersal distances are greater for males than females. Maehr et al. (2002a) reported a mean dispersal distance of 42.5 miles [68.4 km] for male panthers (n = 18) and 12.6 miles [20.3 km] for female panthers (n = 9). 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). Comiskey et al. (2002) found that males disperse an average distance of 25 miles (40 km) and females typically remain in or disperse short distances from their natal ranges. 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. However, panthers have been documented north of the Caloosahatchee River over 125 times since February 1972 through field signs (*e.g.*, tracks, urine markers, scats), camera-trap photographs, carcasses from seven vehicle-related mortalities, telemetry from four radio-collared animals (Land and Taylor 1998; Land et al. 1999; Shindle et al. 2000; Maehr et al. 2002a; Belden and McBride 2005), two captured animals (one of which was radio collared), and one skeleton. From 1972 through 2004, panthers have been confirmed in 11 counties (Flagler, Glades, Highlands, Hillsborough, Indian River, Okeechobee, Orange, Osceola, Polk, Sarasota, Charlotte, and Volusia) north of the river (Belden et al. 1991; Belden and McBride 2005). However, to date, successful panther reproduction has not been documented north of the Caloosahatchee River (Belden and McBride 2005).

The Caloosahatchee River, a narrow (295-328 ft [90-100 m]), channelized river, and is probably is not a significant barrier to panther movements. Western subspecies of *Puma* are known to cross wide, swift-flowing rivers up to a mile in width (Seidensticker et al. 1973; Anderson 1983). However, the combination of the river, SR 80, and land uses along the river seems to have somewhat restricted panther dispersal northward (Maehr et al. 2002a). Documented physical evidence of at least 15 other uncollared male panthers has been confirmed north of the river since 1972, but neither female panthers nor reproduction have been documented in this area since 1973 (Belden and McBride 2005).

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 ac (51,800 hectares [ha]) for resident adult males and 48,000 ac (19,425 ha) for resident adult females; transient males had a home range of 153,599 ac (62,160 ha) (Maehr et al. 1991). Comiskey et al. (2002) examined the home range size for 50 adult panthers (residents greater than 1.5 years old) monitored in south Florida from 1981 to 2000 and found resident males had a mean home range of 160,639 ac (65,009 ha) and females had a mean home range of 97,920 ac (39,627 ha). Beier et al. (2003) found home range size estimates for panthers reported by Maehr et al. (1991) and Comiskey et al. (2002) to be reliable.

Annual minimum convex polygon home range sizes of 52 adult radio-collared panthers monitored between 1998 and 2002 ranged from 15,360 to 293,759 ac (6,216 to 118,880 ha), averaging 89,600 ac (36,260 ha) for 20 resident adult males and 44,160 ac (17,871 ha) for 32 resident adult females (Land et al. 1999, 2002; Shindle et al. 2000, 2001). The most current estimate of home-range sizes (minimum convex polygon method) for established, non-dispersing, adult, radio-collared panthers averaged 29,056 ac (11,759 ha) for females (n = 11) and 62,528 ac (25,304 ha) for males (n = 11) (Lotz et al. 2005). The average home range was 35,089 ac (14,200 ha) for resident females (n = 6) and 137,143 ac (55,500 ha) (n = 5) for males located at 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, confirms panthers move extensively within home ranges, visiting all parts of the range regularly in the course of hunting, breeding, and other activities (Maehr 1997; Comiskey et al. 2002). Males travel widely throughout their home ranges to maintain exclusive breeding rights to females. Females without

kittens also move extensively within their ranges (Maehr 1997). Panthers are capable of moving large distances in short periods of time. Nightly panther movements of 12 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 (FWC 2011a).

Adult females and their kittens interact more frequently than any other group of panthers. Interactions between adult male and female panthers last from 1 to 7 days and usually result in pregnancy (Maehr et al. 1991). Aggressive interactions between males often result in serious injury or death. Independent subadult males have been known to associate with each other for several days and these interactions do not appear to be aggressive in nature. Aggression between males is the most common cause of male mortality and an important determinant of male spatial and recruitment patterns based on radio-collared panthers (Maehr et al. 1991; Shindle et al. 2003). Aggressive encounters between radio-collared males and females also have been documented (Shindle et al. 2003; Jansen et al. 2005).

Food habits

Primary panther prey species are white-tailed deer and feral hog (*Sus scrofa*) (Maehr et al. 1990b; Dalrymple and Bass 1996). Generally, feral hogs constitute the greatest biomass consumed by panthers north of the Alligator Alley section of I-75, while white-tailed deer are the greatest biomass consumed to the south (Maehr et al. 1990b). Secondary prey species include raccoons (*Procyon lotor*), nine-banded armadillos (*Dasypus novemcinctus*), marsh rabbits (*Sylvilagus palustris*) (Maehr et al. 1990b) and American alligators (*Alligator mississippiensis*) (Dalrymple and Bass 1996). No seasonal variation in diet has been detected. Maehr et al. (1990b) rarely observed domestic livestock in scats or kills of the Florida panther, although cattle were readily available in the study area. Recently, a male panther, believed to be associated with calf depredations, was captured and collared in eastern Collier County (FWC 2010c).

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 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 2005b; 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 indicate 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 2005a). 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 aka 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).

Population dynamics / Status 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. Nonetheless, a reproducing population of panthers has not been documented to occur outside of south Florida for at least 30 years despite an extensive search effort (Belden et al. 1991; McBride et al. 1993; Clark et al. 2002). Survey reports and more than 70,000 locations of radio-collared panthers recorded between 1981 and 2004 clearly define the panther's current breeding range. Reproduction is known only in the Big Cypress Swamp and Everglades physiographic region in Collier, Lee, Hendry, Miami-Dade, and Monroe Counties, south of the Caloosahatchee River (Belden et al. 1991). As discussed previously, panthers occasionally disperse north of the Caloosahatchee River. However, these animals are likely all males

searching to establish new territories. There is no evidence of female panthers or successful panther reproduction currently occurring north of the Caloosahatchee River (Nowak and McBride 1974; Belden et al. 1991; Land and Taylor 1998; Land et al. 1999; Shindle et al. 2000; McBride 2002; Belden and McBride 2005).

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

Using a population genetics approach, Culver et al. (2008) estimated that, to reduce the microsatellite variation to that seen in the Florida panther, a very small bottleneck size of approximately two animals (N_e) for several generations and a small effective population size (N_e) in other generations would be necessary. Using demographic data from Yellowstone pumas, Culver et al. (2008) estimated the ratio of effective (N_e) to census (N) population size to be 0.315 (N_e)/(N). Using this ratio, they determined that, for the Florida panther, the census population size necessary to explain the loss of microsatellite variation was approximately 41 (0.315=12.9/41) for the non-bottleneck generations and 6.2 (0.315=1.95/6.2) for the two bottleneck generations.

Minimum population counts

McBride et al. (2008) and McBride (2010) reported minimum population counts (*i.e.*, number known alive) based on physical evidence (*e.g.*, tracks, urine markers, panther treed with hounds, trail-camera photos). They counted adult and subadult panthers, but not kittens at the den. Three rules were used to distinguish individuals: (1) gender was determined by track size or stride length; (2) time (freshness) was determined by known events within the past 24 hours, such as wind or rain; and (3) distance between individual track sets. These rules were used as an exclusionary tool to avoid over-counting (McBride et al. 2008). The number of panthers detected and verified by physical evidence from 1981 to 1994 fluctuated between a high of 30 and a low of 19 adult and juvenile panthers, with the lowest point occurring in 1991 following the removal of seven juveniles and three kittens to initiate a captive breeding program (McBride et al. 2008). In 1995,

eight female pumas from Texas were released to address suspected deleterious effects of inbreeding. From 1996 to 2003, the panther population was increasing at a rate of 14 percent per year with 26.6 kittens being produced annually (Johnson et al. 2010). The effective population size (N_e) rose from 16.4 in 1995 to 32.1 in 2007, with corresponding census populations (N) of 26 and 102, respectively. The corresponding N_e /N ratios were 0.631 and 0.314 (Johnson et al. 2010). The deterministic annual growth rate (λ) for pre-1995 panthers was 0.952 ± 0.026 (SE), suggestive of a shrinking population (Hostetler et al. 2009). However, the λ for the overall population now is 1.052 ± 0.023, suggestive of a growing population (Hostetler et al. 2009).

The population tripled since 1995 (McBride et al. 2008, Johnson et al. 2010), reaching a high of 117 by 2007 (mortalities not subtracted). Data reported in McBride (2000, 2001, 2004, 2006, 2007, and 2008), McBride et al. (2008, 2012), Johnson et al. (2010), and FWC (2002, 2003) noted minimum population counts of 62 panthers in 2000, 78 in 2001, 80 in 2002, 87 in 2003, 78 in 2004, 82 in 2005, 97 in 2006, 117 in 2007, 104 in 2008, 113 in 2009, 115 in 2010, and 111 in 2011.

Population density

Maehr et al. (1991) provide an estimate of population density of 1 panther per 27,520 ac, based on 17 concurrently radio-collared and 4 uncollared panthers. They extrapolated this density to the area occupied by radio-collared panthers (1,245,435 ac) during the period 1985 to 1990 to achieve a population estimate of 46 adult panthers for southwest Florida (excluding ENP, eastern BCNP, and Glades and Highlands Counties). Beier et al. (2003), however, argued that this estimate of density, although "reasonably rigorous," could not be extrapolated to other areas because it was not known whether densities were comparable in those areas. Kautz et al. (2006) provided a density estimate of 1 panther per 31,923 ac 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 covered by McBride et al. (2008) and Kautz et al. (2006), the density estimates range from a low of 1 panther per 81,479 ac to a high of 1 panther per 7,850 ac for the Primary Zone lands within these survey units.

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

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 ac (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 to 23,438 mi^2 (40,469 to 60,703 km^2) would be needed to support an effective population size of 50 individuals (equating to an actual adult population of 100 to 200 panthers [Ballou et al. 1989]). However, to provide for long-term persistence based on an effective population size of 500 individuals (equating to 1,000 to 2,000 adult panthers [Ballou et al. 1989]), could require as much as 156,251 to 234,376 mi^2 (404,687 to 607,031 km^2). This latter acreage corresponds to roughly 60 to 70 percent of the Florida panther's historical range. Although it is uncertain whether this much land is needed for panther recovery, it does provide some qualitative insight into the importance of habitat conservation across large landscapes for achieving a viable panther population (Noss and Cooperrider 1994).

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

A landscape-level strategy for the conservation of the panther population in south Florida was developed using a Florida panther potential habitat model based on the following criteria: (1) forest patches greater than 4.95 ac (2 ha); (2) non-urban cover types within 656 ft (200 m) of forest patches; and (3) exclusion of lands within 984 ft (300 m) of urban areas (Kautz et al. 2006). In developing the model, data from radio-collared panthers collected from 1981 through 2000 were used to evaluate the relative importance of various land cover types as panther habitat, thus identifying landscape components important for panther habitat conservation. Those components were then combined with a least cost path (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 2 and 3). 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 ac (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 ac (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 ac (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 ac (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 ac (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 ac (12,919 ha) value (Kautz et al. 2006) and the higher number is based on the 27,181 ac (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 (GIS) to develop a multivariate landscape-scale habitat model based on the Mahalanobis distance statistic (D^2) to evaluate habitats in south central Florida for potential expansion of the 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 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, 1992; Maehr et al. 1991; Smith and Bass 1994; Kerkhoff et al. 2000; Comiskey et al. 2002, Cox et al. 2006, Kautz et al. 2006, Land et al. 2008) and natal den sites (Benson et al. 2008) were within or close to forested cover types, particularly cypress swamp, pinelands, hardwood swamp, and upland hardwood forests. Global Positioning System data has shown panthers (n = 12) use all habitats contained within their home ranges by selecting for forested habitat types and using all others in proportion to availability (Land et al. 2008).

Kautz et al. (2006) found the smallest class of forest patches (*i.e.*, 9 to 26 ac [3.6 to 10.4 ha]) were the highest ranked forest patch sizes within panther home ranges. The diverse woody flora of forest edges probably provides cover suitable for stalking and ambushing prey (Belden et al. 1988; Cox et al. 2006). Also, dense understory vegetation comprised of saw palmetto provides some of the most important resting and denning cover for panthers (Maehr 1990; Benson et al. 2008). Shindle et al. (2003) estimated 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 important 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 ac (85 ha) in pine forest, 1 per 299 ac (121 ha) in swamps, 1 per 1,280 ac (518 ha) in prairie, 1 per 250 ac (101 ha) in marshes, and 1 per 111 ac (45 ha) in hammocks. Schortemeyer et al (1991) estimated deer densities at 1 per 49 to 247 ac (20 to100 ha) in three management units of BICY based on track counts and aerial surveys. Labisky et al. (1995) reported 1 per 9 ac (20 ha) in southeastern BICY. Using track counts alone, McCown (1994) estimated 1 per 183 to 225 ac (74 to 91 ha) on the FPNWR and 1 per 133 to 200 ac (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, 1992; Maehr et al. 1991; 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, 2004; Beier et al. 2003, 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 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 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 m) wide, and corridors extending 0.6 to 4 miles (1 to 7 km) should be more than 1,312 ft (400 m) wide. The Dispersal Zone encompasses 44 mi^2 (113 km^2) with a mean width of 3.4 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 an important 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 habitat evaluation and compensation

Population Viability Analysis (PVA) has emerged as a key component of endangered species conservation. This process is designed to incorporate demographic information into models that predict if a population is likely to persist in the future. PVAs incorporate deterministic and stochastic events including demographic and environmental variation, and natural catastrophes. PVAs have been criticized as being overly optimistic about future population levels (Brook et al. 1997) and should be viewed with caution; however, they are and have been shown to be surprisingly accurate for managing endangered taxa and evaluating different management practices (Brook 2000). 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. 1988; 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 through June 2010, 182 Florida panthers have been radio-collared and monitored on public and private lands throughout south Florida (FWC 2010a). Radio-collar data were used by researchers to estimate survival rates and fecundity and were incorporated into PVA models previously developed for the Florida panther (Seal and Lacy 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 and 2002 (McBride 2001, 2002).

