United States Department of the Interior

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

September 19, 2007

Memorandum

To: Karen Gustin, Superintendent, Big Cypress National Preserve

From: Paul Souza, Field Supervisor, South Florida Ecological Services Office

Subject: Designated Trail System in Bear Island Unit of Big Cypress National Preserve
Service Consultation Code: 41420-2007-F-0477

This memorandum amends the Fish and Wildlife Service's (Service) July 14, 2000, Biological Opinion (Former Service Log Number 4-1-00-F-550) regarding the implementation of the National Park Service's (NPS) Off-Road Vehicle Management Plan (ORV Plan) (NPS 2000) and its effects on the endangered Florida panther (*Puma [=Felis] concolor coryii*), endangered Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*), endangered wood stork (*Mycteria americana*), endangered red-cockaded woodpecker (*Picoides borealis*), and the threatened eastern indigo snake (*Drymachon corais couperi*) in Big Cypress National Preserve (BICY). Your August 9, 2007, letter provided new information and requested an amendment to the July 14, 2000, Biological Opinion as completed under the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). A complete administrative record of this consultation is on file at the Service's South Florida Ecological Services Office, Vero Beach, Florida.

The 2000 ORV Plan requires NPS to limit ORV use at BICY to no more than 400 miles of primary trails within a designated trail framework, and will eliminate dispersed use of ORVs in BICY. In addition, secondary trails, which would provide access to private property or specific destinations such as campsites, would be identified. These secondary trails, for which no mileage limit was defined, would branch off the primary trails and therefore receive less use than primary trails. The ORV Plan limited the Bear Island Unit to approximately 30 miles of designated primary trails, as compared to the 55 miles of primary trails that existed before the plan was finalized. After the ORV Plan was finalized, NPS reduced the amount of trails in the Bear Island Unit to 24.43 miles of designated primary trail and 0.34 mile of secondary trail.

In mid-January of 2007, NPS contacted the Service to discuss upcoming ORV-related activities at BICY. Service staff met with NPS staff and toured the Bear Island Unit in late January. Additional meetings were held via teleconference. Further discussions and additional information were supplied through email. NPS planned to modify the ORV trail system in the Bear Island Unit by: (1) reclaiming 3.11 miles of primary trail; (2) converting 1.58 miles of primary trail to secondary trail; (3) reopening 15.21 miles of previously closed trail as primary trail; and (4) reopening 7.49 miles of previously closed trail as secondary trail. In total this resulted in a designated trail system for Bear Island consisting of a total of 34.95 miles of

primary trail and 9.41 miles of secondary trail (Figure 1). These would be the only trails designated for ORV use in Bear Island Unit and thus would be consistent with the limitations of the 2000 ORV Plan.

The terms and conditions relating to studies in the July 14, 2000, Biological Opinion were expected to be completed over the implementation period of the 2000 ORV Plan. No clear schedule was set for particular studies. In a letter to the Service dated February 15, 2007, NPS provided a list of actions that would ensure that NPS's proposal complied with the terms and conditions in the 2000 Biological Opinion that related specifically to the Bear Island Unit and panther. These were:

> "*1. Technical assistance has been secured and we expect the project lead to be on site in April 2007 to begin the design phase of the carrying capacity study. The design of this study will enable the NPS to initiate, upon availability of funding, an ORV carrying capacity study for Bear Island. We will then partner with the Service to actively locate and secure funding sources for implementation of the study.*
>
> *2. By August 30, 2007, the NPS will work with the Service to develop a Scope of Work (SOW) on evaluating the impacts of ORV use on panther movement. The NPS and the Service will then work together to secure funding to implement the SOW.*
>
> *3. A mandatory sign-in registration station will be in place at the head of each ORV trail in the BICY by March 1. This data will be collected and analyzed annually to determine the levels of use and use patterns.*
>
> *4. Every 3 months the NPS will conduct a periodic review of habitat conditions adjacent to the trails in Bear Island through a combination of a habitat checklist and photo monitoring points. The NPS will forward this information to Service, and meetings will be held if either agency deems necessary. Annual meetings between the two agencies will be held to assess progress in complying with the July 14, 2000, Biological Opinion for the ORV Plan.*"

Items 3 and 4 in the list above were commitments above and beyond those contained in the 2000 Biological Opinion and were proposed as new terms and conditions designed to fulfill the intent of the original Biological Opinion's reasonable and prudent measures. BICY currently has a cap on annual ORV permits of 2,000 per year, and the cap has never been reached. The mandatory sign-in station will provide an additional mechanism allowing NPS and the Service to identify trends in ORV use in Bear Island. Furthermore, item number 4 will allow NPS and the Service to assess habitat conditions in the future. This information and the ORV use information generated from the mandatory sign-in station will be analyzed to identify the long-term effects of ORV use on Bear Island resources as well as changes in the level and type of use over time. NPS will be able to use the information generated through this commitment to help develop

best management practices for ORV use and resource conservation in the years ahead. After analysis of the NPS's new commitments, the Service revised the terms and conditions of the 2000 Biological Opinion to reflect those new commitments in a memorandum to NPS on February 16, 2007. NPS implemented the 34.95 miles of primary trail and 9.41 miles of secondary trail in late February 2007.

Subsequent to the February 16, 2007 concurrence, NPS and the Service staff met with the Florida Fish and Wildlife Conservation Commission (FWC) to discuss development of the SOW described in item number 2. A number of ideas were considered, including developing a more detailed study similar to the studies completed by Janis and Clark in 1999 and published by Janis and Clark in 2002. The group determined that a study similar to the Janis and Clark study would require an intensive radio-collaring effort on panthers, and may not provide the most useful information regarding ORV use and panther movements. Other ideas such as completing a detailed analysis of existing data on a variety of parameters, including ORV historical use, panther telemetry, backcountry permits, and vegetation in BICY would provide more information on ORV use and panther behavior.

As a result of these discussions, NPS prepared a SOW entitled "Historical Data Analysis Related to Recreational ORV Use and panthers within Big Cypress National Preserve" (attached) and will partner with the Service, FWC, and NPS's Fort Collins Biological Resource Management Division to complete this endeavor. Bear Island will remain a focal unit of this analysis, given that a trail system is in place and no dispersed ORV use is permitted, and that it has the most comprehensive check station records and the longest period of panther location data. The analysis, however, will be broader than originally intended, and will analyze the array of information obtained for the past 25 years on recreational use in all of BICY. Through this analysis, NPS plans to derive trends in hunter use; ORV use, type, and trends; prey distribution; prey harvest; and prey age structure. The analysis is expected to show trends in recreational use and also provide guidance in for management of the panther and ORV use in BICY. This SOW addresses the intent of the original terms and conditions 2 and 3 in the 2000 Biological Opinion which stated:

2. NPS will study the level of ORV use in Bear Island to determine the level that is acceptable and compatible with panther use of this management unit.

3. NPS will initiate a study similar to the Janis and Clark study concurrent with the ORV carrying capacity and level of use study. This will provide data on panther behavior associated with known levels of human activity.

As a result of continuing discussions and new information presented, the NPS asserted and the Service concurred that the July 14, 2000, Biological Opinion as amended in February 2007 should be amended again to reflect the new information, particularly the SOW completed for further study of ORV use as it relates to panthers. We have reviewed the new information, updated each section of the Biological Opinion as appropriate, and this memorandum amends the July 14, 2000, Biological Opinion.

STATUS OF THE SPECIES AND CRITICAL HABITAT RANGEWIDE

The following information on the panther replaces the entire Status of the Species section in the July 14, 2000, Biological Opinion.

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

Efforts to reduce the number of panthers and prey decline resulted in a panther population threatened with extinction. Prior to 1949, panthers could be killed in Florida at any time of the year. In 1950, the Florida Game and Freshwater Fish Commission (now the FWC) declared the panther a regulated game species due to concerns over declining numbers. The FWC removed panthers from the game animal list in 1958 and gave them complete legal protection. On March 11, 1967, the Service listed the panther as endangered (32 FR 4001) throughout its historic range, and these animals received Federal protection under the passage of the Endangered Species Preservation Act (80 Stat. 926). This act, however, stated that the taking of an endangered species was only prohibited on Federal lands. It was not until the 1973 Act that taking of threatened or endangered species was prohibited. The Florida Panther Act (State Statute 372.671), a 1978 Florida State law, made killing a panther a felony. The Florida panther is listed as endangered by the States of Florida, Georgia, Louisiana, and Mississippi.

Since the panther was designated as an endangered species prior to enactment of the Act, there was no formal listing package identifying threats to the species as required by section 4(a)(1) of the Act. However, the technical / agency draft of the Florida Panther Recovery Plan, third revision, addressed the five factor threats analysis (Service 2006). No critical habitat has been designated for the panther.

Taxonomy

The Florida panther was first described by Charles B. Cory in 1896 as *Felis concolor floridana* (Cory 1896). The type specimen was collected in Sebastian, Florida. Bangs (1899), however,

believed that the Florida panther was restricted to peninsular Florida and could not intergrade with other *Felis* spp. Therefore, he assigned it full specific status and named it *Felis coryi* since *Felis floridana* had been used previously for a bobcat (*Lynx rufus*).

The taxonomic classification of the *Felis concolor* group was revised and described by Nelson and Goldman (1929) and Young and Goldman (1946). These authors differentiated 30 subspecies using geographic and morphometric (measurement of forms) criteria and reassigned the Florida panther to subspecific status as *Felis concolor coryi*. This designation also incorporated *F. arundivaga* which had been classified by Hollister (1911) from specimens collected in Louisiana into *F. c. coryi*. Nowell and Jackson (1996) reviewed the genus *Felis* and placed mountain lions, including the Florida panther, in the genus *Puma*.

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

Species Description

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

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

Three external characters—a right angle crook at the terminal end of the tail, a whorl of hair or cowlick in the middle of the back, and irregular, white flecking on the head, nape, and shoulders—not found in combination in other subspecies of *Puma* (Belden 1986), were commonly observed in Florida panthers through the mid-1990s. The kinked tail and cowlicks were considered manifestations of inbreeding (Seal 1994); whereas the white flecking was

thought to be a result of scarring from tick bites (Maehr 1992; Wilkins et al. 1997). Four other abnormalities prevalent in the panther population prior to the mid-1990s included 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 were also suspected to be the result of low genetic variability (Roelke et al. 1993).

A plan for genetic restoration and management of the Florida panther was developed in September 1994 (Seal 1994) and eight non-pregnant adult female Texas panthers (*Puma concolor stanleyana*) were released in five areas of south Florida from March to July 1995. Since this introgression, rates of genetic defects, including crooked tails and cowlicks, have dramatically decreased (Land et al. 2004). In addition, to date neither atrial septal defects nor cryptorchidism have been found in introgressed panthers (M. Cunningham, FWC Personal Communication 2005). As of January 27, 2003, none of the eight female Texas panthers introduced in 1995 remain in the wild.

Population Trends and Distribution

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

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

Puma are wide ranging, secretive, and occur at low densities. However, their tracks, urine markers, and scats are readily found by trained observers, and resident populations are easily located. Van Dyke et al. (1986a) determined that all resident puma, 78 percent of transient

puma, and 57 percent of kittens could be detected by track searches in Utah. In south Florida, the Florida panther's limited range and low densities may make the population count derived from track searches more accurate than in Utah. During 2 month-long investigations – one late in 1972 and early 1973 and another in 1974 – funded by the World Wildlife Fund to determine if panthers still existed in Florida, McBride searched for signs of panthers in portions of south Florida. In 1972, McBride authenticated a road-killed male panther in Glades County and a female captured and released from a bobcat trap in Collier County (R. McBride, Livestock Protection Company, Personal Communication 2005). In 1973, McBride captured one female in Glades County (Nowak and McBride 1974). Based on this preliminary evidence, Nowak and McBride (1974) estimated the "population from the Lake Okeechobee area southward to be about 20 or 30 individuals." In 1974, McBride found evidence of only two additional panthers in the Fakahatchee Strand and suggested that "there could be not more than ten 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). Thirty individual panthers were identified during a wide-ranging survey in 1985 in south Florida (McBride 1985).

Maehr et al. (1991) provides the only published population estimate based on a substantial body of field data (Beier et al. 2003). Maehr et al. (1991) estimated a density of 1 panther / 27,520 acres (ac) [11,137 hectares (ha)] based on 17 concurrently radio-collared and 4 uncollared panthers. They extrapolated this density to the area occupied (1,245,435 ac [504,012 ha]) by radio-collared panthers during the period 1985 to 1990 to achieve a population estimate of 46 adult panthers for southwest Florida (excluding Everglades National Park [ENP], eastern BICY, and Glades and Highlands Counties). Beier et al. (2003), however, argued that this estimate of density, although "reasonably rigorous," could not be extrapolated to other areas because it was not known whether densities were comparable in those areas.

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

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 three years based on 26 radio-collared panthers of both sexes (Maehr et al. 1991). Based on genetics work, some males may become breeders as early as 17 months (W. Johnson, National Cancer Institute, Personal Communication 2005).

