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ABSTRACT--Veterinary medical management has improved the safety of Florida panther (Felis concolor coryi) immobilizations. Since veterinary involvement began in January of 1983, 89 immobilizations involving 40 individuals have been accomplished with one possible capture mortality. The veterinary medical team has been involved in all Florida panther captures by the 2 agencies conducting panther research, the Florida Game and Fresh Water Fish Commission (GFC) and the National Park Service.

The physical condition, body weight, reproductive status, and hematologic and serum values all indicate that the panthers utilizing land north of State Road 84, particularly the private ranches east of Immokalee, the Florida Panther National Wildlife Refuge, Bear Island Unit of the Big Cypress National Preserve (BCNP), and adjacent ranches were in excellent health and in better condition than those in the Everglades National Park (ENP) or Fakahatchee Strand State Preserve (FSSP). The north/south "health cline" in southwestern Florida appears to be associated with the type and abundance of prey taken.

Nine panthers have been rescued and removed from the wild due to injuries or illness; 4 were successfully rehabilitated and released back to the wild, 3 did not survive because of the severity of their injuries or illness, and 2 are still receiving treatment in captivity or are permanent residents. Twenty panther deaths have been documented since 1 July 1986, and human activity continues to be responsible for the majority of all documented panther deaths (road killed, 46.5%; illegally killed, 16.3%). Other important causes of mortality are intraspecific aggression (11.6%) and disease (9.2%).

Serologic evidence from 51 different Florida panthers indicates that they were exposed to or are infected with several potentially pathogenic agents: feline panleukopenia virus (FPV)(65%), feline calicivirus (FCV)(43%), feline enteric corona virus/feline infectious peritonitis virus (23%), feline immunodeficiency virus (25.6%), rabies virus (26%), feline syncytia-forming virus (FeSFV)(33.3%), Toxoplasma gondii (8.0%) and Brucella sp.(2.4%). All were

negative for pseudorabies virus (PRV), feline leukemia virus, and feline viral rhinotracheitis virus (FVRV). The prevalence of FPV was significantly higher in the FS/Big Cypress Swamp (BCS) ecosystem than in the ENP ($p < 0.05$). However, there was no significant difference in prevalence of FCV by location ($p > 0.05$). The significance of many of these agents in free-ranging panthers is yet to be determined, but an unvaccinated panther died of a raccoon rabies virus. We believe that this is the first documented case of rabies in a wild cougar.

A serosurvey of bobcats ($n=113$) indicated that they have been exposed to FPV (44.2%), FCV (33%), FVRV (9.3%), and Toxoplasma gondii (7.1%). One hundred fifty-five other carnivores were tested for FPV antibodies, positive animals included otter (13.2%), raccoon (43.0%), and grey fox (8.3%). One hundred sixty-six non-panther carnivore sera were screened for PRV, and only raccoon (3 of 57) and black bear (2 of 20) were positive. Cytauxzoon felis was documented in both free ranging Florida panthers and bobcats.

Mercury was identified as a significant contaminant in free-ranging panthers, particularly those living in the ENP and the FSSP. Mercury was strongly implicated in the death of one female panther in the ENP with a liver mercury level of 110 ppm (wet weight).

In vitro fertilization experiments produced 141 oocytes (eggs) from seven female cougars. Following insemination, ten cleaved embryos resulted, including one sired by a captive Florida Panther. Transfer of the embryos to two recipient females did not result in any live births.

Results from a population genetics study of Felis concolor reveal that the species has abundant genetic diversity (minimum of 11 of 41 loci are polymorphic (P), allozyme analysis), but F. c. coryi has fewer polymorphic loci (7.5%) and lower heterozygosity (0.019) than other wild subspecies examined. The results of the genetic study coupled with an increase in abnormal male reproductive traits (>90% abnormal spermatozoa and 44.4% cryptorchidism) raise serious concern for the reproductive potential and genetic health of this subspecies.