The use of 41 females in the model was based on the best available data when the model was developed. The total of 41 females represents the number of individual panthers documented in surveys by McBride (2001, 2002). While the total of 41 females includes subadults that do not yet breed, it is reasonable to use this total number in modeling to evaluate population trends for several reasons. First, it is not feasible to differentiate between subadults and adults through field observation. Second, although it is possible some of the 41 females were not breeding in year one of the model, these females would mature to breeding age by year 2 of the model. Third, the Root (2004) model assumed females to have "a 50 percent chance of breeding in a given year," and therefore only half of the 41 females were modeled as breeding each year. The primary reason the model (Root 2004) assumed a 50 percent chance of breeding in a given year is that kittens stay with their mother from 15 to 24 months prior to dispersal; however, this assumption accounts for the likelihood 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. 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 PVA versions

The basic versions of each model incorporated no catastrophes or epidemics, no change in habitat quality or amount, and a ceiling type of density dependence. The basic versions of the models incorporated a carrying capacity of 53 females (106 panthers with a 50:50 sex ratio). Variants of the models were run with differing values for density dependence, various levels of habitat loss, and intermittent catastrophes or epidemics. Each simulation was run with

10,000 replications for a 100-year period. The minimum number of panthers needed to ensure a 95 percent probability of persistence for 100 years was estimated in a series of simulations in which initial abundance was increased until probability of extinction at 100 years was no greater than 5 percent. More detailed information concerning the PVA model parameters appears in Root (2004).

The results of an earlier, conservative PVA model run done by Seal (1989) 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. Later work based on an improved panther modeling and a larger sample of monitored panthers produced both a moderate and optimistic scenario (Root 2004). The moderate model resulted in a 5 percent probability of extinction and a mean final abundance of 42.3 females in 100 years. The probability of panther abundance declining by half the initial amount was 20 percent in 100 years under the moderate model. The optimistic model resulted in a 2 percent probability of extinction and mean final abundance of 51.2 females in 100 years. The probability of panther abundance declining by half the initial amount was only 9 percent in 100 years under the optimistic model. These models also provide a probability of persistence (100 percent minus probability of extinction) over a 100-year period of 95 percent for the moderate model and 98 percent for the optimistic model.

Model results were also provided by Root (2004) for probability of extinctions for 1 percent loss of habitat per year, within the first 25 years of the model run, based on both the moderate and optimistic scenarios. The 1 percent loss of habitat equates to essentially all remaining non-urban privately owned lands in the Primary Zone and corresponds to the estimated rate of habitat loss from 1986 to 1996 for the five southwest counties based on land use changes (Root 2004). For the moderate model, the model runs predict a probability of extinction increase of about 1 percent, 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. Root's (2004) moderate model runs, which have a carrying capacity 53 females (106 individuals), show final populations of 42.3 females (84 total) and 31.2 females (62 total) with extinction rates of 5 percent and 6 percent, respectively, for the basic and 1 percent habitat loss scenarios. The predicted final populations in Root (2004) are 84 and 62 panthers for no loss of habitat and 1 percent loss of habitat, respectively, over a 100-year period.

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

As discussed above, the panther population has shown an increase in the number of panthers reported yearly, beginning in 2000. The Service believes McBride's verified population of 97 panthers in 2006, 117 panthers in 2007, 104 in 2008, 113 in 2009, 115 in 2010, and 111 in 2011 is within Kautz et al.'s (2006) population guidelines representing a population that is likely stable but still may be subject to genetic problems.

The Service also believes the model runs show lands in the Primary Zone are important to the survival and recovery of the Florida panther, and 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 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 and severity of assumptions violated. The Service realizes that habitat loss is occurring at an estimated 0.8 percent loss of habitat per year (R. Kautz, FWC, personal communication, 2003, as cited in Service 2008). The Service 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 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 considered the recent outbreak of feline leukemia in the panther population at Okaloacoochee Slough as a potential catastrophe. The FWC is carefully monitoring the situation and it appears to be under control at this time due to a successful vaccination program. However, if the outbreak spreads into the population, the Service will consider this as a catastrophe and factor this into our decisions.

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

Recovery goals

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

Habitat conservation and protection

Panthers, because of their wide-ranging movements and extensive spatial requirements, are particularly sensitive to habitat fragmentation (Harris 1984). Mac et al. (1998) defines habitat fragmentation as: "The breaking up of a habitat into unconnected patches interspersed with other habitat which may not be inhabitable by species occupying the habitat that was broken up. The breaking up is usually by human action, as, for example, the clearing of forest or grassland for agriculture, residential development, or overland electrical lines." The reference to "unconnected patches" is a central underpinning of the definition. For panther conservation, this definition underscores the need to maintain contiguous habitat and 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, continued action is needed to obtain additions to and inholdings for public lands, assure linkages are maintained, restore degraded and fragmented habitat, and obtain the support of private landowners for maintaining property in a manner that is compatible with panther use. Conservation lands used by panthers are held and managed by a variety of entities including the Service, NPS, Seminole Tribe of Florida, Miccosukee Tribe of Indians of Florida, FWC, Florida Department of Environmental Protection (DEP), Florida Division of Forestry (FDOF), Water Management Districts, non-governmental organizations, counties, and private landowners.

Public lands

From 1944 to the present, approximately 2,756,802 ac (1,115,638 ha) of public lands in south Florida have been acquired, which benefit the Florida panther (Figure 5).

Tribal lands

Lands of the Seminole Tribe of Florida and Miccosukee Tribe of Indians of Florida encompass over 350,079 ac (141,673 ha) in south Florida. Of these, 115,840 ac (46,879 ha) are used by panthers, and comprise 5 percent of the Primary Zone (Kautz et al. 2006). In general, these lands are not specifically managed for the panther and are largely in cultivation. However, in 2007, the Seminole Tribe of Florida reserved about 4,144 ac within the Big Cypress Seminole Indian Reservation Native Area, an area encompassing about 14,724 ac, specifically for the benefit of the Florida panther. The remaining native area, about 10,580 ac, 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 conservation/mitigation banks are all methods that hold untapped potential for conserving private lands. In 1954, the National Audubon Society established the nearly 10,880-ac (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 ac (16,835 ha) in Glades County, and it 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 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).

Adverse effects of roads

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 (Forman 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 164 vehicle-related panther mortalities and 8 vehicle-related panther injuries from 1972 to the present on highways in south Florida. In portions of the panther's range, the rate of panther vehicle-related mortalities may be increasing. Smith et al. (2006) found that vehicle-related panther mortalities in Collier County 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 population growth. Unfortunately, the effect of vehicle-related mortality on the existing panther population is largely unknown.

Wildlife underpasses, or crossings, can be constructed within highway corridors to reduce the potential for panther injuries and mortalities resulting from vehicle collisions. Underpasses allow panthers and other wildlife to safely cross under busy roadways, and maintain connectivity and gene flow within the panther population. Underpasses usually consist of a bridge, prefabricated concrete box, or culvert (Forman et al. 2003). Effective crossing structures are

large enough to allow the passage of panthers and include adequate wing fencing to funnel panthers to the crossing site. Crossings should be designed so panthers have an unobstructed view of habitat on the opposite side of the underpass (Foster and Humphrey 1995). The status of lands adjacent to the crossing site should also be considered when determining the location of a crossing. Unprotected private lands adjacent to the crossing could be developed and render the crossing unviable. Accordingly, lands adjacent to crossings should be acquired or placed under a conservation easement or other protective covenant to ensure the crossing will function in perpetuity.

A number of wildlife crossings with associated fencing have already been constructed within major roadways in southwest Florida to benefit the panther and other wildlife species (Figure 6). In 1991, the Florida Department of Transportation (FDOT) finished the construction of 28 wildlife crossings within the I-75 corridor from U.S. Highway 27 to just west of Everglades Boulevard. A total of five vehicle-related panther mortalities were documented within this corridor prior to construction of the crossings. Following construction of the crossings, a total of four vehicle-related panther mortalities (all in 2009) were recorded in the corridor from 1991 to the present. For three of these mortalities, it appears the panther had entered the I-75 right-of-way through gaps in the fence at existing roadway intersections (*i.e.*, SR 29, Snake Road).

The FDOT also constructed six wildlife crossings on SR 29 between Oil Well Road and US 41. Crossings A, B, C, and D are located north of I-75 and Crossings E and F are located south of I-75. Crossings A and B were constructed in 2007, Crossings C and D were constructed in 1995, Crossing E was constructed in 1997, and Crossing F was constructed in 1999. Prior to construction of the SR 29 Crossings, a total of 10 vehicle-related panther mortalities were recorded near the locations of Crossings A and B from 1980 through 2004, and 2 vehicle-related panther mortalities were recorded near the location of Crossings C and D from 1979 through 1990. Vehicle-related panther mortalities have not been recorded in the vicinity of Crossings A, B, C, or D following their installation. A total of 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 mortalities have 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.

Lee County, Collier County, and other entities proposing developments that may adversely affect the panther are working with the Service to construct additional needed crossings for the panther. For example, the Collier County Road Department is currently constructing two wildlife underpasses and barrier fencing within the Oil Well Road (CR 858) corridor at Camp Keais Strand, in association with the Oil Well Road widening project. Lee County constructed a wildlife underpass and barrier fencing on Corkscrew Road in 2004. Moreover, in 2011, a wildlife underpass and barrier fencing was installed east of Immokalee on County Road (CR) 846 in Collier County, as part of the Habitat Conservation Plan for the City Gate development. Finally, a wildlife underpass was installed on Immokalee Road near CR 951 in association with the Twin Eagles development project.

The wildlife crossings described above represent a commendable effort by the FDOT and others to reduce panther deaths resulting from collisions with motor vehicles; however, more crossings are needed within the major roadways of south Florida to further reduce this threat to the panther and other wildlife species (Smith et al. 2006). 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, 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 new wildlife crossings be considered at various sites along these roadways to reduce vehicle-related mortality of panthers and other wildlife species, and to increase connectivity among wildlife populations. The Service continues to work with the FDOT, county road departments, and other entities to ensure wildlife crossings are installed as needed to promote safe passage of panthers and other wildlife across roadways.

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 43 projects involving the panther and habitat preservation (Table 1). The minimum expected result of these projects is impacts to 71,650 ac and the preservation of 14,677 ac of panther habitat. Of the 71,650 ac of impacts, 38,932 ac are due to agricultural conversion and 32,718 ac to development and mining. Portions (10,370 ac) of the largest agricultural conversion project, 28,700 ac by U.S. Sugar Corporation, were re-acquired by the Federal government as a component of the Talisman Land Acquisition (Section 390 of the Federal Agricultural Improvement and Reform Act of 1996 [Public Law 104-127] Farm Bill Cooperative Agreement, FB4) for use in the Comprehensive Everglades Restoration Plan (CERP). The non-agriculture impacts are permanent land losses, whereas the agricultural conversions may continue to provide some habitat function and value to panthers, depending on the type of conversion.

From August 2003 through the date of this Biological Opinion, the Service concluded consultations on 115 development projects affecting 24,657 ac with preservation of 26,939 ac (Table 1). Following our refugia design assessment approach, the projects affected 11,875 ac in the Primary Zone, 7,970 ac in the Secondary Zone, 37 acres in the Dispersal Zone, and 4,775 ac in the Other Zone. Compensation provided included 24,227 ac in the Primary Zone, 272 ac in the Secondary Zone, 675 ac in the Dispersal Zone, and 1,765 ac 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. The PHU habitat value of these lands to

the Florida panther, following our Panther Habitat Assessment methodology, was 77,891 primary equivalent PHUs; concurrently, the project's provided corresponding PHU preservation and enhancement of 199,096 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.

South Florida panther population goal

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

The principal regulatory mechanism that allows the Service to work directly with private land owners during review of development and land alteration projects is section 10 of the Act. The Service also coordinates with Federal agencies pursuant to section 7 of the Act. In August 2000, the Service, to assist the U.S. Army Corps of Engineers (Corps) in assessing project effects to the Florida panther, developed the Florida panther final interim Standard Local Operating Procedures (SLOPES) for Endangered Species (Service 2000) (update in 2007; Service 2007a). The Florida panther SLOPES provide guidance to the Corps for assessing project effects to the Florida panther and recommends actions to minimize these effects. The Florida panther SLOPES also included a consultation area map that identified an action area where the Service believed land alteration projects may affect the Florida panther. The SLOPES document is available on the Corps' web site at: http://www.saj.usace.army.mil/regulatory/what/species/panther.htm

In the original SLOPES, the consultation area map (the Map) was generated by the Service by overlaying existing and historical panther telemetry data on a profile of Florida and providing a connecting boundary surrounding most of these points. Since the development of the Map, we received more accurate and up-to-date information on Florida panther habitat usage. Specifically, we received two documents that the Service believes reflect the most likely panther habitat usage profiles, although documentation clearly shows panther use of areas outside these locations. These documents are the publications by Kautz et al. (2006) and Thatcher et al. (2006). Based on the information in these documents, we have clarified the boundaries of the Map to better reflect areas where Florida panthers predominate (Figure 2), and we refer to these areas cumulatively as the Florida Panther Focus Area. As part of this review, we also made revisions to components in the SLOPES documents in coordination with the Corps; these revisions address actions that can be taken by the Service, Corps, and project applicants that may benefit panthers and minimize effects from proposed projects (Service 2007a).