Breeding activity peaks from December to March (Shindle et al. 2003). Litters (n = 82) are produced throughout the year, with 56-60 percent of births occurring between March and June (Jansen et al. 2005, Lotz et al. 2005). The greatest number of births occurs in May and June (Jansen et al. 2005, Lotz et al. 2005). Female panthers have bred as young as 18 months (Maehr et al. 1989) and successful reproduction has occurred up to 11 years old. Mean age of denning females is 4.6 ± 2.1 (standard deviation [sd]) years (Lotz et al. 2005). Age at first reproduction for 19 known-aged female panthers averaged 2.2 ± 0.246 (sd) years and ranged from 1.8-3.2 years. Average litter size is 2.4 ± 0.91 (sd) kittens. Seventy percent of litters are comprised of either two or three kittens. Mean birth intervals (elapsed time between successive litters) are 19.8 ± 9.0 (sd) months for female panthers (n = 56) (range 4.1-36.5 months) (Lotz et al. 2005). Females that lose their litters generally produce another more quickly; five of seven females whose kittens were brought into captivity successfully produced another litter an average of 10.4 months after the removal of the initial litter (Land 1994).

Den sites are usually located in dense understory vegetation, typically saw palmetto (*Serenoa repens*) (Maehr 1990a, Shindle et al. 2003). Den sites are used for up to 2 months by female panthers and their litters from birth to weaning. Independence and dispersal of young typically occurs at 18 months, but may occur as early as one year (Maehr 1992).

Survivorship and Causes of Mortality: Mortality records for uncollared panthers have been kept since February 13, 1972, and for radio-collared panthers since February 10, 1981. One-hundred eighty-five mortalities have been documented through June 6, 2006, with 80 (43 percent) of known deaths occurring in the past 5 years (Lotz et al. 2005, FWC unpublished data). Overall, documented mortality averaged 3.6 per year through June 2001, and 16.0 per year from July 2001 through June 2006. Of the 185 total mortalities, 99 were radio-collared panthers that have died since 1981 (FWC unpublished data). From 1990-2004, mean annual survivorship of radio-collared adult panthers was greater for females (0.894 ± 0.099 sd) than males (0.779 ± 0.125 sd) (Lotz et al. 2005). Except for intraspecific aggression, the causes of mortality were found to be independent of gender (Lotz et al. 2005).

Intraspecific aggression was the leading cause of death for radio-collared panthers, accounting for 42 percent (Jansen et al. 2005; Lotz et al. 2005). Most intraspecific aggression occurs between male panthers; but, aggressive encounters between males and females, resulting in the death of the female, have occurred. Defense of kittens and / or a kill is suspected in half (5 of 10) of the known instances through 2003 (Shindle et al. 2003).

Unknown causes and collisions with vehicles accounted for 24 and 19 percent of radio-collared panther mortalities, respectively. From February 13, 1972, through June 30, 2005, Florida panther vehicular trauma (n=86), averaged 2.6 per year (Lotz et al. 2005). Twenty-eight panthers were killed by vehicles from July 1, 2005 through July 2007 (FWC unpublished data).

Female panthers are considered adult residents if they are older than 18 months, have established home ranges and bred (Maehr et al. 1991). Lotz et al. (2005) reported that all 24 female panthers first captured as kittens survived to become residents and 19 (79.2 percent) produced litters. Male panthers are considered adult residents if they are older than three years and have

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

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

Dispersal: Panther dispersal begins after a juvenile becomes independent from its mother and continues until it establishes a home range. Dispersal distances are greater for males (n = 18) than females (n = 9) (42.5 mi [68.4 km] vs. 12.6 mi [20.3 km], respectively) and the maximum dispersal distance recorded for a young male was 139.2 mi (224.1 km) over a 7-month period followed by a secondary dispersal of 145 mi (233 km) (Maehr et al. 2002). Males disperse an average distance of 25 mi (40 km); females typically remain in or disperse short distances from their natal ranges (Comiskey et al. 2002). Female dispersers are considered philopatric because they usually establish home ranges less than one average home range width from their natal range (Maehr et al. 2002). Maehr et al. (2002) 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 for females (9.6 months and 7.0 months, respectively) (Maehr et al. 2002). 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 1997a).

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

Home Range Dynamics and Movements: Panthers require large areas to meet their needs. Numerous factors influence panther home range size including habitat quality, prey density, and landscape configuration (Belden 1988; Comiskey et al. 2002). Home range sizes of 26 radio-collared panthers monitored between 1985 and 1990 averaged 128,000 ac (51,800 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 1981-2000 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. 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) located at BICY (Jansen et al. 2005).

Annual minimum convex polygon home range sizes of 52 adult radio-collared panthers monitored between 1998 and 2002 ranged from 15,360 – 293,759 ac (6,216 – 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; Shindle et al. 2000, 2001; Land et al. 2002). Home ranges of resident adults tend to be stable unless influenced by the death of other residents; however, several males have shown significant home range shifts that may be related to aging (D. Jansen, NPS, Personal Communication 2005). Home-range overlap is extensive among resident females and limited among resident males (Maehr et al. 1991).

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

Telemetry data indicate that panthers typically do not return to the same resting site day after day, with the exception of females with dens or panthers remaining near kill sites for several days. The presence of physical evidence such as tracks, scats, and urine markers confirm that panthers move extensively within home ranges, visiting all parts of the range regularly in the course of hunting, breeding, and other activities (Maehr 1997a; 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 1997a). Panthers are capable of moving large distances in short periods of time. Nightly panther movements of 12 mi (20 km) are not uncommon (Maehr et al. 1990a).

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

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

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

Infectious Diseases, Parasites, and Environmental Contaminants:

Viral Diseases—Feline leukemia virus (FeLV) is common in domestic cats (*Felis catus*), but is quite rare in non-domestic felids. Routine testing for FeLV antigen (indicating active infection) in captured and necropsied panthers has been negative since testing began in 1978 to the fall of 2002. Between November 2002 and February 2003, however, two panthers tested FeLV antigen positive (Cunningham 2005). The following year, three more cases were diagnosed. All infected panthers had overlapping home ranges in the Okaloacoochee Slough ecosystem. Three panthers died due to suspected FeLV-related diseases (opportunistic bacterial infections and anemia) and the two others died from intraspecific aggression. Testing of serum samples collected from 1990-2005 for antibodies (indicating exposure) to FeLV indicated increasing exposure to FeLV beginning in the late 1990s and concentrated north of I-75. There was apparently minimal exposure to FeLV during this period south of I-75. Positive antibody titers in different areas at different times may indicate that multiple introductions of the virus into the panther population may have occurred. These smaller epizootics were apparently self-limiting and did not result in any known mortalities. Positive antibody titers, in the absence of an active infection (antigen positive), indicate that panthers can be exposed and overcome the infection (Cunningham 2005). Management of the disease includes vaccination as well as removal of infected panthers to captivity for quarantine and supportive care. As of June 1, 2005, about one-third of the population had received at least one vaccination against FeLV (FWC and NPS unpublished data). No new positive cases have been diagnosed since July 2004.

Pseudorabies virus (PRV) (Aujeszky's disease) causes respiratory and reproductive disorders in adult hogs and mortality in neonates, but is a rapidly fatal neurologic disease in carnivores. At least one panther died from PRV infection presumably through consumption of an infected feral hog (Glass et al. 1994). At least one panther has also died of rabies (Taylor et al. 2002). This panther was 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) 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. 1993) although no PLV-related mortalities are known to have occurred.

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

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

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

Environmental Contaminants—Overall, mercury in south Florida biota has decreased over the last several years (Frederick et al. 2002). However, high mercury concentrations are still found in some panthers. At least one panther is thought to have died of mercury toxicosis and mercury has been implicated in the death of two other panthers in ENP (Roelke 1991). One individual panther had concentrations of 150 parts per million (ppm) mercury in its hair (Land et al. 2004). Elevated levels of p, p'– DDE were also detected in fat from that panther. The role of mercury and / or p, p'– DDE in this panther's death is unknown and no cause of death was determined despite extensive diagnostic testing. Elevated mercury concentrations have also been found in panthers from Florida Panther National Wildlife Refuge (FPNWR). Two sibling neonatal kittens

from this area had hair mercury concentrations of 35 and 40 ppm. Although other factors were believed to have been responsible, these kittens did not survive to leave their natal den. Consistently high hair mercury values in ENP and FPNWR and the finding of elevated values in some portions of BICY warrant continued monitoring (Land et al. 2004). Other environmental contaminants found in panthers include polychlorinated biphenyls (Arochlor 1260) and organochlorines (p, p'–DDE) (Dunbar 1995; Land et al. 2004).

Habitat Characteristics / Ecosystem

Landscape Composition: Noss and Cooperrider (1994) considered the landscape implications of maintaining viable panther populations. Assuming a male home range size of 137,599 ac (55,685 ha) (Maehr 1990a), an adult sex ratio of 50:50 (Anderson 1983), and some margin of safety, they determined that a reserve network as large as 15,625–23,438 mi^2 (40,469-60,703 km^2) would be needed to support an effective population size of 50 individuals (equating to an actual adult population of 100-200 panthers [Ballou et al. 1989]). However, to provide for long-term persistence based on an effective population size of 500 individuals (equating to 1,000 - 2,000 adult panthers [Ballou et al. 1989]), could require as much as 156,251-234,376 mi^2 (404,687-607,031 km^2). This latter acreage corresponds to roughly 60 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 2003, more than 55,000 locations on more than 100 radio-collared panthers were collected. Belden et al. (1988); Maehr et al. (1991); Maehr (1997a); Kerkoff et al. (2000); and Comiskey et al. (2002) provide information on habitat use based on various subsets of these data. Since almost all data from radio-collars have been collected during daytime hours (generally 0700-1100), and because panthers are most active at night (Maehr et al. 1990a), daytime radio locations are insufficient to describe the full range of panther habitat use (Beyer and Haufler 1994; Comiskey et al. 2002; Beier et al. 2003;Dickson et al. 2005; Beier et al. 2006).

A landscape-level strategy for the conservation of the panther population in south Florida was developed using a Florida panther potential habitat model based on the following criteria: (1) forest patches greater than 4.95 ac (2 ha); (2) non-urban cover types within 656 ft (200m) of forest patches; and (3) exclusion of lands within 984 ft (300m) of urban areas (Kautz et al. 2006). In developing the model, data from radio-collared panthers collected from 1981 through 2000 were used to evaluate the relative importance of various land cover types as panther habitat, thus identifying landscape components important for panther habitat conservation. Those components were then combined with a least cost path analysis to delineate three panther habitat conservation zones for south Florida: (1) Primary Zone – lands essential to the long-term viability and persistence of the panther in the wild; (2) Secondary Zone - lands which few panthers use contiguous with the Primary Zone, but given sufficient habitat restoration could

accommodate expansion of the panther population south of the Caloosahatchee River; and (3) Dispersal Zone - the area which may facilitate future panther expansion north of the Caloosahatchee River (Kautz et al. 2006) (Figure 2).

The Primary Zone is currently occupied and supports the breeding population of panthers. Although panthers move through the Secondary and Dispersal Zones, they are not permanently occupied. The Secondary Zone could support panthers with sufficient restoration. The panther Focus Area (Figure 3) was determined from the results of recent panther habitat models south and north of the Caloosahatchee River (Kautz et al. 2006; Thatcher et al. 2006). 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 necessary to support the current panther breeding population south of the Caloosahatchee River.

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

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

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

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

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

Primary Dispersal/Expansion Area is the Fisheating Creek/Babcock-Webb Wildlife Management Area 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.

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 (R. Kautz, Breedlove, Dennis and Associates, Personal Communication 2005), and includes portions of the BICY, ENP, Fakahatchee Strand Preserve State Park (FSPSP), FPNWR, Okaloacoochee Slough State Forest (OSSF), and Picayune Strand State Forest (PSSF). Targeted and Acquired Acreage Totals of Conservation Lands in South Florida Directly Affecting the Panther within the Panther Focus Area are available in Table 1. The Primary 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 (R. Kautz, Breedlove, Dennis and Associates, Personal Communication 2005). This zone's composition is 43 percent freshwater marsh, 36 percent agriculture, 11 percent forest, 6.1 percent prairie and shrub lands, and 2.3 percent low-density residential areas and open urban lands (Kautz et al. 2006). The Dispersal Zone is 28,160 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 present average density during the timeframe of the study, based on telemetry and other occurrence data, to average 1 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 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, 0 panthers. Taken together, the three zones in their current condition have the capacity to support 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 in that location. 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 to evaluate habitats in south central Florida for potential expansion of the Florida panther population. They identified four potential habitat patches: (1) Avon Park Bombing Range area; (2) Fisheating Creek/Babcock-Webb Wildlife Management Area (WMA); (3) eastern Fisheating Creek; and (4) Duette Park/Manatee County area. These habitat patches are smaller and more isolated compared with the current Florida panther range, and the landscape matrix where these habitat patches exist provides relatively poor habitat connectivity among the patches (Thatcher et al. 2006). Major highways and urban or agricultural development isolate these habitat patches, and they are rapidly being lost to the same development that threatens southern Florida (Belden and McBride 2005).