Mitochondrial DNA (mtDNA) analysis of 8 North American (NA) and 3 South American (SA) subspecies of puma indicates that two groups, or clades, can be discriminated; a NA clade and a SA clade. Further, the mtDNA study has revealed a partitioning of the Florida panther into two populations with differing maternal evolutionary histories; the BCS population is largely descended from NA, historic F. c. coryi animals and the mtDNA of the ENP population is derived from Central American (CA) or SA cougars. It is possible that this introduction of foreign genetic material is the result of non-coryi cougar releases which occurred in the ENP between 1957-1967. The Florida panther may have benefitted from this introgression of SA or CA genes in that the incidence of cryptorchidism is zero in males with ENP mtDNA as compared to 63% of the males with BCS mtDNA.

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INTRODUCTION

The endangered Florida panther (*Felis concolor coryi*), declared the state mammal of Florida in 1982, is estimated to number less than fifty individuals (Hines et al. 1987) and currently is protected under both state and federal endangered species statutes. This remnant population of the subspecies that once occupied the entire southeastern United States is now isolated in the remote

cypress swamps and hardwood hammocks of southern Florida, primarily in the Big Cypress Swamp and Everglades ecosystems (Belden 1986). Human population growth in southern Florida with the concomitant loss of suitable panther habitat is the major threat to the continued survival of this rare mammal. A detailed review of the life history and status of the panther is presented in the United States Fish and Wildlife Service recovery plan (USFWS 1987).

Given the critically small population size of this subspecies and the probable decreased genetic diversity, vitality, and lowered disease resistance that often accompanies inbreeding in mammals (O'Brien et al. 1985), the Florida panther is vulnerable to local population catastrophes that could lead to extinction in the wild such as occurred with the black-footed ferret (Mustela nigripes) in Wyoming (Williams et al. 1988). Very little published information exists concerning the basic physiology, reproduction, or disease agents of the Florida panther with the exception of one paper on parasites by Forrester et al. (1985).

In 1978, preliminary research on the diseases and parasites of wild panthers was initiated. This was expanded in 1983 through a collaborative effort between the College of Veterinary Medicine at the University of Florida and the Florida Game and Fresh Water Fish Commission (GFC) which supported a 3-year veterinary residency position in Wildlife Medicine from 1983 to 1986 (funded by the GFC). The continuation of biomedical research since 1 July 1986 was facilitated by the creation of a full time wildlife veterinarian position with the GFC.

When the veterinary position was originally initiated in 1983, one of the primary objectives was to provide high quality medical care and insure safe handling during the capture and immobilization of free ranging and captive panthers. Since that time, the intensity and scope of the projects' objectives have expanded to encompass many facets of medical management and biomedical research, including infectious diseases and parasites, mortality, pathology, environmental contaminants, reproduction, and genetics. Through this multi-disciplinary approach, it was hoped that factors contributing to the extinction process would be elucidated. Much data have been generated dealing with these topics and are presented here, the breadth of which is unparalleled in most free-ranging carnivore studies.

This document also serves as the Final Performance Report for work conducted under the contract entitled "Studies on Certain Health and Reproductive Parameters of the Florida Panther", D.J. Forrester, principal investigator. This yearly contract, covering 1 July 1986 through 30 June 1990, was between the GFC and the Department of Infectious Diseases, College of Veterinary Medicine, University of Florida, Gainesville, FL.

I wish to recognize the effort and support willingly given to this project by my veterinary assistants: Stephen H. Parker, Andrena J. Anderson, Vincent A. Gibaldi, Toni K. Ruth, and John Christof. Further, without the assistance of the panther field biologists and houndsmen, much of this data could not have been collected; I acknowledge David S. Maehr, John Roboski, Robert C. Belden, Oron L. Bass Jr., Deborah K. Jansen, J. Walter McCown, Jayde C. Roof, E. Derrell Land, and Roy T. McBride in Florida, and Allen E. Anderson and Don Kattner in

Colorado. I thank Dr. Scott Citino of the Miami Metro Zoo for filling in and assisting in the field captures during my absence and Drs. Elliott R. Jacobson and George V. Kollias for their medical support at the Veterinary Medical Teaching Hospital in Gainesville. I also thank Barbara Green for her help in typing and compiling this document. Funding for this project was provided by federal grant-in-aid funds administered through the U.S. Fish and Wildlife Service under section 6 of the Endangered Species Act of 1973 (PL No. 93-205), State Game Trust Fund, Nongame Trust Fund, and donations received through the Florida Panther Research and Management Trust Fund.