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

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

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

Primary Zone

The Primary Zone is 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 area is located within 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 ac (2 ha); (2) non-urban cover types within 656 ft (200 m) of forest patches; and (3) exclusion of lands within 984 ft (300 m) of urban areas. The potential habitat map was reviewed in relation to telemetry data, recent satellite imagery (where available), and panther home range polygons. Boundaries were drawn around lands defined as the Primary Zone (Figures 2 and 3), 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 2 and 3), 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 LCP models and identify optimum panther dispersal corridor(s). The LCP models operated on a cost surface that ranked suitability of the landscape for use by dispersing panthers with lower scores indicating higher likelihood of use by dispersing panthers. Those dispersal routes connecting lands between the Panther Focus Area south of the Caloosahatchee River and the Panther Focus Area north of the Caloosahatchee River, which may facilitate future panther expansion north of the Caloosahatchee River, were defined as the Dispersal Zone (Figures 2 and 3) (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 ac (918,895 ha); the Secondary Zone covers 812,104 ac (328,654 ha); and the Dispersal Zone covers 27,883 ac (11,284 ha); providing a total of 3,110,578 ac (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 ac (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 ac (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 ac (12,919 ha) value (Kautz et al. 2006) and the higher number is based on the 27,181 ac (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 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 8 individuals greater than a population of 82 individuals, which, according to the best available PVA (Root 2004), is 95 percent likely to persist over 100 years (assuming a 50:50 male to female ratio). These eight individuals provide a buffer for some of the assumptions in Root's (2004) PVA. Our process to determine compensation recommendations for project affects that cannot be avoided in both our section 7 and section 10 consultations is based on the amount and quality of habitat we believe is necessary to support a population of 90 panthers in south Florida.

The Service, based on Kautz et al.'s (2006) average panther population density of 31,923 acres per panther, determined 2,873,070 acres of Primary Zone "equivalent" lands need to be protected and managed. Since lands in the Secondary Zone are of less value to panthers than those in the Primary Zone, this equivalency factor is needed to assure additional acreage is acquired in the Secondary Zone to compensate for its lower quality panther habitat. In other words, more than 31,923 acres per panther would be needed, hypothetically, if this acreage were all in the Secondary Zone (see discussion of Primary Zone equivalent lands in the following section). The combined acreage of lands within the Primary, Dispersal, and Secondary Zones is 3,110,577 acres (Kautz et al. 2006). Currently, 2,073,865 acres of Primary Zone equivalent lands are preserved (Table 2) and 1,202,699 acres of Primary Zone equivalent lands are at-risk (private ownership) (Table 3), 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 ac), 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 3. These lands (core lands and Other Zone lands) together are referred to by the Service as the Panther Core Area (labeled on Figure 2 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 2). 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 these values, the habitat value of the Secondary Zone is roughly 69 percent (4.79/6.94=0.69) of the Primary Zone, and restoration is needed to achieve landscape function. Using this assessment, the 503,481 ac of Secondary Zone lands equate to 347,402 ac 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 ac. 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 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 ac of Other Zone lands represent, we applied the 80 percent factor and the 33 percent factor to the available ac, which equate to 216,479 ac 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 in Appendix A.

Analysis of the species likely to be affected

The Florida panther is an endangered cat restricted to 2 to 3 million ac of land in south Florida (6 to 9 percent of the total land area of Florida). The panther is a wide-ranging species that requires large areas of biotically diverse habitat to survive. The burgeoning growth in the human population in southwest Florida has directly led to an increase in development and other human-related activities that have adversely affected the panther. Threats to panthers include habitat loss, habitat fragmentation, road mortality, and human disturbance.

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. This methodology provided a way to assess the level of impacts to panthers expected from a given project, and to evaluate the effect of any proposed compensation offered by the project's applicant. The Habitat Assessment Methodology was updated in 2009. For a full description of our Habitat Assessment Methodology, please see Appendix A.

The NPS has determined the BCNP ORV trail heads and U.S. Highway 41 turn lanes project "may affect and is not likely to adversely affect" the Florida panther. Based on the impacts to panther habitat resulting from the project, the Service cannot concur with this determination. We find the project will result in adverse effects to the Florida panther. The project's adverse effects to the panther will be discussed in the remainder of this Biological Opinion. Critical habitat has not been designated for the Florida panther and will not be affected.

Additional federally listed species may occur within the BCNP ORV trail heads and U.S. Highway 41 turn lanes project area. The NPS has determined the project will not affect the threatened eastern indigo snake and the endangered wood stork.

The project occurs within the geographic range of the eastern indigo snake. To minimize adverse effects to this species, the NPS has agreed to follow the Service's *Standard Protection Measures for the Eastern Indigo Snake* (Service 2004) during construction. The Service does not support the NPS' determination that the project will not affect the eastern indigo snake. We find the project has the potential to affect the eastern indigo snake, but the effects are expected to be insignificant and discountable. Critical habitat has not been designated for the eastern indigo snake and will not be affected. Therefore, we recommend the NPS revise their determination to "may affect, but not likely to adversely affect" the eastern indigo snake; this letter may be used as concurrence with that determination.

The BCNP ORV trail heads and U.S. Highway 41 turn lanes project sites are located within the core foraging area (within 18.6 miles) of several active wood stork breeding colonies. The project will result in the loss of 14 ac of wetlands that may provide foraging habitat for the wood stork. The 14 ac of wetlands to be impacted by the project consist of 11.6 ac of short

hydroperiod (inundated < 180 days per year) and 2.4 ac of long hydroperiod (inundated ≥ 180 days per year) wetlands. The Service has applied our "Wood Stork Foraging Assessment Methodology" (Service 2010) to the wetlands to be impacted by the project. Based on this assessment, the Service has determined that the 11.6 ac of short hydroperiod wetlands to be impacted provide 10.62 kilograms (kg) of wood stork forage biomass and the 2.4 ac of long hydroperiod wetlands to be impacted provide 7.89 kg of wood stork forage biomass. To compensate for the loss of wood stork forage biomass, the NPS proposes to acquire credits from a Service-approved mitigation bank that provide at least 10.62 kg of wood stork biomass from short hydroperiod wetlands and 7.89 kg of wood stork biomass from long hydroperiod wetlands. The Service finds the forage biomass resulting from restored wetlands at the Service-approved mitigation bank will offset the loss of wood stork forage biomass resulting from the project. Further, the NPS expects to provide on-site wetlands mitigation within BCNP; however, details on on-site mitigation activities are not available at this time. The Service does not support the NPS' determination that the project will not affect the wood stork. We find the project has the potential to affect the wood stork, but the effects are expected to be insignificant and discountable. Critical habitat has not been designated for the wood stork and will not be affected. Therefore, we recommend the NPS revise their determination to "may affect, but not likely to adversely affect" the wood stork; this letter may be used as concurrence with that determination.

As discussed above, the Service finds the BCNP ORV trail heads and U.S. Highway 41 turn lanes project is not likely to adversely affect the eastern indigo snake and the wood stork. Therefore, these species will not be considered further in this Biological Opinion.

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.

Climate change

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

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 factors (*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 m (3 ft) will reduce southwest Florida panther habitat by 29 percent, at 3 m (9.8 ft) by 62 percent, and at 5 m (16.4 ft) 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 2007b).

Status of the species within the action area

As stated previously, for the purposes of this consultation, the action area includes the project footprint plus all lands located in the Panther Focus Area within 25 miles of the project footprint (Figure 4). The proposed action may have direct and indirect effects on the ability of panthers to breed, feed, and 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, studies indicate 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). However, this potential bias was not detected in a recent analysis by Land et al. (2008) using GPS location data collected throughout a 24 hour day. This study revealed panther habitat selection patterns are similar when using either aerial telemetry data or GPS location data, and upland and wetland forests were the habitats most selected by panthers. There was an indication grassland-dry prairie habitats were used more at night than during daytime hours.

Only a subset of the panther population has been radio-collared. However, the large database of telemetry locations taken from radio-collared panthers south of the Caloosahatchee River can be used to estimate the size and number of home ranges and travel corridors south of the Caloosahatchee River. The FWC also uses observational data collected during telemetry flights to assess the yearly breeding activity of radio-collared panthers. Female panthers accompanied by kittens or male panthers within proximity of an adult female are assumed to have engaged in breeding activity during that year.

As of July 2012, 49 known radio-collared panthers (alive or status unknown) have been documented within the action area from 6,664 telemetry observations (Table 4 and Figure 7). It is not known if all these animals are currently alive. Panthers greater than 12 years of age are not likely to still be alive based on the known longevity of panthers in the wild of 10 to 12 years (FWC 2011b). The most recent telemetry point in the action area was recorded on June 6, 2011, for panther FP193. Uncollared panthers are also presumed to occur in the action area. In 2009, Rancher's Supply (a consultant to the FWC) found evidence of 80 individual panthers during their annual count of both radio-collared and uncollared panthers in south Florida (FWC 2010a). The area surveyed included the action area for this project. Four of the radio-collared panthers observed in the 2009 survey are now confirmed dead.

Motor vehicles have affected panthers in the action area. There have been 42 documented panther deaths resulting from vehicle collisions within the action area (see Table 5 and Figure 8). The most recent vehicle-related panther mortality occurred February 6, 2012, on U.S. Highway 41, approximately 0.4 miles east of Bass Road.

Factors affecting species environment within the action area

Factors that positively and negatively affect the panther's environment 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 (*e.g.*, prescribed fire, exotic eradication, etc.), hydrological restoration projects, and public and private land protection efforts. 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 injury or death due to vehicle collisions. 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 panther 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.

Past and ongoing Federal and State actions that could affect panther habitat in the Action Area include the issuance of Corps' permits and State of Florida Environmental Resource Permits authorizing the filling of wetlands for development projects and other purposes. Since 1982, the Corps and the State have had a joint wetland permit application process, where all permit applications submitted are distributed to both agencies. Upon review of our records, the Service finds that we have consulted on 8 projects, affecting approximately 3,035 ac of panther habitat, in the action area (subset of Table 1). In addition, a total of 266 ac of habitat was restored or preserved in association with these projects. The Service determined that these Federal actions, individually and cumulatively, did not jeopardize the survival and recovery of the Florida panther.

Other activities within the action area have benefited panthers. Wildlife underpasses have been, installed on I-75 and State Road 29, and are known to be used by panthers. In addition, a Roadside Animal Detection System (RADS) has been installed within a 1-mile stretch of U.S. Highway 41 at the Turner River. The RADS contains sensors that detect panthers and other species of wildlife when they attempt to cross the roadway. When activated, the sensors activate flashers on warning signs adjacent to the roadway that advise motorists to reduce their speed and be alert for the presence of wildlife on the road. These measures have likely reduced the number of vehicle/panther collisions in the Action Area. 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 BCNP and other conservation areas improves habitat for panther prey species and benefits panthers within these areas.

EFFECTS OF THE ACTION

This section analyzes the direct and indirect effects of the proposed action and interrelated and independent actions on the Florida panther and Florida panther habitat.

Factors to be considered

Development projects may have a number of direct and indirect effects on the Florida panther and panther habitat. Direct effects, which are primarily habitat based, may include: (1) the permanent loss and fragmentation of habitat for panthers and their prey; (2) a reduction in the geographic distribution of habitat for the species; (3) harassment of panthers due to construction activities; and (4) enhancement, restoration and preservation of panther habitat resulting from habitat compensation. Indirect effects may include an increase in the potential for intraspecific aggression among panthers due to reduction of the geographic distribution of habitat of the panther.

This project site contains panther habitat and is located within the geographic range of the Florida panther. The timing of construction for this project, relative to sensitive periods of the panther's lifecycle, is unknown. Panthers may be found on and adjacent to the proposed construction footprint year-round. The project may be constructed in a single, disruptive event, or it may be phased over time, depending on funding availability to NPS. It will 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 is not known. The disturbance associated with the project will be permanent and result in a loss of habitat currently available to the panther.

Analyses for effects of the action

The 17.5ac of land to be affected by the BCNP ORV trail heads and U.S. Highway 41 turn lanes project currently provides about 14 ac of high quality habitat for the Florida panther. The lands proposed for development are located within the southern portion of the panther's range. The project site is located in the Primary Zone (Kautz et al. 2006) of the Service's Panther Focus Area.

A variety of wildlife species that provide potential prey for the panther, are known to occur within the BCNP. Potential prey include: white-tailed deer, feral hog, wild turkey (*Meleagris gallopavo*), nine-banded armadillo, striped skunk (*Mephitis mephitis*), eastern grey squirrel (*Sciurus carolinensis*), eastern cottontail (*Sylivilagus floridanus*), and various species of small mammals, wading birds, amphibians, and reptiles.

Habitat assessment methodology application

The Service used our panther Habitat Assessment Methodology to evaluate the panther habitat lost due to the BCNP ORV trail heads and U.S. Highway 41 turn lanes project and the panther habitat provided as compensation at the FPCB (Table 6). The 14 ac of panther habitat at the project site currently provides 103.24 PHUs in the Primary Zone. To calculate the number of PHUs needed to compensate for the PHUs lost in in the Primary Zone due to the project, 103.24 PHUs are multiplied by the 2.5 Base Ratio and the landscape multiplier for the Primary Zone (1.0) for a product of 258.1 PHUs (rounded to 258 PHUs). Therefore, a total of 258 PHUs are needed to compensate for the loss of panther habitat lost due to the project. To meet this compensation need, the NPS will acquire 258 PHUs from an approved conservation or mitigation bank.

Beneficial effects

Beneficial effects are those effects of the proposed action that are completely positive, without any adverse effects to the listed species or its critical habitat. The proposed action will not result in beneficial effects to the Florida panther.

Direct effects

Direct effects are those effects that are caused by the proposed action, at the time of construction, are primarily habitat based, are reasonably certain to occur and include: (1) the permanent loss of panther habitat and habitat that supports panther prey; (2) a reduction in the geographic distribution of habitat for the species; (3) harassment by construction activities; and (4) the enhancement, restoration, and preservation of panther habitat through habitat compensation.

Permanent loss and fragmentation of habitat for panthers and their prey

The project will result in the loss of 14 ac of panther habitat located within the Primary Zone. Panthers may use these habitats for feeding and dispersal. The land will be converted to access driveways, parking areas and paved turn lanes. The project site also provides habitat for panther prey species (*e.g.*, feral hog, white-tailed deer, small mammals, *etc*.). Habitats within the project sites include high quality uplands, and forested and emergent wetlands. The habitat lost due to the project may adversely affect the panther by decreasing the spatial extent of lands available to panthers and their prey, and further fragment habitat that occurs adjacent to the project site.