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

Radio-collar data and ground tracking indicate that panthers use the mosaic of habitats available to them as resting and denning sites, hunting grounds, and travel routes. These habitats include cypress swamps, hardwood hammocks, pine flatwoods, seasonally flooded prairies, freshwater marshes, and some agricultural lands. Although radio-collar monitoring indicates that forest is a preferred cover type, panthers also utilize non-forest cover types (Belden et al. 1988; Maehr et al. 1991; Comiskey et al. 2002). Compositional analyses by Kautz et al. (2006) confirmed previous findings that forest patches comprise an important component of panther habitat in south Florida, but that other natural and disturbed cover types are also present in the large landscapes that support panthers (Belden et al. 1988; Maehr et al. 1991; Comiskey et al. 2002). Kautz et al. (2006) found that the smallest class of forest patches (*i.e.*, 9-26 ac [3.6-10.4 ha]) were the highest ranked forest patch sizes within panther home ranges; this indicates that forest patches of all sizes appear to be important components of the landscapes inhabited by panthers, not just the larger forest patches.

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

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

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

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

Travel and Dispersal Corridors: In the absence of direct field observations/measurements, Harrison (1992) suggested that landscape corridors for wide-ranging predators should be half the width of an average home range size. Following Harrison's (1992) suggestion, corridor widths for Florida panthers would range 6.1-10.9 mi (9.8-17.6 km) depending on whether the target animal was an adult female or a transient male. Beier (1995) suggested that corridor widths for transient male puma in California could be as small as 30 percent of the average home range size of an adult. For Florida panthers, this would translate to a corridor width of 5.5 mi (8.8 km). Without supporting empirical evidence, Noss (1992) suggests that regional corridors connecting larger hubs of habitat should be at least 1.0 mi (1.6 km) wide. Beier (1995) makes specific recommendations for very narrow corridor widths based on short corridor lengths in a California setting of wild lands completely surrounded by urban areas; he recommended that corridors with a length less than 0.5 mi (0.8 km) should be more than 328 ft (100 m) wide, and corridors extending 0.6-4 mi (1-7 km) should be more than 1,312 ft (400 m) wide. The Dispersal Zone encompasses 44 mi^2 (113 km^2) with a mean width of 3.4 mi (5.4 km). Although it is not

adequate to support even one panther, the Dispersal Zone is strategically located and expected to function as a critical landscape linkage to south-central Florida (Kautz et al. 2006). Transient male panthers currently utilize this Zone as they disperse northward into south-central Florida.

PANTHER RECOVERY OBJECTIVES

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

LAND CONSERVATION AND MANAGEMENT

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 within public lands, assure linkages are maintained, restore degraded and fragmented habitat, and obtain the support of private landowners for maintaining property in a manner that is compatible with panther use. Conservation lands used by panthers are held and managed by a variety of entities including the Service, NPS, Seminole Tribes of Florida, Miccosukee Tribe of Indians of Florida, FWC, Florida Department of Environmental Protection, Florida Division of Forestry (FDOF), Water Management Districts (WMDs), non-governmental organizations, counties, and private landowners.

Public Lands: Public lands in south Florida that benefit the panther are listed below:

- In 1947, ENP was established with 1,507,834 ac (610,201 ha) and in 1989 was expanded with the addition of 104,320 ac (42,217 ha).

- In 1974, Congress approved the purchase and formation of BICY, protecting 570,238 ac (230,768 ha), later 145,919 ac (59052 ha) were added.
- In 1974, the State of Florida began acquiring land for the FSPSP, which encompasses over 80,000 ac (32,375 ha). Efforts are underway to acquire about 16,640 ac (6,734 ha).
- In 1985, acquisition of PSSF and WMA began with the complex Golden Gate Estates subdivision buyouts and now comprises over 76,160 ac (30,821 ha). The Southern Golden Gate Estates buyout through State and Federal funds is complete. The South Belle Meade portion of Picayune Strand is about 90 percent purchased and although the State is no longer purchasing in South Belle Meade, Collier County's Transfer of Development Rights program is helping to secure the inholdings.
- In 1989, FPNWR was established and now protects 26,240 ac (10,619 ha).
- In 1989, the Corkscrew Regional Ecosystem Watershed Land and Water Trust, a public / private partnership, was established and to date has coordinated the purchase of 42 26,880 ac (10,878 ha).
- In 1996, the South Florida WMD, purchased the 32,000 ac (12,950 ha) OSSF.
- In 2002 Spirit of the Wild WMA, consisting of over 7,040 ac (2,849 ha), was taken into public ownership by the State of Florida and is managed by FDOF.
- In 2003, Dinner Island Ranch WMA consisting of 21,760 ac (8,806 ha) in southern Hendry County was taken into public ownership by the State of Florida and is managed by FDOF.

Tribal Lands: Lands of the Seminole Tribes 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 (R. Kautz, Personal Communication 2005). These lands are not specifically managed for the panther and are largely in cultivation.

Private Lands: A variety of Federal, State, and private incentives programs are available to assist private landowners and other individuals to protect and manage wildlife habitat. Voluntary agreements, estate planning, conservation easements, land exchanges, and mitigation banks are 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, Fisheating Creek Conservation Easement, 41,600 ac (16,835 ha) in Glades County is a private holding used by dispersing male panthers. Also, 73,235 ac of the 90,845 ac Babcock Ranch were purchased in 2006 by the State of Florida and Lee County for conservation and agriculture. An additional 2,000 ac of this ranch were put into a conservation easement.

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.

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. 1986a) 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 (1990a) reported that indirect human disturbance of panthers may include activities associated with hunting and that panther use of Bear Island 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 as a result of hunting.

Transportation Planning and Improvements

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

There are presently 28 wildlife underpasses with associated fencing suitable for panther use along I-75. There are four underpasses suitable for panther use currently existing, and two additional underpasses presently proposed by the Florida Department of Transportation along SR 29 (Department of the Army Public Notice SAJ-2004-778). Several additional panther/wildlife crossings are proposed along roadways in rural Lee and Collier Counties (Shindle et al. 2001). In addition, Collier County, in cooperation with the National Wildlife Federation and the Florida Wildlife Federation, is coordinating a study of the segment of County Road (CR) 846 east of Immokalee and the section of Oil Well Road where the road crosses Camp Keais Strand to determine the optimum location for wildlife crossing construction (WilsonMiller 2005). An additional crossing of Camp Kies Strand on CR 846 west of Immokalee is also being evaluated. However, vehicular trauma still occurs on outlying rural roads and the FWC is conducting a study to determine the impacts of vehicular collisions to panthers and studying ways to minimize panther vehicle collisions (Swanson et al. 2006). No

panther-vehicle collisions have been recorded in the vicinity of wildlife crossings, with the exception of one collision in December 2005 on SR 29. There have been no collisions on east-west I-75 in the vicinity of crossings since installation in 1991.

From 1972 through 2004, panthers have been confirmed in 11 counties (Flagler, Glades, Highlands, Hillsborough, Indian River, Okeechobee, Orange, Osceola, Polk, Sarasota, Volusia) over 125 times north of the Caloosahatchee River (Belden et al. 1991; Belden and McBride 2005). However, 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 as the Big Cypress Swamp / Everglades physiographic region in Collier, Lee, Hendry, Miami-Dade, and Monroe Counties south of the Caloosahatchee River (Belden et al. 1991). No female panthers have been documented north of the Caloosahatchee River since 1973 (Nowak and McBride 1974; Belden et al. 1991; Land and Taylor 1998; Land et al. 1999; Shindle et al. 2000; McBride 2002; Belden and McBride 2005).

Land Use Changes in Florida: Habitat loss, fragmentation, and degradation, and associated human disturbance are the greatest threats to panther survival and among the greatest threats to its recovery. These threats are expected to continue in Florida. Throughout Florida, between 1936 and 1987, cropland and rangeland increased 6,609 mi^2 (17,118 km^2) or 30 percent, urban areas increased by 6,172 mi^2 (15,985 km^2) or 538 percent, while herbaceous wetlands declined by 6,063 mi^2 (15,702 km^2) or 56 percent, and forests declined by 6,719 mi^2 (17,402 km^2) or 21 percent (Kautz et al. 1993; Kautz 1994). Assuming that all of the forest lost was panther habitat, Kautz (1994) estimated that the 21 percent loss of forests was the equivalent of 35 to 70 male panther home ranges and 100 - 200 female panther home ranges. Between 1985 and 1989 and 2003 an additional 5,019 mi^2 (13,000 km^2) (13 percent) of natural and semi-natural lands (including panther habitat) were converted to urban / developed and agricultural uses (Kautz et al. in draft).

Continued expansion of urban areas on the coasts and the spread of agricultural and urban development in the interior of Florida continue to replace, degrade, and fragment panther habitat. Agricultural development continues to replace and fragment panther habitat. Over 83 percent of the 2,500 mi^2 (6,475 km^2) of agricultural land in southwest Florida has been categorized as rangeland. Between 1986 and 1990, row crop acreage increased by 14 mi^2 (36 km^2) or 21 percent; sugarcane increased by 25 mi^2 (65 km^2) or 21 percent; citrus increased by 84 mi^2 (219 km^2) or 75 percent; and rangeland, much of it suitable for panther occupation, decreased by 250 mi^2 (647 km^2) or 10 percent (Townsend 1991). Rangeland losses were about evenly divided between agricultural and urban development (Townsend 1991).

Based on the current trends of urbanization across the southeast, it is likely that forested habitats will continue to be permanently altered, and the amount of available forest habitat will decrease in some areas (Wear and Greis 2002). Compared to earlier periods, land use in the southeast has been fairly stable since 1945, with the most notable exception of Florida, where developed land uses have expanded substantially (Wear and Greis 2002). Two dominant forces strongly influenced recent land use changes: (1) urbanization driven by population and general economic

growth and (2) changing relative returns to agriculture and timber production; both of these influences are expected to continue (Wear and Greis 2002). As a result of anticipated population and economic growth, rural land will be converted to urban uses.

The extent of land use conversions for southwest Florida (Collier, Lee, Hendry, Charlotte, and Glades Counties) between 1986 and 1996 was estimated using a change detection analysis performed by Beth Stys (FWC unpublished data). The area of disturbed lands increased 31 percent in these five counties between 1986 and 1996, with the greatest increases in disturbed lands occurring in Hendry and Glades Counties. Most (66 percent) of the land use change over the 10-year period was due to conversion to agricultural uses. Forest cover types accounted for 42 percent of land use conversions, dry prairies accounted for 37 percent, freshwater marsh accounted for 9 percent, and shrub and brush lands accounted for 8 percent. Randy Kautz, (FWC, Personal Communication 2003) estimated panther habitat loss to be 0.8 percent per year between 1986 and 1996 using a composite of three different methodologies. These included: (1) review of U.S. Forest Service forest data between 1936 and 1995 using loss of forest as an index of the rate of panther habitat loss, (2) analysis to detect changes in land cover in five south Florida counties (Charlotte, Collier, Glades, Hendry, Lee) between 1986 and 1996 using classified Landsat imagery, and (3) using the Cox et al. (1994) panther habitat model, and based on 1986 Landsat data, 1996 Landsat landcover data was overlaid and then areas originally mapped as panther habitat and subsequently converted to other uses over the 10-year period were tabulated. Kautz (Breedlove, Dennis, and Associates, Personal Communication 2005) believes the estimated annual habitat loss since 1996 may be 2 to 3 times higher than that calculated for the previous period.

More recently, Stys calculated the extent of semi-natural and natural lands that have been converted to agricultural and urban / developed in Florida between 1985 - 1989 and 2003 (B. Stys, FWC, Personal Communication 2005). Based upon this analysis, approximately 570 mi^2 (1,476 km^2) of natural and semi-natural lands in Glades, Hendry, Lee, Collier, Broward, Monroe, and Miami-Dade Counties were converted during this time period (FWC unpublished data). Of these, approximately 340 mi^2 (880 km^2) were conversions to agricultural uses and 230 mi^2 (596 km^2) to urban uses. Nearly 42 percent (142 mi^2 or 369 km^2) of the conversions to agriculture occurred in Hendry County. These conversions have been offset to some degree (19 mi^2 [49 km^2]) by habitat conservation elsewhere in south Florida, particularly in recent years.

Rapid development in southwest Florida has compromised the ability of landscapes to support a self-sustaining panther population (Maehr 1990b, 1992). Maehr (1990b) reported that there were approximately 3,401 mi^2 (8,810 km^2) of occupied panther range in south Florida and that approximately 50 percent is comprised of landscapes under private ownership. In 2005, Kautz found that approximately 22 percent of the land in the Primary Zone, 60 percent of the land in the Secondary Zone, and 100 percent of the land in the Dispersal Zone is in private ownership (R. Kautz, Breedlove, Dennis, and Associates, Personal Communication 2005). Maehr (1990b) indicated that development of private lands may limit panther habitat to landscapes under public stewardship. Given the panther's reliance on public land, the rising cost of land is an impediment to habitat protection and therefore panther conservation and recovery.

Highways in wildlife habitat are known to result in loss and fragmentation of habitat, traffic related mortality, and avoidance of associated human development. As a result, small populations may become isolated, subjecting them to demographic and stochastic factors that reduce their chances for survival and recovery. Two-lane 108 ft (33 m) and four-lane 328 ft (100 m) cleared rights-of-way, respectively, occupy 2.0 and 6.2 percent of each 640 ac (259 ha) of land through which they pass (Ruediger 1998). Highways can also stimulate land development as far away as 2 mi (3.2 km) on either side (Wolf 1981). Thus, for each 1 mi (1.6 km) a highway is extended, 2,500 ac (1,012 ha) are potentially opened to new development (Wolf 1981).