METHODS AND MATERIALS

Field Capture Technique

The primary objective of veterinary involvement on the capture team was to insure safe handling and proper medical management of panthers during the capture effort. The decision to immobilize a treed panther was made after accessing the health status, physical condition, and level of stress experienced by that individual, coupled with an evaluation of the ambient temperature, humidity, site conditions, and other factors that might result in unacceptable risk to the panther.

A compressed air Vario® dart rifle (Telinject USA, Inc.) was utilized to immobilize the panthers and was found safe and effective under field conditions. Lightweight, atraumatic, plastic darts were used to deliver ketamine hydrochloride (Ketamine® 5-10 mg/kg) and/or Telazol® (4-6 mg/kg) as the initial immobilizing agents.

Tranquilized panthers were then removed from the trees by hand and lowered by a rope or allowed to fall into a catch-net and cushioned "crash bag". Once the panther was on the ground the vital signs and depth of anesthesia were evaluated. Intravenous administration of diazepam (Valium® 0.06 - 0.12mg/kg), medazolan (Versed® 1-5 mg/panther), and additional Ketamine and/or xylazine hydrochloride (Rompum® 0.25 - 0.5 mg/kg) were used as needed to maintain an appropriate level of anesthesia to complete necessary procedures. An intravenous catheter was installed in the cephalic or saphenous vein, and fluids were administered continuously. Cardiac, respiratory, and thermoregulatory responses were monitored throughout the anesthetic procedure.

After stabilization, each panther was given a thorough physical examination which included an evaluation of its health, physical condition, and reproductive status. A subjective appraisal of the physical condition of each panther was used to assign each a physical condition score: I - excellent, II - good, III - poor, IV - grave. The qualities used to evaluate condition included the degree of muscling and bony prominences, tail-head and inguinal fat, hair coat luster, brightness of "eye-shine", and alertness. Each animal was weighed, measured (body and tail length, neck and chest girth, foot pads, and teeth), tattooed, and radio-collared. Dental and foot impressions also were taken when possible. Biological samples were taken and included blood, feces, urine, saliva, hair, skin biopsies (for genetic analysis), ectoparasites, and swabs from pharynx, rectum, and vagina. Additionally, the majority of adult males were electro-ejaculated to collect spermatozoa for seminal analysis.

Further, when it was feasible to have the required equipment available, the semen was frozen for future artificial breeding attempts.

Following immobilization, collaring, and collection of biological data and samples, the panthers were placed in a nylon mesh tent and held until fully recovered (Roelke et al. 1985).

Clinical Pathology Analysis

Four different clinical laboratories were utilized during this period depending on the proximity to our field location. These included Diagnostic Services Inc. in Naples, Fl.; James Archer Smith Hospital Laboratory in Homestead, Fl.; Consulab in Miami, Fl.; and the Veterinary Medical Teaching Hospital Laboratory (VMTH) in Gainesville, Fl. In many cases duplicate samples were shipped to two different labs to validate the results that were being obtained from the human hospital laboratories. In these cases the VMTH was used as the veterinary standard.

Sero-survey of Infectious Disease Agents

Ninety-two blood samples were collected from 29 male and 23 female wild panthers. These samples were collected from panthers either immobilized for radio-instrumenting or at necropsy. Serum samples from panthers and other wild carnivores were analyzed for antibodies or antigens by different laboratories and collaborators as follows: Dr. Fred Scott of the Feline Health Center at Cornell University in Ithaca, New York tested for feline panleukopenia virus (FPLV), feline calicivirus (FCV), feline viral rhinotracheitis virus (FVR), feline enteric corona virus/feline infectious peritonitis (FECV/FIPV), feline leukemia virus (FeLV), and Toxoplasma gondii; Dr. Margaret Barr of Cornell

University and Dr. Robert Olmstead of the National Institutes of Health screened the sera for feline immunodeficiency virus (FIV); Dr. Jim Evermann of Washington State University assayed for FECV/FIPV; Dr. Nicoletti of the College of Veterinary Medicine in Gainesville screened for antibodies to Brucella sp; Dr. Charles Rupprecht of the Wistar Institute of Anatomy and Biology analyzed the sera for rabies virus antibodies; Dr. Jack Gaskin of the University of Florida tested for feline syncytia-forming virus (FeSFV); and Dr. Gene Pirtle of the National Animal Disease Laboratory, U.S. Department of Agriculture in Ames, Iowa, and Dr. Paul Gibbs, University of Florida tested the sera for pseudorabies virus (PRV) antibodies.