Reduction in the geographic distribution of habitat for the species

The project will result in the loss of about 14 ac of undeveloped land within the Panther Focus Area. This loss represents 0.001 percent of the 1,962,294 ac of available non-urban private lands in south Florida in the Service's Primary Zone, Secondary zone, Dispersal zone, and Other Zone defined for the Florida panther (Table 3 and Figure 2). The Service finds the habitat value lost due to the project will be offset by the habitat compensation proposed by the applicant. The lands proposed for preservation are consistent with the Service's panther conservation strategy to locate, preserve, and restore lands containing sufficient area, access, and appropriate cover types to ensure the long-term survival of the Florida panther south of the Caloosahatchee River.

Harassment by construction activities

The timing of construction for this project, relative to sensitive periods of the panther's lifecycle, is unknown. However, land clearing associated with the ORV trail head and turn lane construction will be completed in phases as funding becomes available for construction. There are no known den sites within the project boundaries. Therefore, we find it is unlikely project construction will result in direct panther mortality, but it may result in temporary disturbance to resident or dispersing panthers.

Habitat compensation

To compensate for the project's impacts to the panther, the NPS will acquire 258 PHUs from a Service-approved conservation or mitigation bank. Though the project will result in a net loss in number of acres of habitat available to the panther, the habitat provided to the Florida panther through restoration and preservation will be high quality habitat that is protected in perpetuity. Lands at Service-approved banks and surrounding areas contain a diverse mosaic of native plant species that provide foraging value to resident deer and other panther prey species; further, bank sites are managed to prevent infestation by exotic vegetation in perpetuity. This habitat compensation is consistent with the Service's goal to locate and preserve lands containing sufficient area 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 activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. Interrelated or interdependent actions are not expected to result from the project.

Indirect effects

Indirect effects are those effects that result from the proposed action, are later in time, and are reasonably certain to occur. The indirect effects this project will have on the Florida panther within the action area are discussed below and in the assessment of functional habitat values previously discussed. They include an increase in the potential for intraspecific aggression

among panthers due to the reduction in panther habitat in the action area. The proposed project is not anticipated to alter the traffic patterns in this area; therefore, we expect no indirect traffic effects to panthers from this project.

Increased potential for intraspecific aggression

As discussed in the Status of the Species, panther mortalities resulting from attacks of con-specifics are known to occur in the panther population (*e.g.*, males may kill other rival males when defending a territory). Habitat loss may increase the potential for intraspecific aggression among panthers in the action area. A total of 21 panther deaths due to intraspecific aggression have occurred within the action area; the most recent on occurred in May 2012. The Service notes the project will result in the loss of 14 ac of panther habitat. According to the most current home range estimates of the Florida panther (Lotz et al. 2005), this loss represents 0.05 percent of a female panther's average home range (29,059 ac) and 0.02 percent of a male panther's average home range (62,542 ac). Based on the amount of panther habitat lost (14 ac), the Service finds the project should not significantly increase intraspecific aggression in the action area.

ORV access: The proposed ORV trail heads will provide established parking areas for ORVs users at the BCNP. The trails accessed by the ORV trail head sites are already used by permitted ORV users, and ORV users are currently parking along existing roads near the trails. Therefore, construction of the proposed trail heads will not increase the number of permitted ORVs users nor increase the ORV traffic on the adjacent trails. Consequently, the project is not expected to increase disturbance from ORV use, or traffic to and from the use areas, above what is currently experienced by panthers.

Species response to the proposed action

The proposed action will result in increased disturbance to panthers from human activity and noise at the project site. This disturbance will occur during construction of the project and be ongoing following completion of the project due to human use of the access driveways, parking areas and turn lanes. Panthers will respond to the disturbance by avoiding the project area or habituating to the disturbance. The project will also result in the loss of 14 ac of panther habitat. The project area provides habitat for panther prey, and panthers are known to use the project area. The loss of habitat may result in a minor increase the potential for panther intraspecific aggression by decreasing the spatial extent of lands available to the panther. We anticipate any resident panthers with home ranges overlapping or in the vicinity of the project area will adjust the size and location of their ranges to account for this loss and that adjustment is anticipated to occur in concert with project construction.

CUMULATIVE EFFECTS

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

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

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

The Service notes much of the action area contains public lands that are protected for conservation purposes and not likely to be developed. Therefore, to assess cumulative effects in the action area, we used data on non-Federal actions in the action area (ERPs proposed from 2006 through 2009) provided by the consultant for the proposed Hacienda Lakes development (Biological Opinion 2010-CPA-0424, issued July 19, 2012) in Collier County, located northwest of the project sites. The Service considers this data as appropriate for the cumulative effects evaluation for the BCNP ORV trail heads and U.S. Highway 41 turn lanes project because the action area for the Hacienda Lakes development largely overlaps the portion of the action area for this BCNP project that contains privately-owned lands (*i.e.*, lands where non-Federal development actions are most likely to occur).

The footprints of the non-Federal development actions identified in the action area for Hacienda Lakes Development were overlain on the National Wetlands Inventory (NWI) maps to determine presence of wetlands. As described above, parcels with less than 5 percent wetlands were considered to be exempt from the Corps' regulatory review under section 404 of the Federal Clean Water Act. Data in the Service's Biological Opinion for the Hacienda Lakes development indicate that 47 projects affecting 4,072 ac of lands (from 2006 through 2009) or 1,018 ac of land per year (4,072 ac/4 years = 1,018 ac/year) were exempt from Corps regulatory review in the action area. We find this value is representative of future yearly development likely to occur in the action area for the BCNP ORV trail heads and the U.S. Highway 41 turn lanes project due to non-Federal actions. The Service notes many unforeseen factors, such as the recent economic downturn, can affect development in the action area. Therefore, we acknowledge it is difficult to forecast development related to non-Federal actions in the action area with great certainty. However, the Service believes this estimate provides the best approximation available of future, non-Federal actions reasonably certain to occur and meets our definition of a cumulative effect. This level of development represents 3.5 percent of a female panther's average home range (29,059 ac) and 1.63 percent of a male panther's average home range (62,542 ac).

Based on the above analysis, we believe the loss of the habitat associated with these lands is insignificant in the short term, but may adversely impact the panther as development continues to occur in the future in the action area. The Service has accounted for some habitat loss and changes in habitat quality through its habitat assessment methodology and is encouraging State and County environmental staff to develop Habitat Conservation Plans (per Section 10 of the Act) to compensate for adverse effects resulting from non-Federal actions to the Florida panther.

CONCLUSION

As discussed above, the Service finds that construction of the BCNP ORV trail heads and the U.S. Highway 41 turn lanes project is not likely to directly result in the injury or mortality of panthers. However, the project will result in the loss of 14 ac of habitat currently used by panthers and their prey, and result in a permanent reduction in the geographic range of the species. Therefore, the project could increase the potential for intraspecific aggression resulting in panther mortalities. However, this form of take is difficult to quantify due to the wide-ranging habit of the species and the challenge of linking the death or injury of a single panther to increases in panther interactions (intraspecific aggression). According to the most current home range estimates of the Florida panther (Lotz et al. 2005), the loss of 14 ac of panther habitat represents 0.05 percent of a female panther's average home range (29,059 ac), 0.02 percent of a male panther's average home range (62,542 ac), and 0.001 percent of the 1,962,294 ac of available non-urban private lands in the Service's panther core area. Based on the amount of panther habitat lost (14 ac) due to the project, the Service finds that the project should not significantly affect the panther population or increase the potential for intraspecific aggression in the action area. Moreover, the loss of panther habitat due to the project will be offset by the acquisition of 258 PHUs of panther habitat acquired by the NPS from a Service-approved conservation or mitigation bank. The compensation site will be preserved and managed as panther habitat in perpetuity. This habitat compensation is consistent with the Service's goal to locate and preserve lands containing sufficient area and appropriate cover types to ensure the long-term survival of the Florida panther south of the Caloosahatchee River.

After reviewing the current status of the Florida panther, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion the project, as proposed, is not likely to jeopardize the continued existence of the Florida panther. Critical habitat has not been designated for these species and will not be affected.

INCIDENTAL TAKE STATEMENT

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

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

AMOUNT OR EXTENT OF TAKE

The Service has reviewed the biological information for the Florida panther, information presented by the NPS and their consultant, and other available information relevant to this action.

Incidental take of the Florida panther in the form of harm (*i.e.*, the loss and degradation of 14 ac of habitat in the 17.3-acre project footprint) and harassment (*i.e.*, disturbance to panthers resulting from human activity during and following construction of the project) is expected from the action. The Service has chosen not to quantify the level of incidental take in terms of a specific number of animals because documenting the adverse effects of loss of habitat and disturbance on survival and reproduction of panthers from the project is problematic due to the wide-ranging nature of this species. Instead, we have quantified take as the amount of panther habitat lost due to the project. The project will result in the loss of 14 ac of habitat within the Primary Zone of the Service's Focus Area. We find the level of incidental take is moderated by the acquisition 258 PHUs of habitat at a Service-approved conservation or mitigation bank; this habitat will be enhanced and preserved in perpetuity to benefit the Florida panther and its prey.

The Service has determined the anticipated take is not likely to result in jeopardy to the Florida panther. If, during the course of this action, this level of take is exceeded, such take would represent new information requiring review of the reasonable and prudent measures provided. The Federal agency must immediately provide modification of the reasonable and prudent measures.

EFFECT OF THE TAKE

In the accompanying Biological Opinion, the Service determined this level of anticipated take is not likely to result in jeopardy to the Florida panther. Critical habitat has not been designated for the Florida panther and will not be affected.

REASONABLE AND PRUDENT MEASURES

When providing an incidental take statement, the Service is required to give reasonable and prudent measures it considers necessary and appropriate to minimize the take, along with terms and conditions, that must be complied with, to implement the reasonable and prudent measures. Furthermore, the Service must also specify procedures to be used to handle or dispose of any individuals taken. The Service finds the following reasonable and prudent measures are necessary and appropriate to reduce take and to minimize the direct and indirect effects of the proposed project on the Florida panther:

1. Minimize the adverse effects of harm and harassment to the Florida panther by implementing an appropriate habitat compensation plan.

2. Notify the Service of any unauthorized take of the Florida panther.

TERMS AND CONDITIONS

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

1. At least 30 days prior to construction, the NPS will provide proof to the Service in the form of a letter or email from a Service-approved conservation or mitigation bank indicating that credits providing at least 258 PHUs have been acquired. Additionally, proof that bank credits providing 10.62 kg of short-hydroperiod and 7.89 kg of long-hydroperiod wood stork forage biomass shall be provided concurrently with proof of PHU acquisition. Credits purchased from a bank which provides both PHUs and wood stork kg of biomass may be used towards both species.

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

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

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service is not proposing any conservation recommendations at this time.

REINITIATION NOTICE

This concludes formal consultation on the BCNP ORV trail heads and the U.S. Highway 41 turn lanes project. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded (see below); (2) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; (3) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

The amount of incidental take authorized by this consultation may be exceeded should impacts from the proposed project increase or mitigation fail to provide habitat values proposed and analyzed within this Biological Opinion. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Thank you for your cooperation in the effort to protect fish and wildlife resources. If you have any questions regarding this project, please contact John Wrublik at 772-469-4282.

Attachment

cc: w/attachment (electronic only)
Corps, Fort Myers, Florida (Cynthia Ovdenk, Tunis Mcelwain)
EPA, West Palm Beach, Florida (Richard Harvey)
FWC, Naples, Florida (Darrell Land)
FWC, Tallahassee, Florida (FWC-CPS)
Service, Atlanta, Georgia (Ken Graham)
Service, Florida Panther NWR, Naples, Florida (Kevin Godsea)

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Table 1. Habitat preservation efforts resulting from formal and informal consultations with the Service for projects affecting Florida panther habitat from March 1984 through August 2012.

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
03/29/84	4-1-83-195	83M-1317	CMC Development Corporation (Ford Test Track)	Collier	530	0	0	0
02/21/85	4-1-85-018	FAP #?	USDOT, FHA (conversion of Hwy 84 to I-75)	Broward Collier	1,517	0	0	0
10/17/86	4-1-87-016 4-1-87-017	unknown	NPS, BCNP (Exxon Master Plan Modification)	Collier	9	0	0	0
01/07/87	4-1-86-303	86IPM-20130	Collier Enterprises (citrus grove)	Collier	11,178	0	0	0
01/11/88	4-1-88-029	unknown	NPS, BCNP (NERCO - Clements Energy, Inc.)	Collier	3	0	0	0
02/23/88	4-1-88-055	unknown	NPS, BCNP (Shell Western E&P, Inc.)	Collier Dade Monroe	0	0	0	0
02/10/89	4-1-89-001	FAP IR-75-4(88)81	USDOT, FHA (SR 29/I-75 Interchange)	Collier	350	0	0	0
08/15/90	4-1-90-289	unknown	NPS, BCNP [I-75 Rec. Access Plan (MM 31, 38, 49)]	Collier	150	0	0	0
09/24/90	4-1-90-212	89IPD-20207	U.S. Sugar Corp (46 mi2 ag conversion)	Hendry	28,740	700	0	700
10/23/1991	4-1-91-309	199130649	Miller Boulevard Extension (dirt road, pot hole fill and repair)	Collier	5	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	575	437	107	544