Belden and Hagedorn (1993) observed that Texas pumas introduced into northern Florida established home ranges in an area with one-half the road density of the region in general, and tended to avoid crossing heavily traveled roads. Of 26 western puma home ranges examined by Van Dyke et al. (1986b), 22 (85 percent) included unimproved dirt roads, 15 (58 percent) included improved dirt roads, and only six (23 percent) included hard-surfaced roads. Female panthers rarely establish home ranges in areas bisected by highways (Maehr 1997b). Because home ranges of resident males typically encompass the ranges of up to six female panthers, males are less likely than females to find sufficiently large areas devoid of major roads. Males tend to cross highways more frequently than females and suffer more vehicle-related injuries and mortalities.

In addition to a direct loss and fragmentation of habitat, constructing new and expanding existing highways may increase traffic volume and impede panther movement within and between frequently used habitat blocks throughout the landscape (Swanson et al. 2006). Increases in traffic volume, increasing size of highways (lanes), and habitat alterations adjacent to key road segments may limit the panther's ability to cross highways and may ultimately isolate some areas of panther habitat (Swanson et al. 2006). The addition of wildlife crossings and fencing has ameliorated this threat in the immediate vicinity of these structures. The addition of more wildlife crossings, especially in areas with a history of collisions and where traffic is projected to increase, can help address this significant threat. Between January and July of 2007, 14 panthers were killed on roadways from vehicle collisions. This increase probably reflects the expansion of the panther population since the genetic restoration effort in the mid 1990s, as well as the increase in urban development and related traffic.

Past land use activity, hydrologic alterations, and lack of fire management (Dees et al. 1999) have also affected the quality and quantity of panther habitat. The effect of invasive plants on panther habitat utilization, particularly melaleuca, is unknown. As the remaining forested uplands are lost, sloughs containing cypress, marsh, and shrub wetlands comprise a greater percentage of the remaining habitat available to panthers, relative to habitat historically available to the species.

Human Population Growth: Insight can be gained into expected rates of habitat loss in the future by reviewing human population growth projections for the south Florida region. Smith and Nogle (2001) developed low, medium, and high population growth projections for all Florida counties from 2000 through 2030. Using their medium projections, which they believe provide

the most accurate forecasts, Smith and Nogle (2001) estimate that the human population of the 10 counties in south Florida will increase from 6.09 to 9.52 million residents by 2030, an increase of 56 percent.

The Florida population increased from 87,000 in 1850 to over 17 million in 2000 (cited in Swanson et al. 2006, U.S. Census Bureau 2004). From 1990 - 2004, the population in Collier County increased from 152,099 to 296,678 (U.S. Census Bureau 2002, 2004). During the same time period, the population in Lee County increased from 335,113 to 514,295 (U.S. Census Bureau 2002, 2004). The population of southwest Florida, particularly Collier and Lee Counties, is projected to increase 21percent by 2010 (cited in Swanson et al. 2006).

In summary, potential panther habitat continues to be affected by urbanization, residential development, conversion to agriculture and silviculture, mining and mineral exploration, lack of land use planning, and other sources of stress. With human population growth and increased human disturbance, the extent of potentially suitable habitat remaining is expected to decrease. Habitat loss, fragmentation, degradation, and disturbance from human activity are expected to remain among the greatest threats.

ENVIRONMENTAL BASELINE

The following information on the panther is added to the Environmental Baseline section in the July 14, 2000, Biological Opinion. Table 2 includes a list of the projects that have resulted in formal consultations for panthers since 1984.

Status of the Species Within the Action Area

In the July 14, 2000, Biological Opinion, the action area was defined as the entire range of the panther. Therefore, the same information described previously in the Status of the Species section also relates to this section: the status of the species within the action area. In addition, we would like to provide more detail about panther use in BICY, which is located within the Primary Zone of the panther. According to telemetry data, a total of 31 living, radio-instrumented Florida panthers have included all or a portion of BICY in their home ranges at some time in their lives (Table 3). This includes 12 adult males and 19 adult females. Telemetry data represent the annual range and movements of radio-collared panthers and not that of uncollared panthers which may have been, or could be, present in the vicinity of the proposed action. Telemetry data are gathered three times per week, or on 43 percent of the days during which the animal may be wearing a functional radio-collar. Telemetry data are collected between sunrise and mid-day and primarily reflect a panther's choice of day rest sites, or maternal den sites. Mating and denning behavior, aggressive encounters between males, movements and home range shifts, dispersal, survival, recruitment, displacements and replacements of individuals, and other social and ecological interactions are interpreted from telemetry data and field investigations (Land et al. 1999).

According to (McBride, Personal Communication 2007), four radio-instrumented and eight uncollared male Florida panthers use the area north of I-75, east of SR 29 to the L-28. One radio-instrumented and seven uncollared female Florida panthers also use this area.

The area described includes Bear Island, the Addition Lands, the Seminole Indian Reservation, and McDaniels Ranch. The other area McBride describes includes an area north of U.S. Highway 41, south of I-75, east of SR 29, and west of L-28. In this area, three radio-instrumented and six uncollared male Florida panthers and six radio-instrumented, six uncollared female Florida panthers have been identified. For each area described above another four unknown gender uncollared Florida panthers were identified. The yields a total of 24 Florida panthers in the area north of I-75 and 25 Florida panthers in the area south of I-75.

EFFECTS OF THE ACTION

The following information on the panther is added to the "Effects of the Action" section in the July 14, 2000, Biological Opinion.

Factors to be Considered

The designated trail system was initiated in Bear Island in February 2007. The designated trails could be closed or changed as warranted by the condition of the trail or environmental conditions in BICY. Extreme high water events would prompt closure of some trails that would be inaccessible during these types of events.

The proposed action is located in part of a contiguous system of south Florida public lands that includes FSSP, FPNWR, PSSF, and ENP. Human activity currently occurs year-round at BICY. ORV use is greatest during the hunting season. Late summer usually sees the smallest number of visitor days each year and BICY is closed for 60 days typically during the late spring to summer months. High water and high temperatures at this time of the year undoubtedly contribute to the low level of visitation during this time. During years of extreme high water, human activity is greatly reduced to non-existent in some portions of BICY.

Trails within could be closed or changed as warranted by condition of the trail or environmental conditions in BICY. Extreme high water events would prompt closure of some trails that would be inaccessible during these types of events.

Analysis for Effects of the Action

The 2000 ORV Plan required NPS to limit ORV use at BICY to no more than 400 miles of primary trails within a designated framework, and will eliminate dispersed use in BICY. In addition, secondary trails, which would provide access to private property or specific destinations such as campsites, would be identified. These trails, for which no mileage limit was defined, would branch off the primary trails and receive less use. The ORV Plan limited the Bear Island Unit to approximately 30 miles of designated primary trails, as compared to the 55 miles of primary trails that existed before the plan was finalized. The Service's July 14, 2000, Biological Opinion analyzed the effects of development and implementation of the ORV Plan. After the ORV Plan was finalized, NPS reduced the amount of trails in the Bear Island Unit to 24.43 miles of designated primary trail and 0.34 mile of secondary trail. In February of 2007,

NPS designed 34.95 miles of trail available, which is within the description of the number of miles ("approximately 30") analyzed as part of the 2000 ORV Plan. Sixteen miles of these trails are above-ground roads constructed prior to establishment of the BICY.

Reopening trails in Bear Island (from 24.43 to 34.95 miles) will allow ORV users to reach more remote sections of Bear Island than have been available since 2000. Designated trails focus human activities to smaller footprints, thereby minimizing the potential for habitat degradation off of the trails. Trails, for the most part, are located in areas with firm substrate such as sand, providing a resilient surface that requires little maintenance. As described in the environmental baseline, 24 panthers use Bear Island and adjacent areas. This indicates that management and recreation activities are compatible within Bear Island and adjacent areas.

Continued use of BICY by ORV users and other visitors would maintain the risk of human / panther interaction at levels that are no greater than those present before 2000, when 55 miles of primary trails were in place. The limit of permit issuance to 2,000 permits in BICY ensures levels of permitted ORV users do not increase above that analyzed in the General Management Plan (NPS 1991) and the 2000 Biological Opinion.

The continuation of ORV activities in areas occupied by panthers, particularly Bear Island, will result in a continuation of the avoidance behavior characterized as "minor" based on the observations of Janis and Clark (2002). According to the study, "Panther locations during the hunting season in Bear Island were, on average, only 180 m farther from trails than before the hunting season. An increase of 180 m probably has minor biological consequences. Furthermore, it is possible that the effect we observed was not a reaction by panthers to human activity, but a reaction of their prey" (Janis and Clark 2002). The study also identified decreased use of Bear Island by panthers and concluded it "most likely reflects a direct reaction to human activity" (Janis and Clark 2002)." The "magnitude of that change was not great," and the authors found that panthers spent more time on private lands north of Bear Island in the hunting season (Janis and Clark 2002). The duration of the effects will last as long as ORV use continues.

The reduction in the extent of trails could reduce the extent of trail avoidance observed from pre Plan conditions; we expect panthers may avoid the remaining trails. This avoidance of remaining trails may be affecting home range patterns and selection of denning and day rest sites, although the impact is difficult to measure. The extent to which this movement affects panthers is unknown. No reduction in litter size or levels of reproductive success has been documented. The "analyses of female panther movement rates (a measure of energy expenditure) and predation success (a measure of energy intake) did not suggest a negative impact from hunting" (Janis and Clark 2002).

The use of designated trails in Bear Island will reduce the fragmentation of habitat. Dispersed ORV use has, in the past, resulted in large areas of habitat compromised by loss of vegetation and rutting. Trails have the potential to become widened and rutted when the water is too deep, there are holes in the bottom of the trail, or when the substrate is too soft to provide adequate traction, and these impacts are mitigated through trail stabilization. On the other hand, trails in Bear Island are primarily on sandy, firm substrate that will continue to support ORV use with minimal maintenance.

Restoration activities included in the plan should increase the amount and quality of habitat for both panther and prey species. This increase could contribute to population recovery by providing additional, higher quality prey items.

Species Response to the Proposed Action

The panther should continue to move away from designated trails in Bear Island, and possibly elsewhere as a result of the proposed action. This could alter normal breeding, feeding, and sheltering behavior to some degree. Since females have been located denning adjacent to designated trails, it is unknown if all panthers with home ranges in Bear Island will react in the same manner as those observed in (Janis and Clark 2002).

Adverse effects to the panther will be minimized by reducing the extent of designated trails in Bear Island as compared to pre-ORV Plan conditions, providing opportunities for recovery-oriented research and management activities on BICY, and improvements in habitat quality through restoration efforts. The primary and secondary trails that were abandoned will be restored, thereby increasing the extent of habitat available for panther prey species.

CUMULATIVE EFFECTS

The following information is added to the Cumulative Effects section in the July 14, 2000, Biological Opinion. Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

State, local, and private actions which further fragment existing panther habitat and reduce the quantity and quality of habitat (*e.g.*, development and conversion of natural habitats to other uses) are likely to continue throughout Florida. These actions are likely to result in varying degrees of adverse effects to panthers such as temporary and permanent habitat loss, degradation, and fragmentation, as well as other impacts. Throughout Florida, land development and conversions from natural lands to non-natural, urban, and agricultural uses (*e.g.*, ranching, citrus, sugarcane) will continue to adversely affect the panther through direct habitat loss, degradation, and fragmentation. Similarly, actions such as conversion of low-intensity agricultural land uses (*e.g.*, cattle grazing on non-improved pastures) to high-intensity agricultural (*e.g.*, row crops, sod farms) and urban uses will also continue to adversely affect the panther through habitat loss, degradation, and fragmentation. These actions reduce the existing quality and quantity of habitat and are likely to continue. The extent to which habitat loss, degradation, and fragmentation that is expected to occur due to land development and conversion from non-Federal actions is difficult to determine.

To estimate future private actions that would affect panthers and that may reasonably be certain to occur in the action area, the Service first identified the types of land alteration actions that could occur in the action area, then developed a mechanism to distinguish between those that will require future federal review and those that are not likely to become future federal actions, and

thus meet the cumulative effects definition. To estimate future non-federal actions, the Service chose to identify and tabulate recent past non-federal actions and project this level of development as the best representation of likely future non-Federal actions.

Within the action area, past and ongoing state and county actions affecting panther habitat include: (1) State of Florida DRI Orders (2001 to 2004); (2) Comprehensive Plan Amendments (2003 to 2004); (3) Lee and Collier County Zoning Amendments (2003 to 2004); (3) Collier County's PUDs (2001 to 2004); (4) Lee County's PUDs (2003 to April 2004); and (5) South Florida Water Management District's Environmental Resource Permits (2003 to 2004). To evaluate these effects, the Service incorporated the Florida Land Use, Cover and Forms Classification System (FLUCCS) mapping to determine properties that may be exempt from Federal Clean Water Act section 404 wetland regulatory reviews by the U.S. Army Corps of Engineers (Corps). To determine which of these projects would likely be exempt from wetland regulatory reviews by the Corps, we identified the percentage of the project site that was classified as wetland habitat, based on the FLUCCS mapping units. The mapping units relied on by the Service included the 600 series (wetland classifications) and the 411 and 419 pine flatwood classifications (hydric pine systems). For listing purposes, properties with less than 5 percent wetlands were considered by the Service to be generally exempt from regulatory review as these quantities of wetlands could be avoided by project design.