Genetic Analysis

Blood and tissue samples for genetic analysis were obtained from every Florida panther immobilized, as well as necropsied specimens. The blood samples were processed and frozen for later analysis while the skin biopsies for fibroblast tissue culture were sent to the National Cancer Institute.

Blood and tissue samples were collected from several western subspecies of wild cougar (Felis concolor sp.) for inclusion in the Florida panther/puma population genetics research. Included were 10 SW Colorado mountain lions (F. c. hipolestes), 13 SW Oregon cougars (F. c. oregonensis/californica), 5 NE Oregon cougars (F. c. missoulensis), 4 California cougars (F. c. californica), 12 Arizona mountain lions (F. c. browni/azteca/kaibabensis), 2 Utah mountain lions (F. c. kaibabensis), and 22 west Texas mountain lions (F. c. stanleyana).

Additionally, samples from twenty-one cougars held in various zoological institutions and in private ownership were collected for genetic evaluation.

Eight of the captives were alleged to have descended from wild Florida panthers captured in the 1940's in the Devil's Garden area east of Immokalee, FL and were raised and bred at Everglades Wonder Garden in Bonita Springs, FL.

The genetic analysis was initiated in August 1986 at the Laboratory of Viral Carcinogenetics of the National Cancer Institute (NCI) in Frederick, Maryland. Isozyme extracts of red blood cells, leukocytes, and plasma were subjected to electrophoresis using starch or acrylamide gels. Histochemical and protein stains were used to identify enzymes of approximately 46-50 different loci. Polymorphic loci (genes) were identified as variants of electrophoretic mobility.

Post Mortem Analysis

Twenty dead F. c. coryi specimens were examined during the past 4 years. When decomposition was not advanced, the cadavers were subjected to a complete post mortem examination by pathologists at the College of Veterinary Medicine, University of Florida. A complete exam included gross and microscopic examination of tissues, serology, bacteriology, parasitology, and radiography. When the carcass was very fresh, attempts were made to collect and preserve living spermatozoa and skin. Hides and skeletal remains were deposited in the Florida Museum of Natural History (FMNH). Dr. Maples of the FMNH, a forensic pathologist, was consulted when the cause of death was not obvious or if we suspected some illegal activity.

Data Analysis

The association of location, age, and sex factors with prevalence of FPV and FCV antibodies were tested with chi-square tests of independence. T-tests

were used to compare mean liver concentrations of mercury by age group and region. Linear regression was used to develop a prediction model for liver mercury given hair mercury level. Mercury concentrations were log-transformed prior to analyses. The annual rate of change in the odds of cryptorchidism prevalence was estimated by the linear logit model (Agresti 1990).

RESULTS AND DISCUSSION

MEDICAL MANAGEMENT OF FLORIDA PANTHERS

Field Capture of Free-Living Panthers

Since 1 July 1986 a total of 556 hunt-days by the field capture teams of the Florida Game and Fresh Water Fish Commission (GFC) and the National Park Service (Everglades National Park (ENP) and Big Cypress National Preserve (BCNP)) resulted in the successful capture of 26 uncollared panthers and 67 immobilizations involving 38 individuals (Table 1). During this period, GFC's efforts have produced 18 previously uncollared cats on private ranches, Fakahatchee Strand State Preserve (FSSP), Florida Panther National Wildlife Refuge (FPNWR), Bear Island (BI) Unit of the BCNP, and adjacent private ranches. Efforts in the ENP resulted in 9 new panthers, and BCNP's team captured two cats.

As of 30 June 1990, 23 Florida panthers were part of our radio-telemetry and captive breeding projects. Two animals are in captivity at White Oak Plantation (WOP), and 21 radio-instrumented, free-ranging panthers are being monitored; 17 in southwestern Florida and 4 in the ENP/BCNP.

Physical condition and body weights of wild Florida panthers

Early in this study it was noted that the physical condition scores and body weight of many of the panthers examined on the public land south of State Road 84 (SR 84), were poor, particularly among the females. Further there were no successfully breeding females in that area, nor had there been since 1981 (R.C. Belden, GFC, pers. commun.).