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
10/27/94	4-1-94-430	199302371 (IP-BB) 199400807 (IP-BB) 199400808 (IP-BB)	Timberland and Tiburon Florida Gulf Coast University Treeline Boulevard	Lee	1,088	526	0	526
03/15/95	4-1-94-F-247	19,930,041	Port LaBelle citrus farm revision	Glades Hendy	23	0	0	0
04/03/95	4-1-93-F-390	199,301,206	Sarasota County Landfill revision	Sarasota	550	0	0	0
05/24/95	4-1-95-230	199302130 (IP-TB)	FDOT, I-75 (Turner River access @ MM 70)	Collier	1,936	0	0	0
08/07/95	4-1-95-274	199405501 (IP-AW)	Bonita Bay Properties, Inc. (golf course)	Collier	509	491	0	491
08/15/95	4-1-94-214	199301495 (IP-MN)	SWFIA, Northeast Access Road	Lee	14	0	0	0
09/19/96	4-1-95-F-230	199302052 (IP-TB) 199301404 (IP-TB)	FDOT, I-75 (Central and West Broward access) FDOT, I-75 (Miami Canal Access)	Broward	116	0	0	0
03/10/98	4-1-98-F-3	L30(BICY)	NPS, BCNP (Calumet Florida, Inc. seismic testing)	Collier Dade Broward	0	0	0	0
03/27/98	4-1-97-F-635	199604158 (IP-SB)	Bonness, Joseph D., Jr. Trustee (Willow Run Quarry)	Collier	359	190	0	190
06/11/99	4-1-98-F-398	199800622 (IP-SS)	STOF, BCSIR (water conservation plan)	Hendry	1,091	0	0	0
09/27/99	4-1-98-F-310	199130802 (IP-SB)	Lee County DOT (Daniels Parkway extension)	Lee	2,093	0	94	94
12/08/99	4-1-98-F-517	199607574 (IP-MN)	Kaufmann Holdings, Inc. (Cypress Creek Farms)	Collier	239	0	24	24
04/17/00	4-1-98-F-428	199507483 (IP-AM)	Miromar Development, Inc. (Miromar Lakes)	Lee	785	0	194	194
02/21/01	4-1-00-F-135	199803037 (IP-SR)	Wortzel & Landl, Co-Trustees (Corkscrew Ranch)	Lee	106	0	0	0

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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
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	491	57	98	155
06/23/03	4-1-01-F-143	199905571 (IP-SR)	Airport Technology Center	Lee	116	55	175	230
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
06/16/04	4-1-03-I-3401	198900960 (IP-HWB)	Olde Cypress Golf Club	Collier	389	175	0	175
01/18/05	4-1-04-F-4259	199702228 (TWM)	Bonita Springs Utilities	Lee	79	0	108	108
03/31/05	4-1-04-F-5656	200306759 (NW-MAE)	Gateway Shoppes II	Collier	82	0	122	122
04/08/05	4-1-04-F-8176	2004-5312 (AEK)	Big Cypress Rock Mine	Broward	110	0	220	220
04/29/05	4-1-04-F-5780 4-1-04-F-5982	2003-5331 (IP-TWM) 2003-6965 (IP-TWM)	Worthington Holdings Arborwood & Treeline Avenue Extension	Lee	2,330	0	1,700	1,700

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06/06/05	4-1-03-F-7855	2003-11156 (IP-RMT)	Collier Regional Medical Center	Collier	44	0	64	64
06/29/05	4-1-03-F-3915	199806220 (IP-MAE)	Wenthworth Estates V.K. Development	Collier	917	0	458	458
07/15/05	4-1-04-F-5786	199405829 (IP-CDC)	Land's End Preserve	Collier	231	0	61	61
09/26/05 10/26/05	4-1-04-F-9348	2004-1122 (IP-RMT)	Super Target Brentwood Land Partners	Collier	34	0	20	20
11/23/05	4-1-04-F-6043	20039414	Waterways Join Venture IV	Collier	108	0	61	61
11/29/05	4-1-04-F-8847	20048995	Seminole Tribe of FL Administrative Complex	Collier	6	0	8	8
12/06/05	4-1-03-F-3483	200302409	Southwest Florida Investment Property, LLC	Lee	207	0	305	305
12/06/05	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	67	0	43	43
01/04/06	4-1-04-F-9777	20048577	Logan Boulevard Extension	Collier	40	0	10	10
01/13/06	4-1-04-F-6707	20042404	Journey's End	Collier	66	0	34	34
01/26/06	4-1-04-F-8940	20047053	The Orchard	Lee	93	0	81	81
02/09/06	4-1-05-11724	2005384	Firano at Naples	Collier	24	0	19	19
02/22/06	4-1-04-F-6505	200101122	Corkscrew Road	Lee	17	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
02/25/05 03/*16*/05 06/29/05 04/04/06	4-1-04-F-6866	200309416 (NW-MAE)	Ava Maria University	Collier	5,027	0	6,114	6,114
05/09/06	41420-2006-F-0089	200403248	Collier Boulevard, Immokalee Rd. to Goldengate Blvd.	Collier	14	0	16	16
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	200506248	Santa Barbara Radio Road, Widening.	Collier	29	0	20	20

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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	326	326
07/28/06	4-1-04-F-7279	20041695	Raffia Preserve	Collier	131	0	119	119
07/28/06	4-1-05-F-12330	20047920	Hamilton Place	Dade	10	0	50	50
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
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
07/02/03 10/16/06	4-1-98-F-428 41420-2006-F-0667	199507483	Miromar Lakes Addition	Lee	366	169	390	559
10/18/06	41420-2007-F-0026	2004777	Treeline Preserve	Lee	97	0	95	95
10/25/06	41420-2006-F-0442	20047046	Koreshan Boulevard Extension	Lee	14	0	30	30
10/26/06	41420-2006-I-0849	20055702	Marina Del Lago	Lee	49	0	36	36
10/26/06	41420-2006-F-0787	200306755	Jetway Tradeport	Collier	38	0	52	52
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	41420-2007-FA-0222	200412415	Barry Goldmeier 5th Avenue Estates	Dade	15	0	18	18
11/15/06	41420-2006-TA-0727	N/A	Liberty Landing	Collier	27	0	19	19
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

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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	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	36	36
05/01/07	41420-2006-I-0992	20045223	Seminole Motocross	Hendry	58	5	19	24
05/04/07	41420-2007-TA-0623	NA	Abercia North	Collier	25	0	31	31
05/07/07	41420-2007-I-0581	1999-4313	Savanna Lakes	Lee	124	0	140	140
06/19/07	41420-2007-I-0997	2006-2583	Caloosa Reserve	Collier	111	29	110	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
06/14/04 03/21/05 08/24/07	4-1-04-F-5744	199603501 (IP-TWM)	Terafina	Collier	437	210	261	471
08/31/07	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
09/17/07	41420-2007-FA-1540 41420-2007-FA-1540	2006-7875	Ave Maria Substation	Collier	4	0	3	3
10/31/07	41420-2007-F-1035	2004-3931	Big Cypress Regional General Permit - 83	Hendry Broward	100	0	175	175
01/09/08	41420-2006-FA-0927,0871	2006-1359	Horseshoe Community Expansion	Glades	52	37	19	57
01/22/08	41420-2008-FA-0021 41420-2008-I-005	2007-4503	I-75 from Collier County Line to South of Corkscrew Road	Lee	7	0	44	44
01/30/08	41420-2008-FA-0009 41420-2008-I-003	2007-4884	I-75 from Corkscrew Road to Daniels Parkway	Lee	7	0	12	12
02/07/08	41420-I-0015	200502117	Cleveland Clinic	Lee	36	0	19	19
02/07/08	41420-2007-FA-1120 41420-2007-I-0862	1993-0862	Poinciana Parkway	Polk	187	0	236	236
04/28/08	41420-2008-I-0313	2007-6414	Immokalee Rd Substation	Collier	1	0	1	1

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04/28/08	41420-2008-FA-0126	2007-5187	A&H Commerce Park	Miami-Dade	100	0	150	150
06/26/08	41420-2007-FA-1150 41420-2007-F-1144	2007-2175	Immokalee Master Plan	Collier	506	0	1,015	1,015
07/02/08	41420-2007-FA-0592 41420-2007-F-0491	2005-7439	Kaicasa	Collier	72	0	183	183
07/14/08	41420-2008-I-0508	2005-6488	Amerimed Medical Center	Collier	19	0	14	14
07/14/08	41420-2008-I-0509	2007-4314	Gridley Medical Building	Collier	4	0	2	2
03/09/07 07/23/08	4-1-04-F-6112	20021683	Alico Airpark (Haul Ventures)	Collier	166	0	315	315
07/23/08	41420-2006-FA-0165 41420-2006-F-0846	2004-182	Premier Airport Park	Lee	180	0	211	211
09/04/08	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
10/21/08	41420-2007-FA-01444	2007-0754	Royal Home Villas	Miami-Dade	19	0	57	57
12/17/08	41420-2006-FA-0023 41420-2008-F -0018	1999-4926	Sembler Partnership McMullen Parcel	Collier	40	0	49	49
01/13/09	41420-2007-FA-1111 41420-2007-I-1083	2007-1264	Big Corkscrew Island Fire Control & Rescue	Collier	5	2	5	7
01/30/02 02/12/09	4-1-98-F-372 and 41420-2006-F-0267	199402492 (IP-ML)	Florida Rock Industries, Inc. (Fort Myers Mine #2)	Lee	2,913	1,960	0	1,960
02/26/09	41420-2006-FA-0548 41420-2006-F-1011	2006-7018	Oil Well Road Widening	Collier	328	529	356	885
03/30/09	41420-2006-FA-1342	HCP - 2009	City Gate Development	Collier	240	0	102	102
04/30/09	41420-2009-FA-0555 41420-2009-I-0262	2009-00315	Alligator Alley Service Plaza Expansion	Broward	25	0	35	35
06/10/09	41420-2008-FA-0804	2007-7467	Greenfrog Substation	Miami-Dade	3	0	12	12

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06/29/09	41420-2007-FA-1534 41420-2007-I-1186	2007-1676	Tamiami Crossing Commercial Development	Collier	25	0	19	19
07/10/09	41420-2007-FA-0283 41420-2007-I-0367	2008-4470	Home Center Plaza	Collier	16	0	5	5
11/03/09	41420-2009-FA-0619	Miccosukee	Emergency Helicopter Pad	Miami-Dade	1	0	1	1
11/03/09	41420-2007-FA-0620 41420-2007-I-0262	none	Tiger Camp Expansion	Miami-Dade	1	0	1	1
11/06/09	41420-2009-FA-0522	Seminole Tribe	Stanlo Compost Facility	Glades	2	0	6	6
01/05/10	41420-2009-FA-0523 41420-2009-I-0262	2005-2117	Bonita Beach Road East Water Storage Tank	Lee	15	0	5	5
01/28/10	41420-2010-CPA-0081 41420-2010-I-0068	2009-03039	Snake Road Improvements	Broward Hendry	18	0	20	20
03/03/10	41420-2010-CPA-0154 41420-2010-I-0129	2009-03450	Naples Landfill Gas to Energy	Collier	1	0	2	2
06/21/10	41420-2008-FA-0798 41420-2008-I-0928	2008-2429	Shaggy Sypress Ag. Operation	Collier	10	0	22	22
06/21/10	41420-2008-FA-0799 41420-2008-I-0929	2008-2429	Camp Keais Strand Ag. Operation	Collier	6	0	36	36
04/05/11	41420-2010-CPA-0134 41420-2010-F-0462	N/A	Big Cypress Seminole Indian Reservation Home Site Plan	Hendry, Broward	225	0	395	395
02/21/03 03/09/05 03/02/07 05/03/07 05/24/11	4-1-01-F-607	200001926 (IP-SB)	Mirasol	Collier	810	914	363	1277
06/28/11	41420-2010-CPA-0525 41420=2010-F-0395	201001432 (IP-JPF)	I-75 Recreation Area at L29 Canal	Collier	15	0	28	28
03/30/11 07/07/11	41420-2011-CPA-0106 41420-2011-F-0108	2011-00391	Green Meadow Water Treatment Plant	Lee	23	0	33	33
08/04/11	41420-2010-FA-0265,F-0164	2010-00191 (IP-JPF)	SR 80 from CR 833 to US 27 Widening	Hendry	40	0	41	41

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)
10/19/11	41420-2007-FA-0564	2008-615-(ACR)	Hogan Island Quarry	Collier	968	41	1,181	1222
01/25/12	41420-2012-CPA-0112, F-0179	2009-01116	University Highlands Limited	Lee	208	0	181	181
08/21/06 02/07/12	4-1-03-F-3127	19956797	Atlantic Civil Ag Permit Extension	Miami-Dade	981	0	1,553	1,553
03/06/12	41420-2011-CPA-0133, F-0132	SAJ-2011-00926 (IP-GGL)	I75 Interchange and Access Road at SWFIA	Lee	139	0	44	44
11/13/07 03/21/12	41420-2006-FA-1430	2005-782	Summit Lakes	Collier	138	0	134	134
05/01/12	41420-2011-CPA-0220, 41420-2011-F-0213	SAJ-2011-00942	SR 80 from Birchwood Parkway to Dalton Lane Road Widening	Hendry	40	0	23	23
06/04/12	41420-2011-CPA 0225, 41420-2011-F-0218	SAJ-1993-1540 (IP-GGL)	I-75 Rest Area and Recreation Area at Mile Marker 63	Collier	7	0	22	22
06/09/00 06/06/12	4-1-99-F-553	199900619 (IP-SB)	Vineyards Development Corp. (Naples Reserve GC)	Collier	748	75	346	421
09/08/05 02/28/08 07/13/12	41420-2008-FA 0018, 41420-2008-F-0112	SAJ-2001-06580	Parklands Collier	Hendry	301	341	434	775
07/18/12	41420-2006-F-0204	2003-11158 (IP-MJD)	Hacienda Lakes	Collier	728	1,534	0	1,534
pending	41420-2011-F-0240	2009-03941 (IP-JSC)	Seminole Rock Mine	Broward	205		1,062	1,062
08/13/12	41420-2012-CPA 0140, 41420-2012-F-0139	Not yet assigned	BCNP ORV trailheads and U.S. Highway 41 turn lanes	Collier	14	0	0	*
				Total	96,242	11,392	32,719	44,111

*528 PHUs of habitat compensation will be provided at a Service-approved conservation or mitigation bank. The actual acreage protected is not known at this time.

Table 2. Land Held for Conservation within the Florida Panther Core Area.

Zone	Acres	Primary Equivalent Factor	Primary Equivalent Acres
Primary	1,659,657	1.00	1,659,657
Dispersal	0	1.00	0
Secondary	308,623	0.69	212,950
Other	609,872	0.33	201,258
TOTAL	2,578,152	TOTAL	2,073,865

Table 3. Undeveloped Privately Owned Land within Florida Panther Core Area

Zone	Acres	Primary Equivalent Factor	Primary Equivalent Acres
Primary	610,935	1.00	610,935
Dispersal	27,883	1.00	27,883
Secondary	503,481	0.69	347,402
Other	655,996*	0.33	216,479
Total	1,798,295		1,202,699

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

Table 4. Alive or Status Unknown Radio-collared Panthers Recorded within the Action Area.