Within the action area, based on FLUCCS mapping, about 1,094.45 acres could be expected to be subject to development without Federal permit involvement through the Clean Water Act section 404. This level of development represents 3.77 percent of a female panther's average home range (29,059 ac) and 1.75 percent of a male panther's average home range (62,542 ac).

State and county land alteration permits in southwest Florida not part of those actions listed above, generally included single-family residential developments within Northern Golden Gate Estates and Lehigh Acres. Vacant lands within the area of Northern Golden Gate Estates (north of I-75), also within the action area, totaled about 34,028 ac as of September 2004. To evaluate these effects, the Service overlaid the plat boundaries on 2004 aerials, queried the parcel data from Collier County's Property Appraisers Office, noted lots with developments, compared those to 2003 aerials, and noted the changes. Vacant lands within the area of Northern Golden Gate Estates (north of I-75) totaled approximately 35,768 ac as of August 2003. The breakdown of acres for August 2003 is: (1) wetlands, approximately 17,572 ac; (2) uplands, approximately 17,990 ac; and (3) water, approximately 210 acres. These changes were overlain on the National Wetlands Inventory (NWI) maps for presence of wetlands. This evaluation was used to estimate the acreage of properties that may be exempt from Federal Clean Water Act section 404 wetland regulatory review by the Corps. A comparison of the 2003 and 2004 data for Northern Golden Gate Estates indicates approximately 1,740 ac of land were converted from vacant to developed with the breakdown as: (1) wetlands, approximately 696 ac; and (2) uplands, approximately 1,740 ac.

The evaluation process provided an estimate of 417 lots totaling 1,740 acres for Northern Golden Gate Estates. Therefore, using NWI mapping for the Northern Golden Gate Estates, a total of about 1,740 ac could be expected to be subject to development in a year in these areas without

Federal involvement. Based on historical records for wetland permits issued by the Corps for these areas, most of these projects will involve the construction of single-family residences in partially developed areas and will involve less than an acre of impact. This level of development represents 3.59 percent of a female panther's average home range (29,059 ac) and 1.67 percent of a male panther's average home range (62,542 ac).

Vacant lands within the area of Lehigh Acres, also within the action area, totaled about 34,852 ac as of April 2003. The breakdown of acres is: (1) wetlands, approximately 1,057 ac; (2) uplands, approximately 33,592 ac; and (3) water, approximately 202 ac. A review of aerial photography and Lee County building permit data for Lehigh Acres from the 1-year period prior to April 2003 indicates approximately 441 ac of land was converted from vacant to occupied, during the one-year period. The breakdown of converted acres is estimated as: (1) wetlands, 66 ac; (2) uplands, 375 ac; and (3) water, 0 ac. Therefore, using NWI mapping, about 375 ac could be expected to be subject to development in a year in this area without Federal permit involvement.

In conclusion, the Service's cumulative effects analysis has identified approximately 3,209.45 ac within the action area that could be developed without Federal involvement. This level of development, which the Service believes is representative of future non-Federal actions, is reasonably certain to occur and, therefore, meets the definition of cumulative effect. This level of projected future development represents 11 percent of a female panther's average home range (29,059 ac) and 5.13 percent of a male panther's average home range (62,542 ac), though the impacts will be scattered and generally located on the fringes of occupied panther habitat, supported primarily with disturbed vegetative communities, in row crops, or in partially developed areas. These lands represent 0.16 percent of the non-urban private lands at risk in the Service's panther core area (1,962,294 ac) (Table 4). Based on the above analysis, we believe the loss of the habitat associated with these lands, may adversely affect 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 in reviews of project proposals that convert panther habitat to development and other permanent changes, and is encouraging State and county environmental staff to pursue the section 10 (Habitat Conservation Planning) process to account for and compensate for adverse effects to the Florida panther.

CONCLUSION

The following information is amended to the "Conclusion" section in the July 14, 2000, Biological Opinion.

The continuation of ORV activities in areas occupied by panthers as described in the 2000 ORV Plan represents a decrease in trail mileage available to users when compared to pre-ORV Plan conditions. The continuation of these activities at the currently described levels in the Bear Island Unit will likely continue to result in the trail avoidance behavior observed by Janis and Clark (2002). The best available information on panther response to ORV use suggests that the effects are probably minor (Janis and Clark 2002). According to the study, "Panther locations during the hunting season in Bear Island were on average, only 180 m farther from trails than before the hunting season. An increase of 180 m probably has minor biological consequences.

Furthermore, it is possible that the effect we observed was not a reaction by panthers to human activity, but a reaction of their prey" (Janis and Clark 2002). The study also identified decreased use of Bear Island and concluded it "most likely reflects a direct reaction to human activity" (Janis and Clark 2002). The "magnitude of that change was not great," and the authors found that panthers spent more time on private lands north of Bear Island in the hunting season (Janis and Clark 2002).

The avoidance of remaining trails may be affecting home range patterns and selection of denning and day rest sites, although the effect is difficult to measure. The extent to which this movement affects panthers is unknown. No reduction in litter size or levels of reproductive success has been documented. The "analyses of female panther movement rates (a measure of energy expenditure) and predation success (a measure of energy intake) did not suggest a negative impact from hunting" (Janis and Clark 2002). Furthermore, as a result of genetic restoration, the panther population has increased since the Biological Opinion was issued in 2000.

In addition, implementation of the ORV Plan should have a number of benefits to panthers. The reduction in the extent of trails in Bear Island compared to before the ORV Plan was finalized should reduce the extent of avoidance. In addition, the use of designated trails in Bear Island will reduce the fragmentation of habitat. Dispersed ORV use (*i.e.*, the use of ORVs off of designated trails) has, in the past, resulted in areas of habitat compromised by loss of vegetation and rutting. The selection of the designated trail locations is such that trail expansion into unimpacted habitat is unlikely. Trails usually become widened and rutted when the water is deep, there are holes in the bottom of the trail, or when the substrate is too soft to provide adequate traction. Trails in Bear Island are mainly on sandy, firm substrate that will continue to support ORV use with minimal maintenance. Restoration activities included in the plan should increase the amount and quality of habitat for both panther and prey species.

AMOUNT OR EXTENT OF TAKE ANTICIPATED

The following section replaces the "Amount or Extent of Take Anticipated" section in the July 14, 2000, Biological Opinion.

The Service anticipates panthers could be incidentally taken by implementation of the proposed action. The incidental take is expected to be in the form of harassment. The Service anticipates incidental take of Florida panthers will be difficult to detect for the following reasons: (1) losses may be masked by seasonal fluctuations in numbers or movements; (2) the panthers' large home range and use of its habitat make incidental take difficult to quantify; and (3) data collection on radio-instrumented panthers provides limited knowledge on actual daily movement patterns. However, the level of take for the Florida panther is anticipated to include all panthers with all or a portion of their home range located in the Bear Island Management Unit of BICY. Take will be in the form of harassment and will manifest as movement away from designated trails along 34.95 miles of primary trail and 9.41 miles of secondary trail in Bear Island for the life of the ORV Plan. In addition, we expect this same level of take in other locations where panthers occur and designated trails are in place, consistent with the 2000 ORV Plan.

TERMS AND CONDITIONS

The terms and conditions below replace the terms and conditions in the July 14, 2000, Biological Opinion. In order to be exempt from the prohibitions of section 9 of the Act, NPS must comply with the following terms and conditions, which implement the reasonable and prudent measures in the July 14, 200, Biological Opinion and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary. We note that part of term and condition 1 has been completed. Specifically BICY reduced the extent of trails in Bear Island from 55 miles of primary trail to a designated trail system including 34.95 miles of primary trail and 9.41 miles of secondary trail.

1. As defined in the attached SOW, BICY will complete an historical analysis of ORV use and panther movements in Bear Island and other locations within the preserve. When available, BICY will use this information, as appropriate, to determine best management practices such as levels of ORV use that will ensure panther conservation.

2. NPS will maintain the mandatory sign-in stations at all access locations in BICY and calculate levels of use over time.

3. NPS and the Service will meet annually to review information collected from the mandatory sign-in stations.

4. NPS will collect habitat information in Bear Island quarterly as defined by photo monitoring points.

5. NPS will provide photo monitoring point updates to the Service quarterly and meet with the Service annually to review the condition of designated trails.

6. Upon locating a dead, injured, or sick panther specimen, or any other threatened or endangered species, initial notification must be made to the nearest Service Law Enforcement Office (Eddie McKissick; Fish and Wildlife Service; 10426 Northwest, 31 Terrace; Miami, Florida 33172; 305-526-2610). Secondary notification should be made to the Florida Fish and Wildlife Conservation Commission. Care should be taken in handling sick or injured specimens to ensure effective treatment and care or in the handling of dead specimens to preserve biological material in the best possible state for later analysis as to the cause of death. In conjunction with the care of sick or injured panthers or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure evidence intrinsic to the specimen is not unnecessarily disturbed.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the effect of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of

the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

If modifications are made to the project, additional information involving potential effects to listed species becomes available, or if a new species is listed, reinitiation of consultation may be necessary. If you have any questions regarding this amended memorandum, please contact Jane Tutton at 772-562-3909, extension 235.

Attachment

cc: with attachment
Service, Atlanta, Georgia (Noreen Walsh)
Office of Regional Solicitor, Atlanta, Georgia (Mike Stevens)

LITERATURE CITED

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

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

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

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

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

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

Beier P., M.R. Vaughan, M.J. Conroy, and H. Quigley. 2006. Evaluating scientific inferences about the Florida panther. Journal of Wildlife Management 70:236-245.

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

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

Belden, R.C. and B.W. Hagedorn. 1993. Feasibility of translocating panthers into northern Florida. Journal of Wildlife Management 57:388-397.

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

Belden, R.C. and R.T. McBride. 1983b. Florida panther surveys – South Florida Indian Reservations. Final report to Natural Resources Management Corporation.

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

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

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

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

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

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

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

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

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

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

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

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

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

Dees, C.S., J.D. Clark, and F.T. van Manen. 1999. Florida panther habitat use in response to prescribed fire at Florida Panther National Wildlife Refuge and Big Cypress National Preserve. Final report to Florida Panther National Wildlife Refuge. University of Tennessee, Knoxville, Tennessee.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Kautz, R.S. 1994. Historical trends within the range of the Florida panther. Pages 285-296 *in* D. B. Jordan (ed). Proceedings of the Florida panther conference. U.S. Fish and Wildlife Service, Gainesville, Florida.

Kautz, R.S., D.T. Gilbert, and G. M. Mauldin. 1993. Vegetative cover in Florida based on 1985-1989 Landsat Thematic Mapper imagery. Florida Scientist 56:135-154.

Kautz, R., R. Kawula, T. Hoctor, J. Comiskey, D. Jansen, D. Jennings, J. Kasbohm, F. Mazzotti, R. McBride, L. Richardson, and K. Root. 2006. How much is enough? Landscape-scale conservation for the Florida panther. Biological Conservation 130:118-133.

Kautz, R., B. Stys, and R. Kawula. In draft. Florida vegetation 2003 and land use change between 1985-89 and 2003. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

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

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

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

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

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

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

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

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

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

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

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

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

Maehr, D.S. 1990b. The Florida panther and private lands. Conservation Biology 4:167-170.

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

Maehr, D.S. 1997a. The comparative ecology of bobcat, black bear, and Florida panther in south Florida. Bulletin of the Florida Museum of Natural History 40:1-176.

Maehr, D.S. 1997b. The Florida panther: Life and death of a vanishing carnivore. Island Press; Washington, D.C.

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

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

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

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

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

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

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

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

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

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

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

McBride, R.T., R.M. McBride, J.L. Cashman, and D.S. Maehr. 1993. Do mountain lions exist in Arkansas? Proceedings Annual Conference Southeastern Fish and Wildlife Agencies 47:394-402.

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

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

National Park Service. 2000. Final Off-Road Vehicle Management Plan Supplemental Environmental Impact Statement. Big Cypress National Preserve; Ochopee, Florida.

National Park Service. 1991. General Management Plan and Final Environmental Impact Statement. Big Cypress National Preserve; Ochopee, Florida.

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

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

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

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

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

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

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

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

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

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

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

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

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

Ruediger, B. 1998. Rare carnivores and highways moving into the 21st century. Pages 10-16 *in* Evink, G.L., P. Garrett, and J. Berry (eds). Proceedings of the international conference on wildlife ecology and transportation. FL-ER-69-98, Florida Department of Transportation; Tallahassee, Florida.

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

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

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

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

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

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

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

Smith, S.K., and J.M. Nogle. 2001. Projections of Florida population by county, 2000-2030. Florida Population Studies Bulletin 128. Bureau of Economic and Business Research, University of Florida; Gainesville, Florida.

Swanson, K., D. Land, R. Kautz, and R. Kawula. 2006. Use of least cost pathways to identify key highway segments for panther conservation. Unpublished report. Florida Fish and Wildlife Conservation Commission; Tallahassee, Florida.