The physical condition of an animal is generally accepted as the external manifestation of its well being and healthfulness. Data from panthers in the FSSP when compared to published values for wild cougars (Currier and Russell 1982) exhibited a non-regenerative anemia, including low red cell numbers, hemoglobin (HGB), packed cell volume (PCV)(expressed as the percentage of cellular elements in whole blood), and serum iron. The exact reason for these medical findings were not entirely clear, however, the most likely causes were: a) poor nutritional status, b) chronic blood and iron loss from internal and external parasites and fetal development in the females, and c) chronic disease. The poor physical condition of many of the females in the FSSP may have accounted for the observed low rate of reproduction and recruitment of young in that area.

These observations prompted an analysis comparing panther weights and physical condition from different locations. The results of this comparison showed that panthers occupying land north of SR 84 were heavier, were in better physical condition and probably would have more normal hematological values than those panthers occupying the FSSP (Roelke et al. 1985, 1986).

A small sample of females from the northern portion of this study area did not allow the same degree of analysis. However, these female data and extrapolations from the male data led us to suggest that the FSSP females were approximately 18% underweight and that this was probably associated with their poor productivity.

Prior to 1986 we were denied access to most of the private lands north of SR 84 so we focused our study efforts on the public land, primarily the FSSP and eastern BCNP, and had only road-kill data for panthers to the north. Beginning in January 1986, we gained access to the private lands north of SR 84 and have since concentrated our capture efforts there. With this access we were able to test the hypothesis that the body weights, physical condition, hematological values, and reproductive success varied by location. Tables 2, 3, 4, and 5 summarize the capture data and compare body weights, physical condition scores, reproductive traits, and select hematology values between various capture locations.

Of the various areas where panthers have been captured since 1981, the private ranches east and southeast of Immokalee, FL, owned by ALICO Inc. and Collier Enterprise, Inc., yielded the largest and healthiest Florida panthers. Males in these areas weighed > 140 lbs., and the one female weighed 85 and 100 lbs. during 2 captures. PCV's for both male and female panthers were > 45% on the private ranches. BI/BCNP, northern Fakahatchee Strand (NFS) (including the FPNWR), and adjacent ranches supported panthers in moderate-to-good condition with body weights ranging from 120-135 lbs. for males and 90-100 lbs. for females. PCV's ranged from 34-45%. Panthers in the FSSP were generally in poor

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to moderate condition. Adult males weighed 80-120 lbs. with PCV's of 30-44% and females weighed only 66-86 lbs. with PCV's of 25-37.0%. The physical condition of ENP panthers was better than those in the FSSP, but not as robust as those in the NFS. The 3 adult ENP females weighed 50-85 lbs. with PCV's of 30-37%, and the 2 adult males weighed 102-104 with PCV's of 29-39. A female from the eastern BCNP weighed 98 lbs. and had a PCV of 47%. This female was in very good physical condition and much heavier than expected based on the 2 males (122 lbs.) and 1 female (est. 60 lbs.) captured in 1982-84. ^{- old? - not handled} ^{- same as N males} higher than

This north/south "health cline" in southwestern Florida appears to be associated with the type and abundance of prey taken as indicated by scat analysis. On a frequency of occurrence basis, the panthers living primarily north of Alligator Alley were killing predominantly large prey (82-83%; feral hogs (Sus scrofa) and white-tailed deer (Odocoileus virginianus)) while those panthers living in the FSSP were taking a large number of small prey (34-61%; raccoon (Procyon lotor) and armadillo (Dasypus novemcinctus))(Maehr et al. 1990, Roelke et al. 1986).

Reproductive success of females also varied by location. It was highest where the ungulates were the primary prey (north of SR 84) and lowest in the FSSP. Since 1981, 3 females have been monitored for 127 months (10.6 years) in the FSSP, and only 2 surviving offspring have been documented despite a minimum of 7 documented pregnancies. In addition to providing an inadequate nutritional base, raccoons may be the source of mercury contamination noted in panthers living in the FSSP. Mercury can compromise reproduction by causing abortion and still births (see Mercury section).