Panther	Number of Telemetry Points	Sex	Year that last telemetry location was taken
FP54	1123	Male	1998
FP56	290	Female	1994
FP57	716	Female	1998
FP61	195	Female	2001
FP62	98	Male	1997
FP65	3	Male	1998
FP66	17	Female	1999
FP71	448	Female	2004
FP75	803	Female	2005
FP88	371	Female	2002
FP93	692	Female	2002
FP94	5	Female	2001
FP95	4	Female	2001
FP101	71	Female	2003
FP113	761	Female	2009
FP119	878	Male	2009
FP121	3	Female	2005
FP124	563	Female	2005
FP125	124	Male	2004
FP142	1	Female	2006
FP143	1	Male	2007
FP145	460	Female	2009
FP146	410	Male	2007
FP147	94	Male	2006
FP148	40	Female	2006
FP149	59	Female	2007
FP150	52	Female	2007
FP151	147	Female	2011
FP153	219	Female	2009
FP154	82	Male	2007
FP161	439	Female	2011
FP162	443	Female	2009
FP163	7	Male	2011
FP167	5	Male	2009
FP 171	296	Male	2009
FP175	215	Female	2010
FP177	164	Male	2011
FP 178	183	Female	2011
FP179	1	Male	2010
FP180	198	Female	2010
FP181	64	Male	2010
FP182	192	Female	2010
FP183	67	Male	2011
FP184	80	Female	2011
FP187	59	Male	2011
FP190	56	Female	2011
FP191	52	Female	2011
FP192	50	Female	2011
FP193	21	Male	2011

Total Telemetry Points = 6,664

Table 5. Panther-Vehicle Collisions within Action Area as of June 2012.

ID	Location	Year	Sex	Result
UCFP04-(G80-4)	SR 29 North of I-75	1979	Female	Death
UCFP06-(G81-19)	SR 29 near Copeland	1981	Female	Death
FP01	I-75 at mile marker 18	1983	Male	Death
Big Guy	U.S. Highway 41	1984	Male	Injury
UCFP12-(G84-26)	I-75 at mile marker 16	1984	Female	Death
UCFP13-(BNZ)	I-75 at mile marker 16	1985	Female	Death
FP04	I-75 at mile marker 17	1985	Male	Death
FP07	SR 29 south of I-75	1985	Male	Death
UCFP15	SR 84 at mile marker 16.5	1986	Female	Death
FP37	SR 29 north of I-75	1990	Male	Death
UCFP30	U.S. Highway 41 at Turner River	1996	Female	Death
FP51	SR 29 at Bear Island Grade	1998	Male	Death
UCFP26	U.S. Highway 41	1998	Male	Death
UCFP39	SR 29 north of Jerome	2001	Female	Death
UCFP40	SR 29 north of Jerome	2001	Male	Death
UCFP46	SR 29 north of Deep Lake	2002	Male	Death
UCFP60	U.S. Highway 41 east of CR 92	2003	Male	Death
UCFP62	U.S. Highway 41 near 40 mile Bend	2004	Female	Death
UCFP65	SR 29 near Bear Island Grade	2004	Male	Death
FP120	U.S. Highway 41 west of Turner River	2004	Female	Injury
K156	U.S. Highway at Turner River	2004	Male	Death
UCFP71	U.S. Highway 41 near 11 mile Road	2005	Male	Death
UCFP72	SR 29 near Jerome	2005	Male	Death
FP120	U.S. Highway 41 at Turner River	2005	Female	Death
K49	SR 29 north of Wagon Wheel Road	2005	Female	Death
FP70	U.S. 41 near Turner River	2006	Female	Death
UCFP92	U.S. Highway 41 west of SR 29	2007	Male	Death
UCFP98	I-75 at Jerome Wildlife Underpass	2007	Male	Death
UCFP102	I-75 east of SR 29	2007	Male	Death
UCFP104	SR 29 north of U.S. Highway 41	2008	Female	Death
K253	I-75 at SR 29	2009	Male	Death
UCFP119	U.S. Highway 41 near Turner River	2009	Female	Death
UCFP121	SR 29 south of I-75	2009	Male	Death
UCFP124	I-75 at mile marker 90	2009	Female	Death
UCFP133	I-75 west of Snake Road	2009	Male	Death
UCFP135	SR 29 north of Jerome	2009	Male	Death
FP158	U.S. Highway 41 east of San Marco Road	2010	Female	Death
FP169	U.S. Highway 41 west of Monroe Station	2010	Male	Death
UCFP 147	U.S. 41 1.7 miles east of Monroe Station	2010	Female	Death
FP83	U.S. Highway 41 west of Port of the Islands	2011	Female	Death
UCFP160	U.S. Highway 41 at 55 mile bend	2011	Male	Death
UCFP168	U.S. Highway 41 0.4 miles east of Bass Road	2012	Male	Death

Table 6. Panther Habitat Units – BCNP ORV trailheads and U.S. Highway 41 turn lane project sites*.

Land Cover Type	Habitat Score	Ac in Panther Primary Zone	PHUs Provided
Pine Forest	9.5	3.5	33.25
Cypress Swamp	9.2	4.9	45.08
Wet Prairie	4.7	5.3	24.91
Surface Waters	0.0	0.3	0
Urban Lands	0.0	3.5	0
	Total	17.5	103.24

PHUs needed to compensate for impacts in Primary Zone: 103.24 PHUs x 2.5 (Base Ratio) x 1.0 (Landscape Multiplier for Primary Zone) = 258.1 PHUs (rounded to 258 PHUs)

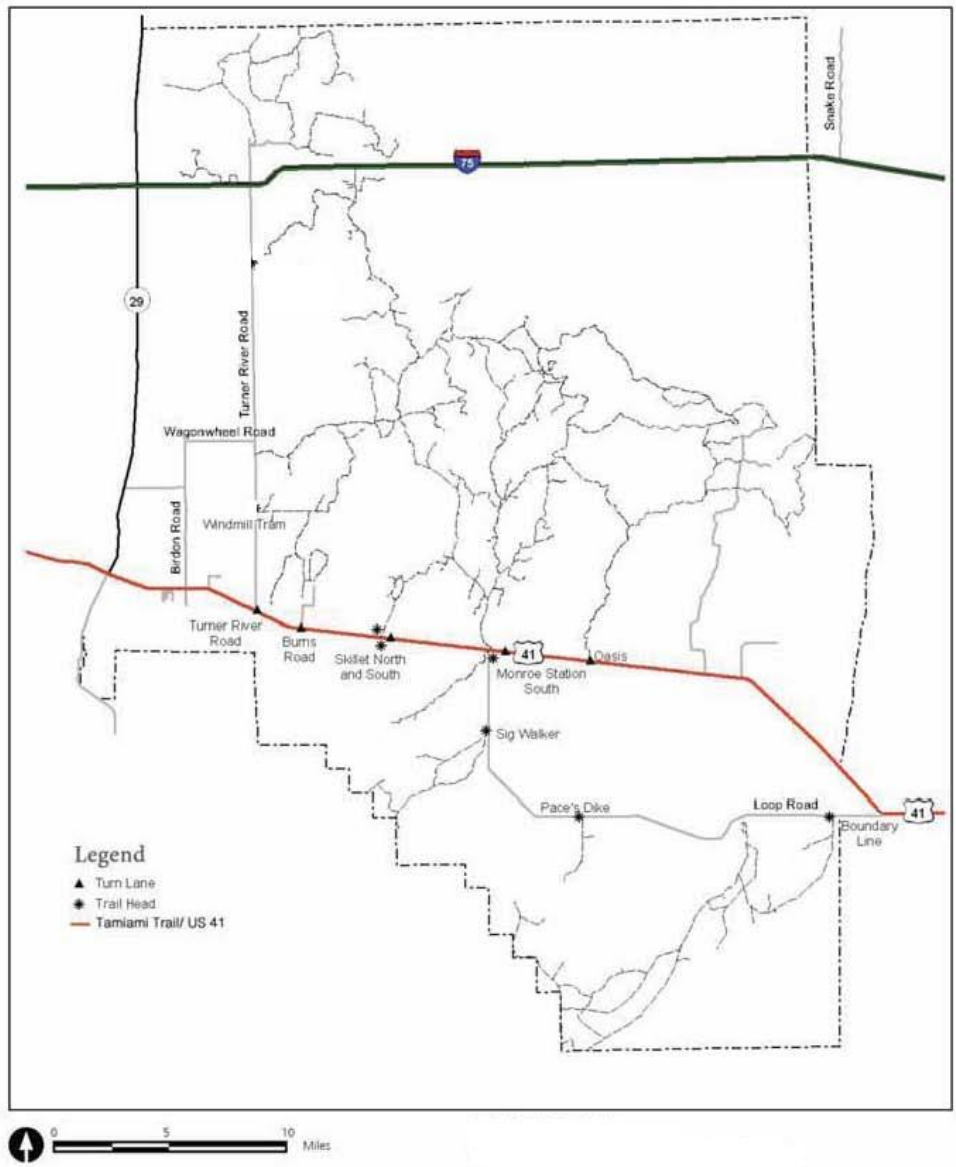

Figure 1. Location Map of proposed ORV trail heads (denoted by black diamonds) and U.S. Highway 41 turn lanes (denoted by black triangles) at the BCNP.

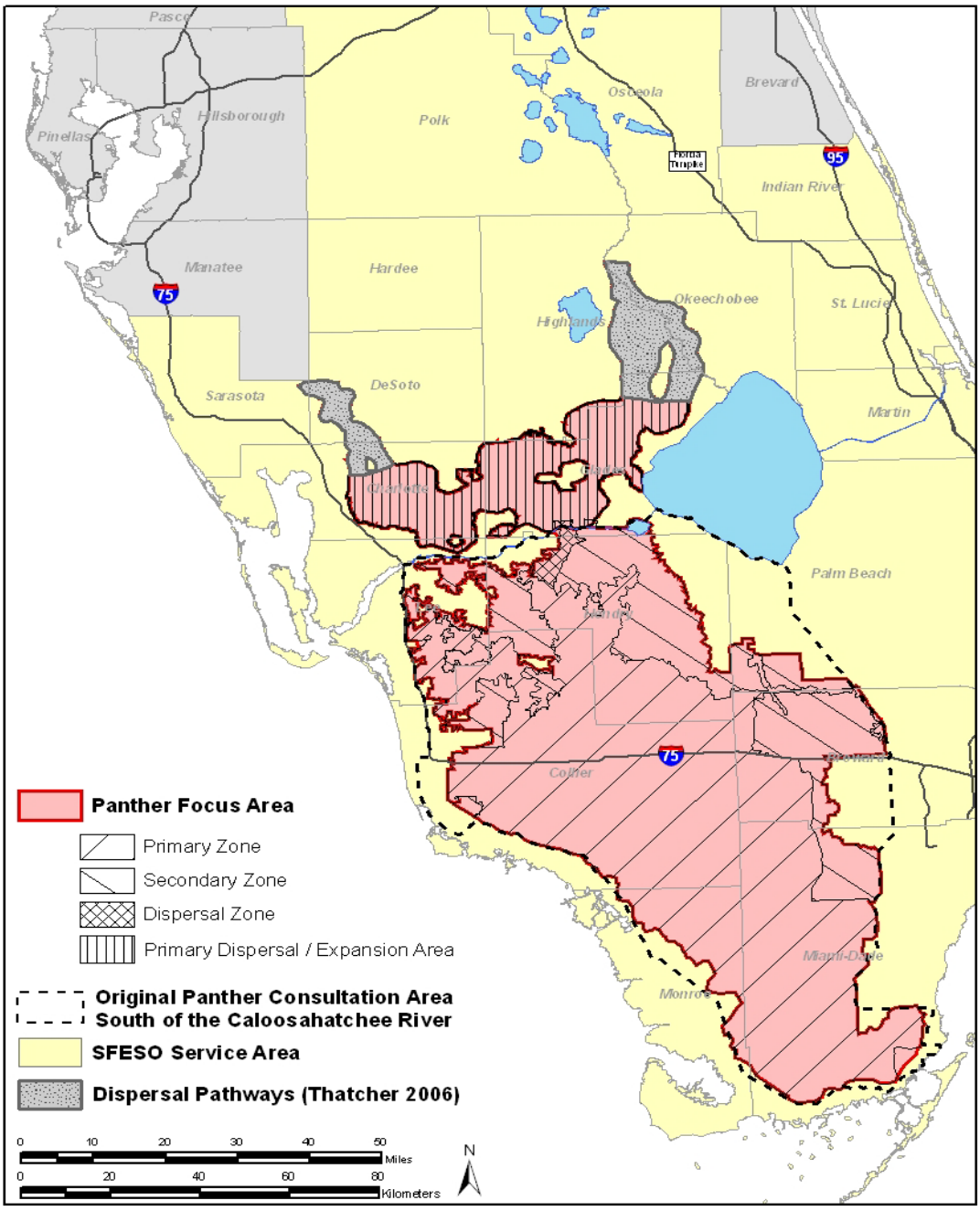

Figure 2. Florida Panther Focus Area and Original Panther Consultation Area.