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

Thatcher, C., F.T. van Manen, and J.D. Clark. 2006. An assessment of habitat north of the Caloosahatchee River for Florida panthers. Final Report to U.S. Fish and Wildlife Service.

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

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

Townsend, D. 1991. An economic overview of the agricultural expansion in southwest Florida. Unpublished report. Hendry County Extension Office, LaBelle, Florida.

U.S. Census Bureau. 2002. Table CO-EST2001-12-12 – time series of Florida intercensal population estimates by county: April 1, 1990 to April 1, 2000.

U.S. Census Bureau. 2004. Population estimates, census 2002, 1990 census.

U.S. Fish and Wildlife Service. 2006. Technical/Agency Draft, Florida panther recovery plan (*Puma concolor coryi*), Third Revision. Atlanta, Georgia.

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

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

Wear, D.N., and J.G. Greis (eds). 2002. Southern forest resources assessment. General Technical Report SRS-53. U.S. Department of Agriculture, Forest Service, Southern Research Station; Asheville, North Carolina.

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

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

WilsonMiller. 2005. E-mail message to the U.S. Fish and Wildlife Service, South Florida Ecological Services Office, dated February 11, 2005.

Wolf, P. 1981. Land in America: its value, use and control. Pantheon Books, New York, New York.

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

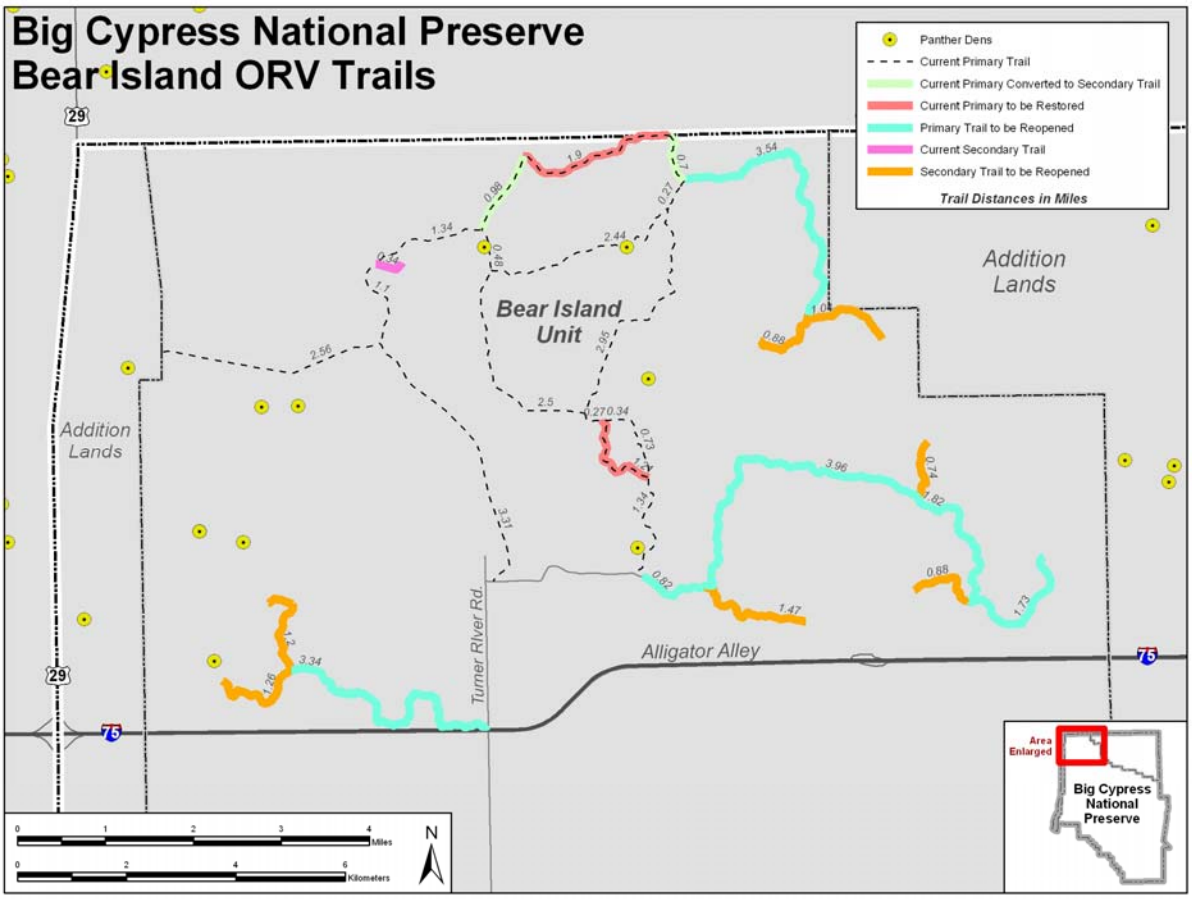

Figure 1. Bear Island Management Unit of Big Cypress National Preserve with Florida panther den locations and designated trail locations.

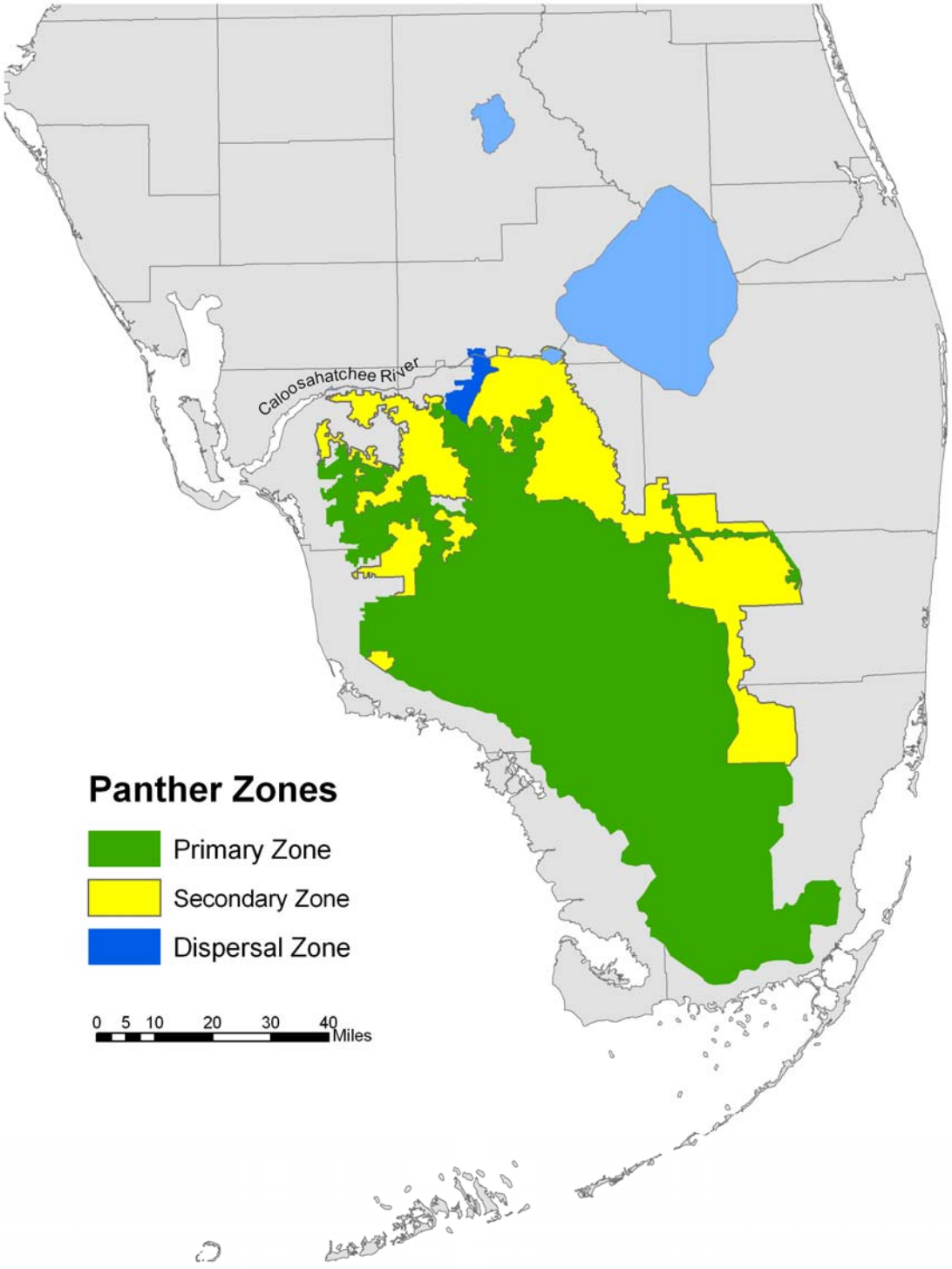

Figure 2. Florida Panther Zones in South Florida (Kautz et al. 2006).

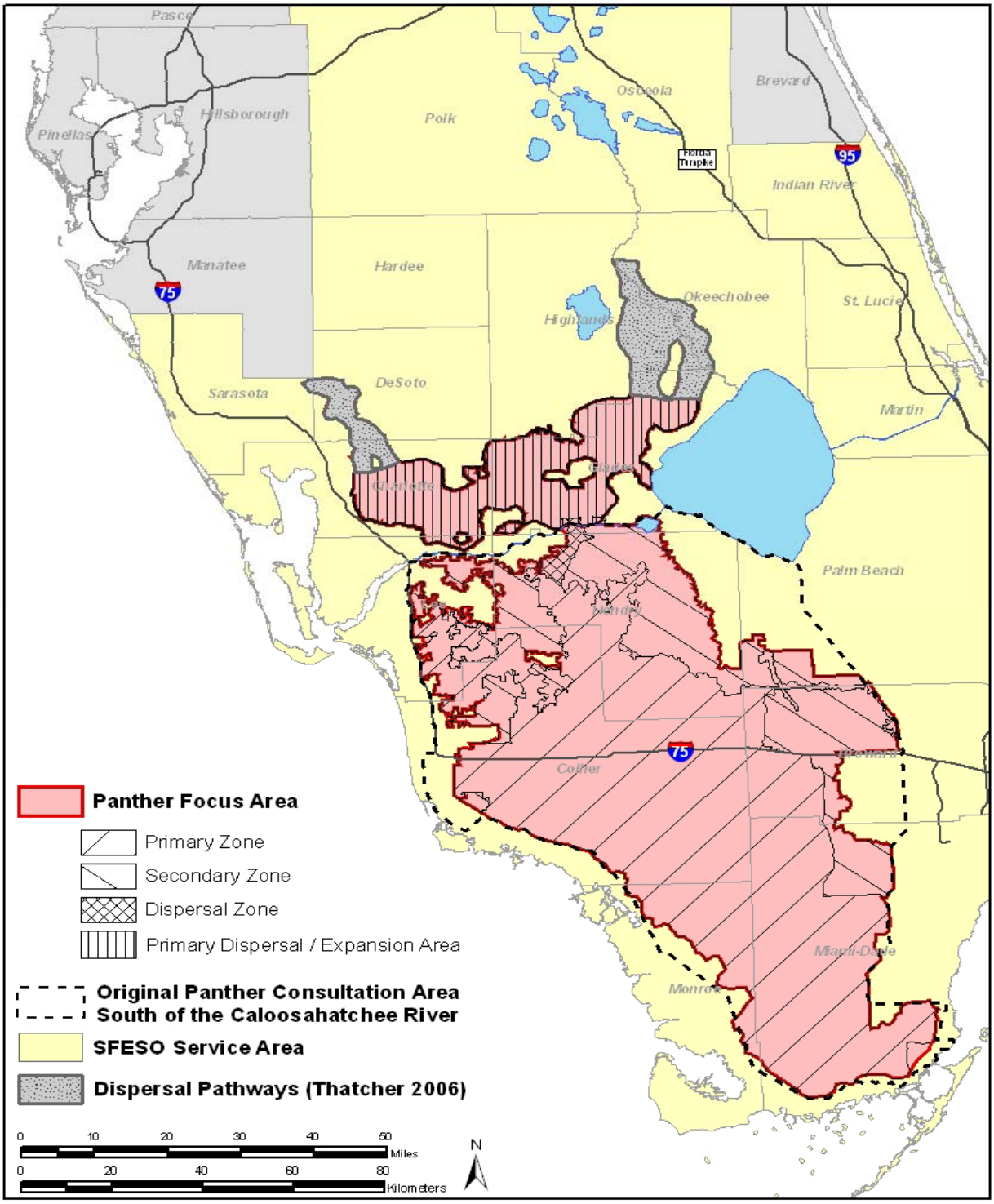

Figure 3. Florida Panther Focus Area.

Table 1.*Targeted and Acquired Acreage Totals of Conservation Lands in South Florida Directly Affecting the Panther within the Panther Focus Area.

Name	Targeted[1] Acreage	Acquired Acreage	Indian Reservation
Federal Conservation Lands			
Everglades National Park	1,508,537	1,508,537	--
Big Cypress National Preserve	720,000	720,000	--
Florida Panther National Wildlife Refuge	26,400	26,400	--
Subtotal	**2,254,937**	**2,254,937**	--
State of Florida: Florida Forever Program			
Belle Meade	28,505	19,107	--
Corkscrew Regional Ecosystem Watershed	69,500	24,028	--
Twelvemile Slough	15,653	7,530	--
Panther Glades	57,604	22,536	--
Devil's Garden	82,508	0	--
Caloosahatchee Ecoscape	18,497	2,994	--
Babcock Ranch	91,361	0	--
Fisheating Creek	176,760	59,910	--
Subtotal	**540,388**	**136,105**	--
State of Florida: Other State Acquisitions			
Water Conservation Area Number 3	491,506	491,506	--
Holey Land Wildlife Management Area	33,350	33,350	--
Rotenberger Wildlife Management Area	25,019	20,659	--
Fakahatchee Strand State Preserve	74,374	58,373	--
Picayune Strand State Forest	55,200	55,200	--
Okaloacoochee Slough State Forest and WMA	34,962	34,962	--
Babcock-Webb Wildlife Management Area	79,013	79,013	--
Subtotal	**793,424**	**773,063**	--
Indian Reservations[2]			
Miccosukee Indian Reservation	--	--	81,874
Big Cypress Seminole Indian Reservation	--	--	68,205
Brighton Seminole Indian Reservation	--	--	37,447
Subtotal	**--**	**--**	**187,526**
GRAND TOTALS	**3,588,749**	**3,164,105**	**187,526**

[1] Targeted acres not available for all lands. In Such cases, targeted equals acquired acreage.
[2] Indian lands are included due to their mention in the MSRP. Acreages taken from GIS data.
* Table 1was excerpted from the Brief of Amicus (2003). However, the lands shown as acquired in this table may include some private in-holdings and may include lands currently under sales negotiations or condemnation actions.

Table 2. Habitat preservation efforts resulting from formal and informal consultations with the Service for projects affecting Florida panther habitat from March 1984 through May 2007.

Date	Service Log Number	Corps Application Number	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	Ford Test Track	Collier	530	0	0	0
02/21/85	4-1-85-018	unknown	I-75	Broward Collier	1,517	0	0	0
10/17/86	4-1-87-016 4-1-87-017	unknown	Exxon Master Plan	Collier	9	0	0	0
01/07/87	4-1-86-303	86IPM-20130	Citrus Grove	Collier	11,178	0	0	0
01/11/88	4-1-88-029	unknown	NERCO - Clements Energy	Collier	3	0	0	0
02/23/88	4-1-88-055	unknown	Shell Western E&P	Collier Dade Monroe	0	0	0	0
02/10/89	4-1-89-001	FAP IR-75-4(88)81	SR 29/I-75 Interchange	Collier	350	0	0	0
08/15/90	4-1-90-289	unknown	I-75 Recreational Access	Collier	150	0	0	0
09/24/90	4-1-90-212	89IPD-20207	U.S. Sugar Corporation	Hendry	28,740	700	0	700
03/12/91	4-1-91-229	90IPO-02507	Lourdes Cereceda	Dade	97	0	0	0
01/14/92	4-1-91-325	199101279	Dooner Gulf Coast Citrus	Collier	40	40	0	40
09/25/92	4-1-92-340	unknown	STOF, BCSIR Citrus Grove	Hendry	1,995	0	0	0
06/18/93	4-1-93-217	199200393	Corkscrew Road	Lee	107	0	0	0
02/25/94	4-1-94-209	199301131	Daniels Road Extension	Lee	65	0	0	0
05/09/94	4-1-93-251	199202019	Corkscrew Enterprises	Lee	900	100	100	200
10/27/94	4-1-94-430	199302371 199400807 199400808	Florida Gulf Coast University Treeline Boulevard	Lee	1,088	526	0	526
05/24/95	4-1-95-230	199302130	Turner River Access	Collier	1,936	0	0	0
08/07/95	4-1-95-274	199405501	Bonita Bay Properties	Collier	509	491	0	491
08/15/95	4-1-94-214	199301495	SW Florida Airport Access Road	Lee	14	0	0	0
09/19/96	4-1-95-F-230	199302052 199301404	I-75 Access Points	Broward	116	0	0	0
03/10/98	4-1-98-F-3	L30 (BICY)	Calumet Florida	Collier Broward Dade	0	0	0	0
03/27/98	4-1-97-F-635	199604158	Willow Run Quarry	Collier	359	190	0	190

Table 2. Continued.

Date	Service Log Number	Corps Application Number	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
06/11/99	4-1-98-F-398	199800622	STOF Water Conservation Plan	Hendry	1,091	0	0	0
09/27/99	4-1-98-F-310	199130802	Daniels Parkway	Lee	2,093	0	94	94
12/08/99	4-1-98-F-517	199607574	Cypress Creek Farms	Collier	239	0	24	24
04/17/00	4-1-98-F-428	199507483	Miromar	Lee	1,323	0	194	194
06/09/00	4-1-99-F-553	199900619	Naples Reserve	Collier	833	0	320	320
02/21/01	4-1-00-F-135	199803037	Corkscrew Ranch	Lee	106	0	0	0
04/17/01	4-1-00-F-584	200001436	Sun City	Lee	1,183	0	408	408
07/30/01	4-1-94-357	199003460	Naples Golf Estates	Collier	439	175	0	175
08/31/01	4-1-00-F-183	199900411	Colonial Golf Club	Lee	1,083	0	640	640
12/14/01	4-1-00-F-585	199301156	SW Florida Airport	Lee	8,058	0	6,986	6,986
03/07/02	4-1-00-F-178	199901251	Southern Marsh Golf	Collier	121	75	80	155
04/24/02	4-1-01-F-148	199901378	Hawk's Haven	Lee	1,531	267	0	267
09/24/02	4-1-01-F-135	200001574	Verandah	Lee	1,456	0	320	320
10/08/02	4-1-02-F-014	199602945	Winding Cypress	Collier	1,088	840	1,030	1,870
05/19/03	4-1-02-F-1741	200200970	Apex Center	Lee	95	10	18	28
06/10/03	4-1-01-F-1955	200003795	Walnut Lakes	Collier	157	21	145	166
06/18/03	4-1-01-F-136	199701947	Twin Eagles Phase II	Collier	593	57	98	155
06/23/03	4-1-01-F-143	199905571	Airport Technology	Lee	116	55	175	230
07/02/03	4-1-98-F-428	199507483	Miromar Lakes	Lee	342	158	340	498
09/04/03	4-1-02-F-1486	200206725	State Road 80	Lee	33	2	12	14
10/06/03	4-1-02-F-0027	200102043	Bonita Beach Road	Lee	1,117	145	640	785
12/29/03	4-1-02-F-1743	200202926	The Forum	Lee	650	0	310	310
01/18/05	4-1-04-F-4259	199702228	Bonita Springs Utilities	Lee	79	0	108	108
03/31/05	4-1-04-F-5656	200306759	Gateway Shoppes II	Collier	82	0	122	122
04/08/05	4-1-04-F-8176	2004-5312	Seminole Mine	Broward	110	0	220	220
04/29/05	4-1-04-F-5780 4-1-04-F-5982	2003-5331 2003-6965	Arborwood and Treeline Avenue	Lee	2,329	0	1,700	1,700

Table 2. Continued.

Date	Service Log Number	Corps Application Number	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
06/06/05	4-1-03-F-7855	2003-11156	Collier Regional Medical	Collier	44	0	64	64
02/22/05 03/16/05 06/29/05 04/04/06	4-1-04-F-6866	200309416	Ava Maria DRI	Collier	5,027	0	6,114	6,114
06/29/05	4-1-03-F-3915	199806220	Wenthworth Estates	Collier	917	0	458	458
07/15/05	4-1-04-F-5786	199405829	Land's End Preserve	Collier	231	0	61	61
09/08/05	4-1-04-F-5260	200106580	Parklands Collier	Collier	489	157	434	591
09/23/05 10/26/05	4-1-04-F-9348	200101122	Super Target-Tarpon Bay Plaza	Collier	34	0	20	20
11/23/05	4-1-04-F-6043	20034914	Summit Place	Collier	108	0	61	61
11/29/05	4-1-04-F-8847	20048995	STOF Administrative Complex	Collier	6	0	8	8
12/06/05	4-1-03-F-3483	200302409	SW Florida Commerce Center	Lee	207	0	305	305
12/06/05	4-1-04-F-6691	200310689	Rattlesnake Hammock Road Widening	Collier	23	0	23	23
01/04/06	4-1-04-F-8388	2004554	Immokalee Regional Airport - Phase I	Collier	67	0	43	43
01/04/06	4-1-04-F-9777	20048577	Logan Boulevard Extension	Collier	30	0	10	10
1/13/06	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
02/19/06	4-1-05-F-11724	2005834	Firano at Naples	Collier	24	0	19	19
02/22/06	4-1-04-F-6504	200491	Corkscrew Road	Lee	20	0	47	47
02/23/06	4-1-04-F-5244	200312276	Summit Church	Lee	10	0	13	13
03/31/06	4-1-05-F-11343	20051909	Coral Keys Homes	Miami-Dade	41	0	61	61
05/05/06	41420-2006-I-0274	20056176	Santa Barbera , Davis to Radio Road, Widening	Collier	6	0	3	3
05/9/06	41420-2006-I-0263	20056298	Santa Barbara and Radio Road Widening	Collier	29	0	20	20

Table 2. Continued.

Date	Service Log Number	Corps Application Number	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
05/9/06	41420-2006-F-0089	20043248	Collier Boulevard, Immokalee Rd. to Goldengate Blvd.	Collier	14	0	16	16
05/16/06	4-1-05-F-10309	19971924	Sabal Bay	Collier	1,017	1,313	223	1,536
06/05/06	4-1-05-I-8486	20041688	Seacrest School	Collier	31	0	16	16
06/09/06	4-1-05-I-10965	200303733	HHJ Development	Dade	3	0	4	4
06/14/06	4-1-05-F-11855	200411010	Keysgate School	Dade	39	0	62	62
06/15/06	41420-2006-FA-0811 and I-0362	20056149	Collier County Wellfield	Collier	29	0	36	36
07/12/06	41420-2006-F-0282	200311150	Cypress Shadows	Lee	244	0	160	160
07/28/06	4-1-04-F-12330	20047920	Hamilton Place	Dade	10	0	50	50
07/28/06	4-1-04-F-7279	20041695	Raffia Preserve	Collier	131	0	119	119
08/15/06	41420-2006-I-0151	20031963	Naples Custom Homes	Collier	10	0	9	9
08/21/06	4-1-03-F-3127	19956797	Atlantic Civil Agriculture Expansion	Dade	981	0	1553	1553
08/21/06	4-1-03-I-0540	20041813	ASGM Business Park	Collier	41	0	25	25
9/12/06	41420-2006-FA-0589 and F-0554	20037414	Miccosukee Government Complex	Dade	17	0	37	37
9/22/06	41420-2006-I-0355	20040047	Immokalee Seminole Reservation Road Improvements	Collier	17	0	35	35
10/16/06	41420-2006-FA-1488 and F-0442	199507483	Miromar Lakes Addition	Lee	366	0	390	390
10/05/06	41420-2006-I-0616	20065295	New Curve on Corkscrew Road	Lee	12	0	18	18
10/18/06	41420-2007-FA-0029 and F-0787	2004777	Treeline Preserve	Lee	97	0	95	95
10/25/06	41420-2006-FA-1129 and F-0442	20047046	Koreshan Boulevard Extension	Lee	14	0	31	31
10/26/06	41420-2006-FA-1636 and F-0787	200306755	Jetway Tradeport	Lee	38	0	51.5	52

Table 2. Continued.

Date	Service Log Number	Corps Application Number	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
10/26/06	41420-2006-I-0849	20055702	Marina Del Lago	Lee	49	0	36	36
10/27/06	41420-2006-I-0203	20057180	Living Word Family Church	Collier	18	0	35	35
10/30/06	41420-2006-I-0607	200604878	Seminole Tribe Access Road	Hendry	2	0	5	5
11/15/06	41420-2006-TA-0727	N/A	Liberty Landing	Collier	27	0	19	19
11/15/06	41420-2007-FA-0222	200412415	5th Avenue Estates	Dade	15	0	18	18
11/16/06	41420-2006-TA-0060	N/A	Collier County Elementary School K	Collier	26	0	17	17
12/5/06	41420-2006-I-0883	20057179	Roberts Group	Lee	46	0	18	18
12/7/06	41420-2006-I-0327	20041689	Cypress Landing	Collier	59	0	29	29
03/09/07	41420-2006-F-0850	200312445	Airport Interstate Commerce Park	Lee	323	0	371	371
03/09/07	4-1-04-F-6112	20021683	Alico Airpark (Haul Ventures)	Collier	241	75	414	489
04/13/07	41420-2007-TA-0618	NA	Collier County School Site J – Everglades Blvd.	Collier	39	0	56	56
02/21/03 03/09/05 03/02/07 05/03/07	4-1-01-F-607 41420-2007-F-0674	200001926	Mirasol	Collier	773	940	182	1,122
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
06/14/04 03/21/05 08/28/07	4-1-04-F-5744 41420-2007-F-0677	199603501	Terafina	Collier	437	210	252	462
				Totals	88,838	6,547	26,517	33,064

Table 3. Radio-instrumented living Florida panthers with home ranges occurring totally or partially within big Cypress National Preserve.