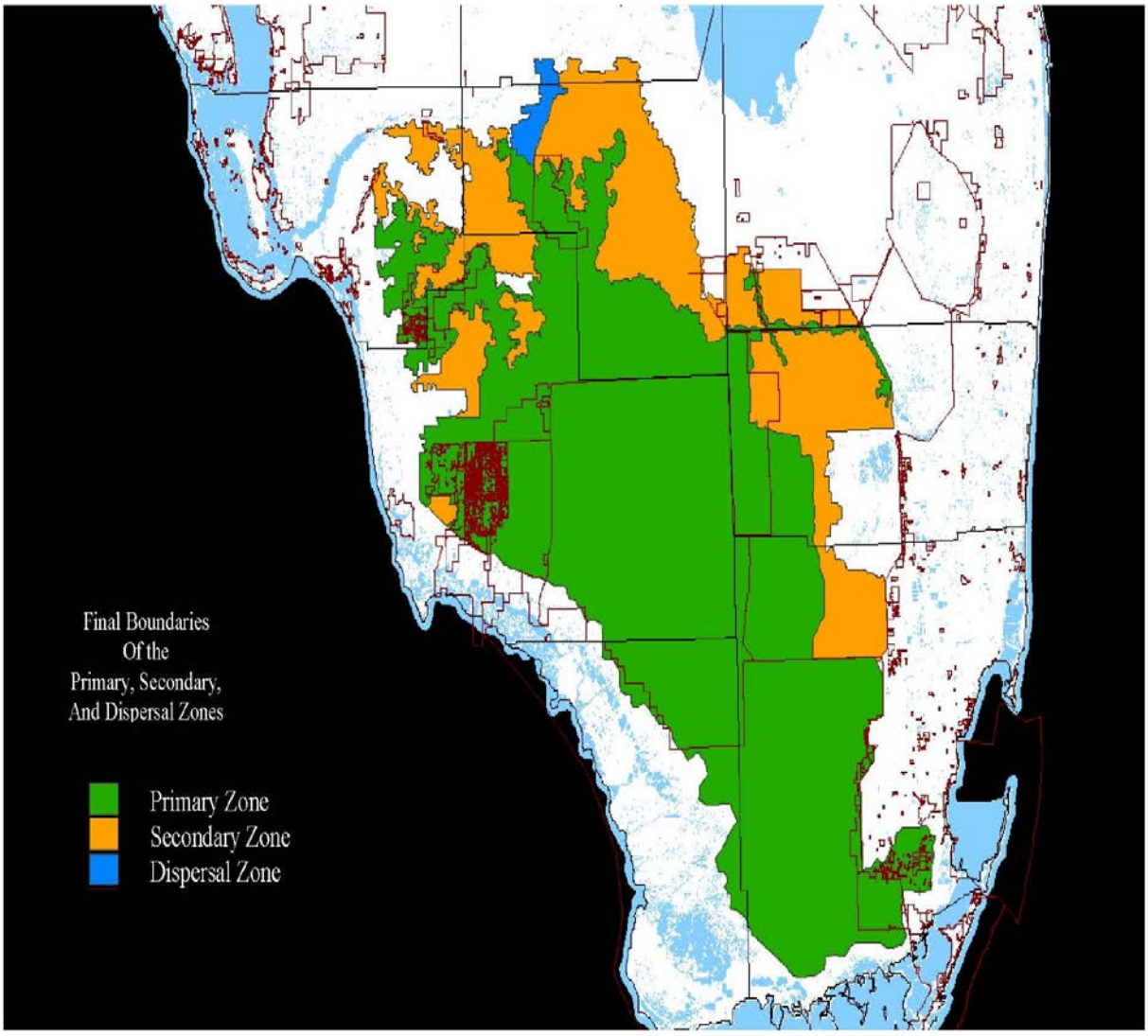

Figure 3. Primary, Secondary, and Dispersal Zones from Kautz et al. (2006).

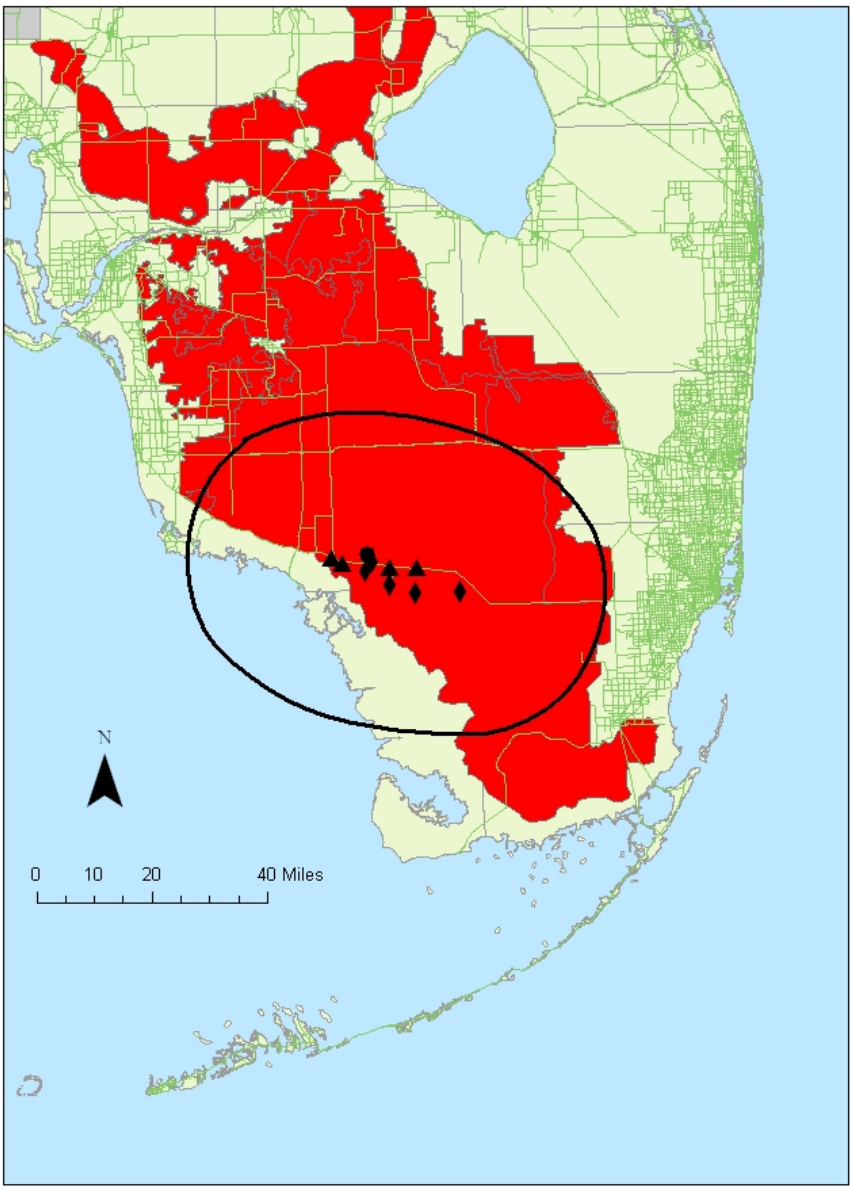

Figure 4. Map showing action area for the proposed ORV trail heads (denoted by black diamonds) and U.S. Highway 41 turn lanes (denoted by black triangles). The black circle denotes all lands within 25 miles of project sites. Red indicates the Service's Focus Area for the panther. The action area is defined as the project footprint and all lands in the Focus Area within 25 miles of the project site.

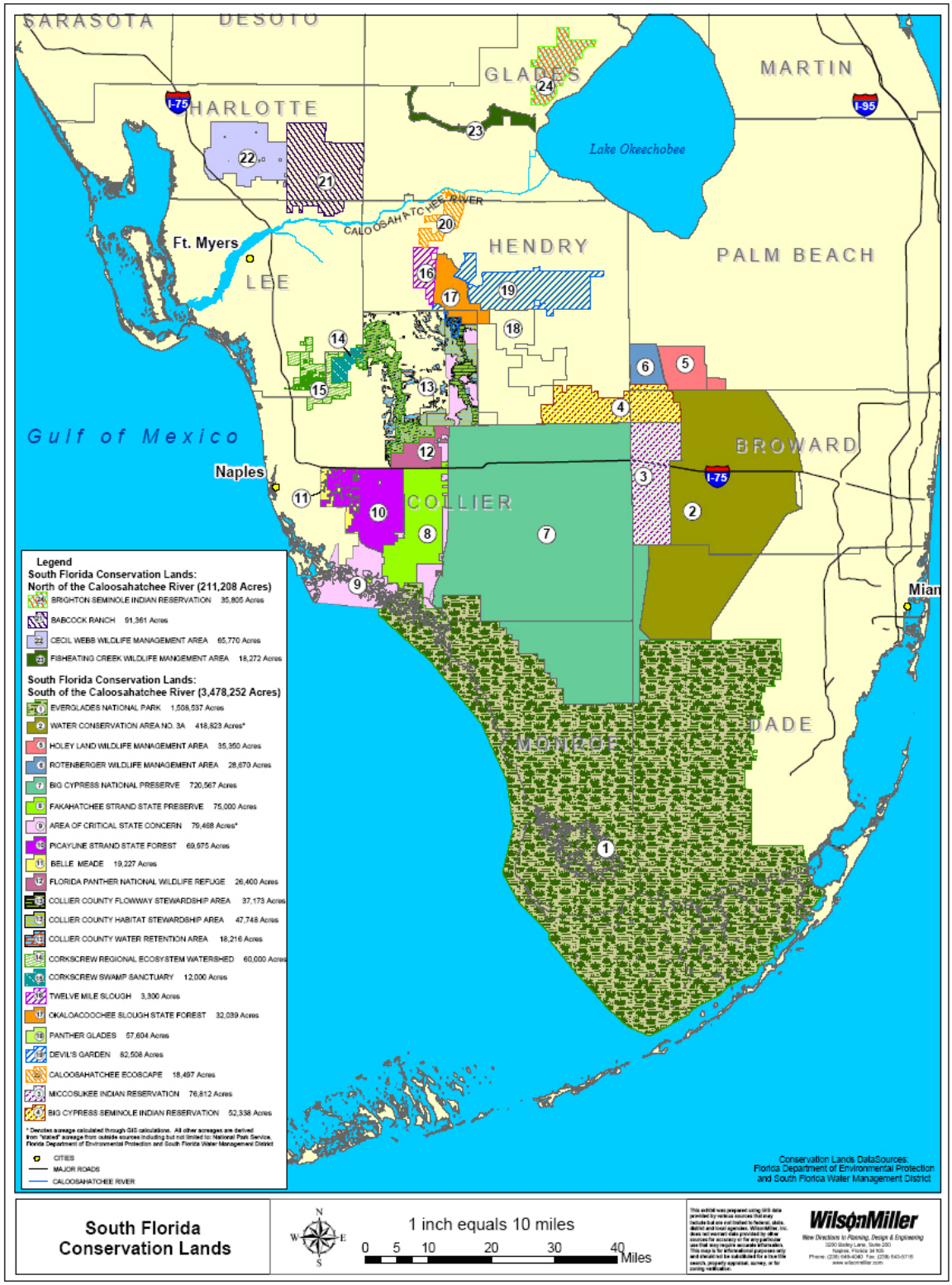

Figure 5. Southwest Florida conservation lands.

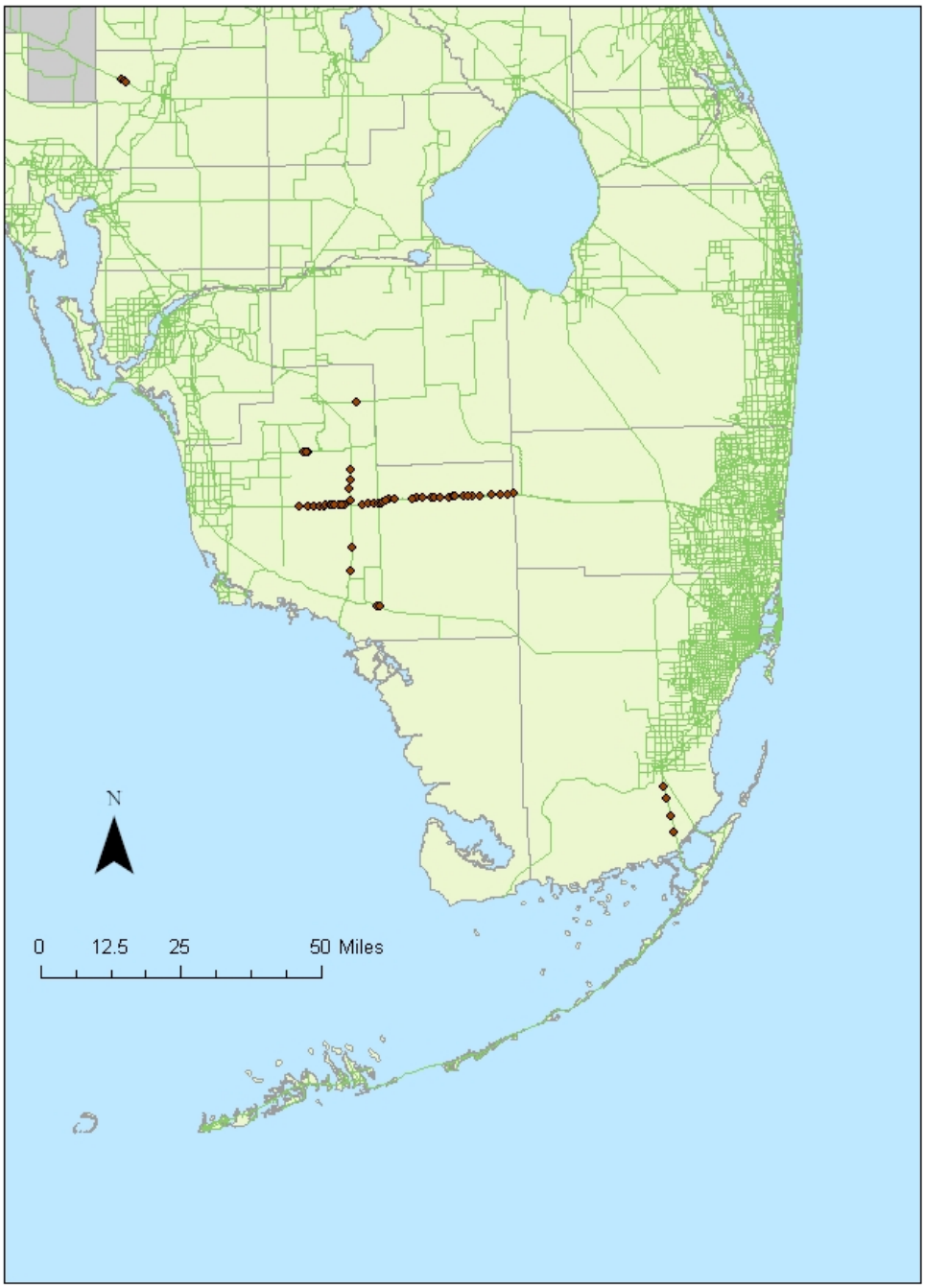

Figure 6. Locations of wildlife crossings in Southwest Florida (indicated by red diamonds).