Panther number	Gender	Approximate Age
FP54	Male	15
FP56	Female	15
FP57	Female	16
FP60	Male	10
FP61	Female	11
FP62	Male	11
FP65	Male	10
FP66	Female	10
FP71	Female	10
FP75	Female	9
FP81	Male	11
FP83	Female	8
FP88	Female	8
FP93	Female	8
FP94	Female	8
FP95	Female	8
FP101	Female	8
FP102	Female	9
FP107	Female	7
FP110	Female	6
FP113	Female	5
FP119	Male	5
FP121	Female	6
FP124	Female	7
FP127	Male	5
FP128	Female	7
FP131	Male	8
FP133	Male	7
FP137	Male	5
FP138	Male	6
FP139	Male	5

Table 4: 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	819,995	0.33	216,479

Attachment

Scope of Work

Title: Historical Data Analysis Related to Recreational ORV Use and Panthers within Big Cypress National Preserve

Start Date: September 15, 2007

End Date: December 31, 2008

Introduction

The Florida panther (Puma concolor coryi) is one of the rarest mammals in the world with approximately 80-100 animals inhabiting 1.5 million ha of land in south Florida, the bulk of which includes the Big Cypress National Preserve (BICY) (Maehr 1990). South Florida contains the only breeding population of panthers in eastern North America and its use of habitats at the landscape level, often encompassing several land parcels with a variety of public and private owners, presents some unique, yet critical, management challenges for BICY.

Visitors to BICY commonly use off-road vehicles (ORV) to hunt deer (Odocoileus virginianus) and hogs (Sus scrofa) and for general recreation. Hunting, and ORV use have been continuously managed by BICY and the Florida Fish and Wildlife Conservation Commission since 1980. However current, and future increased interest in ORV use associated with hunting and general recreation raises concerns over their possible impacts to panthers and other natural resources in BICY.

A study to address the potential impacts of ORV use by hunters on panthers was completed by Janis (1999). In that study, radio telemetry data were collected on 21 panthers from August through February 1994-98 and data collected since 1982 by the National Park Service (NPS) and the Florida Fish and Wildlife Conservation Commission (FWC) were analyzed. Janis and Clark (2002) also examined 8 behavioral variables: morning activity rates, movement rates, predation success, home range size, home range shifts, distance from panther locations to trails, frequency of use of the Bear Island (BI) management unit, and habitat selection. Janis (1999) failed to detect changes that could be attributed to public use for 6 of the variables, but did find that the average distance of radio located panthers to roads and trails increased by 180 meters. Panthers also reduced their use of the BI unit, during the peak of the hunting season (Janis 1999). Janis (1999) stated that the small increase in the average distance from trails was probably minor from a biological standpoint and may be related to prey availability. He also found many relationships that indicated panther behavior was more profoundly affected by environmental factors, such as water level and temperature, than it was by the levels of human activity currently occurring in Big Cypress at the time. Although statistically significant, the biological consequences of these changes in panther behavior are unclear.

A comprehensive ORV management plan was recently completed at BICY (NPS 2000). Among other things, the plan requires that ORV users obtain permits, restricts the vehicle type, and reduces the number of miles of ORV roads and trails. The plan specifically reduces vehicle access to the BI unit, where much of the hunting use in BICY occurs. To date, approximately 30 miles of roads and trails are open to ORV use, reduced from some 100 miles in previous years. The BICY ORV Management Plan limits the number of permits issued to ORV users annually to 2000. These 2000 permits allow access throughout the Preserve and impose no restriction with regard to numbers of ORVs allowed at any one time in any of the management units.

Recreational ORV use opportunities within the region are being reduced as development and land use restrictions occur. As these opportunities are lost elsewhere, ORV users may focus more attention on public lands where ORV use is allowed, concentrating use on those public lands. Should interest in BICY as an ORV use destination occur, the potential exists that without management unit restrictions, the intensity of use of the ORV roads and trails in the BI unit may increase in the future compared to current use levels. The effects of local disturbance to endangered panthers and other natural resources resulting from increased intensity of use are unknown.

Although Janis (1999) was able to detect changes in panther behavior during the hunting season, his study has only limited application to management of BICY because it was limited to the hunting season and did not address recreational ORV users, the prey base, nor threshold levels or type of ORV use that may impact panthers. Consequently, the U.S. Fish and Wildlife Service (FWS) and BICY have a need to expand upon Janis' (1999) study in order to provide the necessary information to properly manage recreational use, panthers and other natural resources in BICY.

Study Area

The data that will be analyzed were collected primarily in BICY (figure 1). Because panther home ranges extend beyond the boundary of BICY, applicable data collected outside of BICY may also be used in analyses if they exist and are available. Analyses will initially focus on the area encompassed by historical panther home ranges that partially or completely used the Bear Island management unit (BI) of BICY (figure 2). The BI unit is currently the highest priority for park management of recreational ORV use, hunters and trail management. Because of the small size of the BI unit, and the exploratory nature of these analyses, it is anticipated that the existing data for the BI unit will not adequately address all the post-hoc hypotheses of interest. Consequently, analyses will be conducted on existing data for all the management units of BICY.

Purpose

The purpose of this study is to conduct exploratory analyses of historical data related to ORV use, hunting, and panthers in BICY in order to provide baseline information for a more comprehensive examination of ORV use and its impacts on panthers and other natural resources. Extensive data sets collected by BICY and FWC since 1980 will be used to identify patterns in

ORV use, hunter pressure and harvest, panther locations and movements, deer and hog population trends. The results of the study will not only be useful for identifying patterns and estimating parameters for future studies, but will also provide information for more informed management of BICY.

Objectives

1. Conduct data mining and, as necessary, data entry and quality assurance/quality control on existing data sets related to recreational ORV use, hunter pressure and game harvest, backcountry permits issued, panther movements and their prey base distribution within BICY in order to prepare them for exploratory statistical analyses.

2. Conduct exploratory statistical analyses within and among the existing data sets in order to identify patterns and derive parameters that can be used to inform BICY management of the implications of ORV use levels and hunting pressure and game harvest on panther biology in BICY.

3. Draft a final report suitable for conversion to publication format in a professional journal and presentation at a professional conference.

Anticipated Results

This project will identify historical patterns and correlations of ORV use and panther biology at BICY that will enable managers to make informed decisions about management of ORVs relative to panthers in all units of the Preserve.

Hypotheses

Because the data are historical, and the data analyses will be exploratory in nature, the post-hoc hypotheses that will be addressed will be many, and new ones will emerge as patterns are discovered. The following post-hoc hypotheses, among others, are currently of interest and will be addressed to the extent possible with the existing data:

- Are there spatial or temporal patterns or trends in recreational ORV use, hunter pressure and harvest, panther locations and movement, hogs or deer attributes?
- What are the potential interactions among recreational ORV us, hunter pressure and harvest rates, panther locations and movements and hogs and deer attribures?
- Do panther locations/movements differ with regard to the designated trail system during hunting versus non-hunting periods?
- Do panther den locations differ with regard to the designated trail system during hunting versus non-hunting periods?
- Do panther locations and movements differ among areas with dispersed trails versus designated trails?
- Are there patterns or trends in recreational ORV use that have occurred over the past 25 years such as ORV type (buggy, ATC, airboat, and street legal)?

- Are there impacts of past recreational use on the prey base of panthers?
- Has the type of ORV (buggy, ATC, airboat, and street legal) use changed over the years?
- Does the type of ORV impact panther locations and/or movements with regard to trails or BICY proper?
- What are the categories of recreational use that have been recorded over the study time period? Categories would include, but not be limited to: 1) hunting, 2) recreational ORV use, and 3) hiking and camping.
- How has general recreational use fluctuated over the period of time that the data is being analyzed?

Cooperators/Partners

By necessity, this project will have several cooperating partners:

Big Cypress National Preserve (BICY): BICY has a need for this study in order to better manage ORV use and panthers. BICY is partially funding this project. BICY will provide data sets that they have collected that are pertinent to this study, oversight on data entry and or data verification/validation on these data sets, and expertise on historical collection of data and deer, hog and panther biology in south Florida.

NPS Biological Resource Management Division (BRMD): The mission of the BRMD is to provide the expertise and leadership needed to preserve, protect and manage biological resources and related ecosystem processes in the National Park System. BRMD will provide a principle investigator, data analyses and biostatistics support.

Florida Fish and Wildlife Conservation Commission (FWC): FWC will provide data sets that they have collected that are pertinent to this study, oversight on any necessary data entry and/or data verification/validation on these data sets, and expertise on historical collection of data, hunter use and harvest, and deer, hog and panther biology in south Florida.

U.S. Fish and Wildlife Service (FWS): The FWS has a need for this study in order to provide guidance on panther management in south Florida according to the Endangered Species Act. The FWS is partially funding this study. The FWS will provide data sets that they have collected that are pertinent to this study, oversight on data entry and or data verification/validation on these data sets, and expertise on historical collection of data and deer, hog, and panther biology in south Florida.

Data Sets

Table 1 describes the existing data sets currently available and believed to be pertinent to this study. Appendix I provides more detail on existing data.

Table 1. Known data sets believed to be pertinent to this study and current status.

Data Set	Description	Provider	Data Entry Status	Quality Status
Hunting	Number of deer and hogs harvested as well as hunter pressure by day and week, by unit, since the 1988 – 1989 season; weight of deer and hogs harvested; deer age (based on tooth wear) and antler characteristics.	NPS & FWC	Data by week already entered. Daily data need to be entered.	Not completely verified/validated.
Panthers	Radio-collared panther locations and den sites beginning in 1981.	NPS & FWC	Entered	Not completely verified & validated
Vegetation	Vegetation layer for all management units based on the UGA vegetation survey.	NPS	Entered	Verified & validated
Trails	Trail maps for all management units.	NPS	Entered	Verified & validated
ORVs	Permits issued/vehicle type	NPS	Entered	Not completely verified & validated
Backcountry use	Permits issued	NPS	Not completely entered	
Deer Surveys	Buck-doe deer surveys (late July to early August) for Bear Island since 2002. Doe-fawn surveys (mid-May to early June) since 2003; GPS locations, number of deer identified as bucks, does, fawns, or unknowns, and number of points for each buck. (See Appendix 1 for details of datasets for other units)	NPS	Verified & validated	Verified & validated

Principle Investigators:

BRMD
Mark Wotawa
Ecologist
Biological Resource Management Division
1201 Oakridge Drive, Suite 200
Fort Collins, CO 80525
Phone: 970-225-3567
Fax: 970-225-3597
Email: mark_wotawa@nps.gov

BICY
Deborah Jansen
Wildlife Biologist
Big Cypress National Preserve
33100 Tamiami Trail East
Ochopee, FL 34141
Phone: 239-695-1179
Fax: 239-695-2084
Email: deborah_jansen@nps.gov

FWCC
Rebecca L. Mihalco
Biological Scientist
Big Cypress Field Office
Florida Fish and Wildlife Conservation Commission
566 Commercial Blvd.
Naples, FL 34104
Phone: 239-643-4220
Fax: 239-643-0385
Email: Rebecca.Mihalco@MyFWC.com

FWS
Jane Tutton
Wildlife Biologist
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
Phone: 772-562-3909 x 235
Fax: 772-562-4288
Email: jane_tutton@nps.gov

Schedule

The project will have 3 phases: data preparation, data analyses and report preparation. Table 2 depicts the schedule.

Data Preparation: During this phase, a search will be conducted to locate other data sets that may be pertinent to this study. Each data set believed to be pertinent to this study will be evaluated for its availability, data-entry and quality status. Those that will be included in the analyses will be, if necessary, entered into digital format and subjected to verification/validation procedures to ensure high quality. In particular, the FWC hunter/harvest survey data set will be entered and verified/validated during this phase.

Data Analysis: During this phase, exploratory statistical analyses will be conducted within and among data sets using the latest techniques and statistical software (e.g. SAS, R-statistics, etc.) as appropriate and necessary. The Data Analysis phase will overlap the Data Preparation phase because some existing data sets are already sufficiently prepared for analysis.

Reporting: During this phase, a final report will be prepared.

Table 2. Schedule.

Date(s)	**Tasks**
Sep. 15, 2007	Start of project
Sep. 15, 2007 to Mar. 31, 2008	Data preparation phase: locate pertinent data sets, evaluate data sets, enter and verify/validate data as necessary.
July 15, 2008	Preliminary data summary
Sep. 15, 2007 to Sep. 30, 2008	Data analysis phase: conduct statistical analyses within and among data sets.
Sep. 30, 2008 to Dec. 31, 2008	Reporting phase: Prepare final report.
Nov. 30, 2008	Due date: Draft final report
Dec. 31, 2008	Due date: Final report
Dec. 31, 2008	End of Project

Products

This project will produce a Preliminary Data Summary and a Final Report:

Preliminary Data Summary:
The Preliminary Data Summary will be a summary of completed analyses to date, but will not include conclusions, management recommendations, or future study recommendations.

Final Report:
The Final Report will include the following sections at a minimum:
Introduction/Background

Study Area
Data Sets
Methods
Results
Conclusions
Management Recommendations
Future Study Recommendations

All Principle Investigators and partners will be acknowledged on all products and any derivatives, and will participate as authors if they so choose.