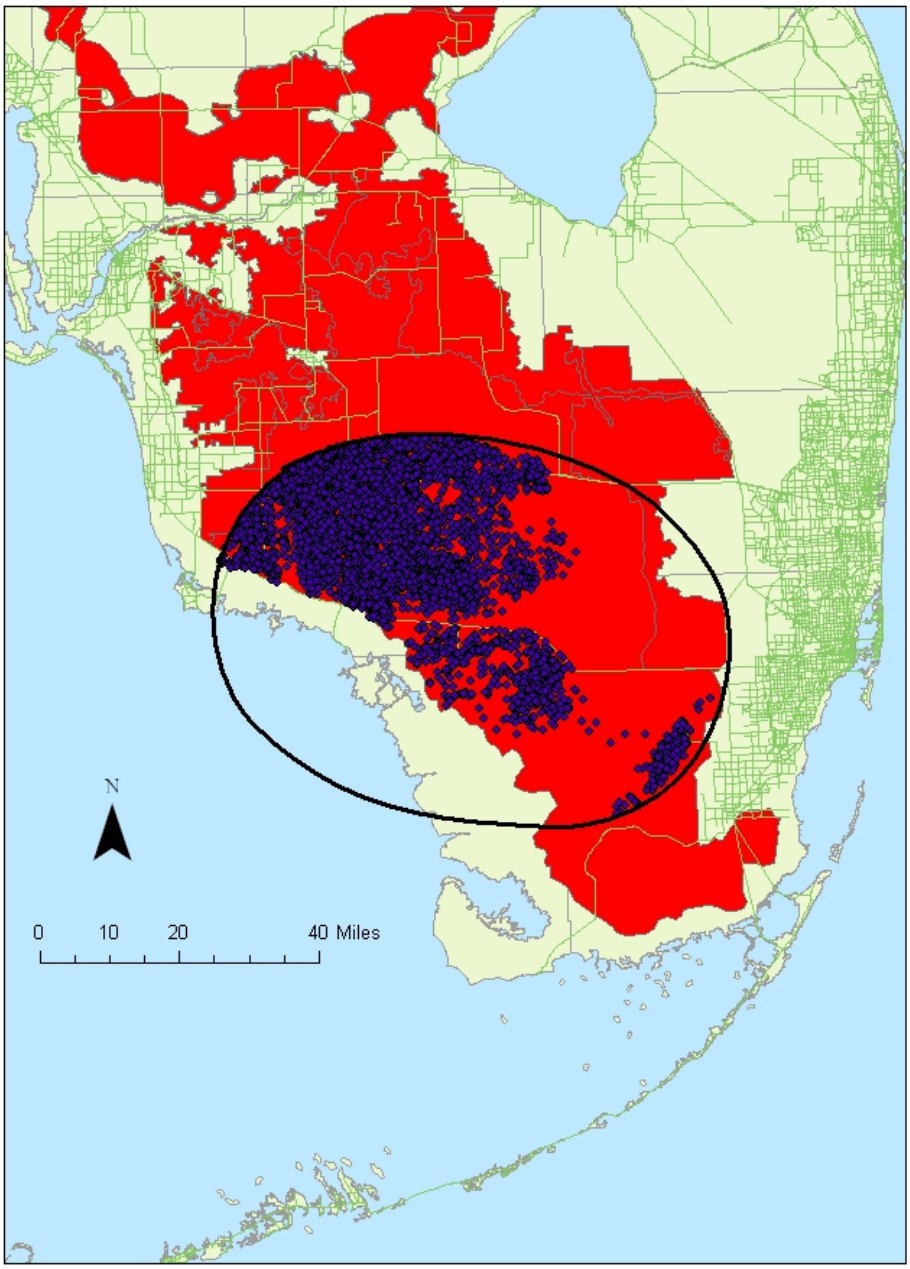

Figure 7. Telemetry data points for all panthers (alive or unknown status) within 25-mile action area.

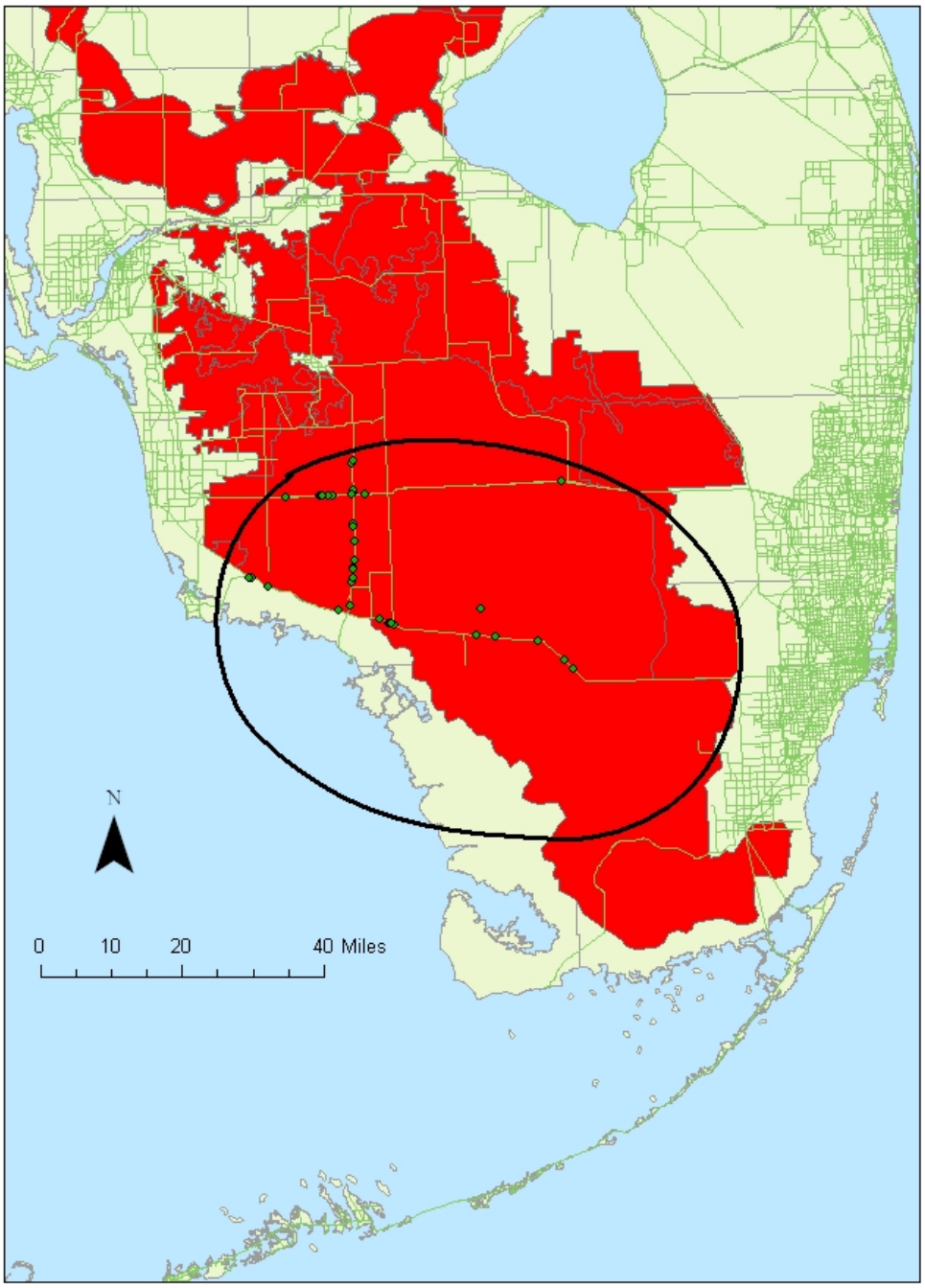

Figure 8. Locations of panther/motor vehicle collisions (indicated by diamonds) within the action area.

Appendix A

Panther Habitat Assessment Methodology

Panther Habitat Assessment Methodology

The Service developed the panther habitat assessment methodology in 2006 and updated the methodology in 2009. 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 ranks 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 Comprehensive Everglades Restoration Plan (CERP) water treatment and retention areas. We used these values (Tables PM1 and PM2) as the basis for habitat evaluations and the recommended compensation values to minimize project effects to the Florida panther, 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 (31,923 acres per panther [Kautz et al. (2006)]) from the acreage of primary zone equivalent non-urban lands at risk, we developed the following approach.

The available primary zone equivalent lands at the time the methodology was developed (2006) were estimated at 3,276,563 acres (ac) (see Tables PM3 and PM4), with 2,073,865 ac of primary zone equivalent, non-urban lands preserved. The remaining non-urban, at-risk, private lands were estimated at 1,202,698 ac of primary zone equivalent lands. To meet the protected and managed lands threshold for a population of 90 panthers, an additional 799,205 ac 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 ac) by the result of the acres of at-risk habitat in the primary zone (610,935 ac) times the value of the primary zone (1); plus the at-risk acres in the dispersal zone (27,883 ac) times the value of the dispersal zone (1); plus the at-risk acres in the secondary zone (503,481 ac) times the value of the secondary zone (0.69); plus the at-risk acres in the other zone (655,996 ac) times the value of the other zone (0.33); minus the at-risk ac of habitat to be protected (799,205 ac). The results of this formula provide a base value of 1.98.

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

In evaluating habitat losses in the consultation area, we used an estimate of 0.8 percent loss of habitat per year (R. Kautz, FWC, personal communication, 2004) to predict the amount of habitat loss anticipated in south Florida during the next 5 years (*i.e.*, 6,000 hectares/year [14,820 ac/ year]). We conservatively assume that we would be aware of half of the development projects that occur within the primary zone and the secondary zone combined. We further assume that 50 percent of these projects would be located in the primary zone and 50 percent would be located in the secondary zone. Based on these assumptions, we estimated that over a 5-year period about 37,000 ac (primary

zone equivalent of 31,265 ac) would be developed without Federal review. To reflect this loss of habitat we adjusted the base acreage density of 31,923 acres per panther (Kautz et al. [2006]) to a new base density of 32,275 ac per panther, an increase of 352 acres (31,265/90=352+31,923=32,275). This adjustment results in a base ratio change from 1.98 to 2.23.

The Service realizes 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 5.0 ac 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 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, based on the 0.08 percent annual loss referenced by Kautz (2004), we estimated the development of vacant lands (2003) in northern Golden Gate Estates and Lehigh Acres in Collier and Lee counties, respectively, at about 2,590 ac per year per development, or about 12,950 ac per development over a 5-year period. As above, to reflect this loss we adjusted the revised base acreage density to 32,563 ac, an increase of 288 acres (25,900/90=288+352+31,923=32,563). 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 ac per year of habitat loss for these types of projects, with a not to exceed value of 2,500 ac over the 5-year period. The 500 ac per year is based on average cost of FDOT bridge/box culvert crossings (3.6 to 5 million dollars) converted to acreage equivalent costs (8,500/ac). This 2,500 acre habitat surrogate adds an additional 28 acres per panther to the above adjusted base for a new base of 32,951 ac per panther (2,500/90=28+288+352+31,923=32,591). 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 2007).

The average population size south of the Caloosahatchee 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 ac protected for every acre developed. Furthermore, if we 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 highest 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 PM5 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 PM1 and PM2. 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 Swanson et al. (2005) and Kautz et al. (2006) and adjusted by the Service to consolidate similar types of habitats and to include CERP water treatment and retention areas located in the panther's range (Table PM1). 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 PM6). 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 PM7). 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:

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.

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.

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.

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) stormwater 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.

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 prey foraging value, or lack thereof, 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.

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

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

However, this neutral effect assessment is only applicable to land conversions from nonnative habitats to STAs. For those projects that remove natural habitats, the Service considers STA functional values to mimic the value of the natural system the STA is designed to achieve. As an example, an 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.

Reservoirs (Everglades restoration, large water storage area, mines): Reservoirs were originally 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 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 ac of grassed berms and 50 ac of berms with roads along the top would be evaluated as 900 ac of open water, 50 ac of pasture, and 50 ac of urban.

We also recognized the habitat matrix (Table PM7) 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's (Service 2008) action 1.1.1.2.3 recommends habitat preservation and restoration within the primary zone be provided in situations where land use intensification cannot be avoided. We view this recommendation as a key parameter in our conservation goal to locate, preserve, and restore 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 PM7). We also believe 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 summary, we believe 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 PM2).

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 PM2, 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 ac of pine flatwoods with 10 percent exotics would be treated in our habitat assessment methodology as 90 ac of pine flatwoods and 10 ac of exotics. Adding another 100 ac of cypress swamp with 10 percent exotics would change our site from 90 ac of pine flatwoods and 10 ac of exotics to 90 ac of pine flatwoods, 90 ac of cypress swamp, and 20 ac 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 ac of hydric pine flatwoods and 10 ac 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 ac of pine flatwoods x 9.5 [the habitat suitability value for pine flatwoods] = 855 PHUs) + (10 ac 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.

Table PM1. 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 PM2. 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 pages 5- 7 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 6 for the accompanying text for guiding criteria for these systems.

Table PM3. Land Held for Conservation within the Florida Panther Core Area.

	Acres	Primary Equivalent Factor	Primary Equivalent Acres
Primary	1,659,657	1.00	1,659,657
Dispersal	0	1.00	0
Secondary	308,623	0.69	212,950
Other	609,872	0.33	201,258
TOTAL	2,578,152	TOTAL	2,073,865

Table PM4. Undeveloped Privately Owned Land within Florida Panther Core Area.

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

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

Table PM5. 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 PM6. 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 PM7. 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