Other factors that may be adversely impacting panthers are internal and external parasites. Seven species of ticks comprise the major ectoparasite fauna (Forrester et al. 1985). Each tick can concentrate ingested blood 7 fold during feeding (T. Logan, GFC, pers. commun.) and a hundred or more ticks can often be found on a single panther, particularly in the Fakahatchee Strand (FS). Collectively, over time, this could account for considerable blood loss. The same may be true of the hookworm, Ancylostoma pluriidentatum, that frequently infects panthers (5 of 7 necropsied panthers) (Forrester et al. 1985).

Hematology and Serum Chemistry

The complete blood count provides information about the two major cell types in the circulatory system, the white blood cells (WBC)(leukocytes) and the red blood cells (RBC). An analysis of the leucogram (WBC) supplies information relevant to cases of systemic inflammation, stress, infection, certain parasitic diseases, or immune suppression. This is accomplished by considering both the total number of leukocytes as well as the distribution and type of cells present. An examination of the RBCs can detect the presence or absence of anemia by evaluation of the total number of erythrocytes, the hemoglobin level (HGB), the packed cell volume (PCV), and the size and shape of the individual erythrocytes. The PCV can be used by itself as an indicator of anemia, as HGB, total erythrocyte count, and the PCV are interrelated and generally will all elevate or decline together.

Certain human hospital laboratories used for analysis were not capable of accurately counting the very small cougar RBCs, this resulted in depressed calculated PCVs and elevated mean corpuscular hemoglobin concentrations (MCHC)

(above 36% is considered biologically improbable). In the absence of pronounced RBC anomalies, most mammals generally exhibit a 3:1 ratio of hemoglobin to PCV. Using this ratio as a guide line ($\pm 10\%$) and a threshold of 36% for the MCHC, a subset of Florida panther samples were "selected" as representing the most probable group of normal values for comparative purposes, whereas "all" included all the samples from every lab tested (Table 6).

Table 6 displays hematology data from Florida panthers and from free living cougars from Colorado and Oregon. Female Florida panthers have significantly lower red cell parameters (HGB, PCV, and red cell number) than do male panthers (or females of other subspecies). Such sexual dimorphism has never been documented in the cougar, and it is felt that this is an abnormal situation. This discrepancy is thought to be primarily due to their plane of nutrition and their internal and external parasite burden. Hematology values track closely the physical condition score and body weight of the panther. The lowest values were seen in panthers from the FSSP and the highest in those from the private ranches north of SR 84 (Tables 2, 3, 4).

Similarly, Table 7 compares the serum chemistry data for Florida panthers with data from 2 other wild populations. All values for male and female panthers were similar and within normal published ranges of the cougar (Anderson 1983). The most striking differences between the Florida sample and 2 western cougar populations were in the levels of creatine phosphokinase (CPK). The means for the non-Florida males were 2-2.5 times higher than the Florida mean, and the Oregon female mean was 22 times higher than the Florida mean. CPK is released from damaged muscle tissue and is indicative of the amount of running

and/or trauma the animals experienced prior to immobilization. The behavior of the Colorado males after capture was very different than that seen in Florida. They were much more prone to jump from the trees, both before and after darting, and required an additional chase, treeing, and drugs before immobilization could be accomplished. This running and jumping could easily damage muscles and would account for the increased CPK level. The Oregon blood samples were supplied without any capture information.

Rescue, Rehabilitation, and Release of Injured Wild Panthers

A goal of the recovery effort is to enhance the probability of survival of all panthers. This can be accomplished by treating serious medical problems. Nine panthers have been rescued from the wild because of road injuries (n=5), illness (n=2), gunshot (n=1), and orphaning (n=1). Four of these were rehabilitated and returned to the wild, 2 died within hours to days of capture, and 3 remained in captivity following their initial rehabilitation (one of these died 16 months later).

Florida Panther #PCO 10

On 2 November 1984, a young, uncollared male panther was struck by a vehicle on SR 41, two miles east of Turner River Road. After capture and stabilization, the cat was transported to the Veterinary Medical Teaching Hospital where radiographs revealed fractures to both femurs and one foot. The bones were fitted with permanent stainless steel plates, and the cat was kept in Gainesville for approximately 1.5 years for initial recovery and rehabilitation. In 1986, this male was moved to White Oak Plantation (WOP) for further rehabilitation and to become part of the captive breeding program. He

remains at WOP to this date, though he has not been a successful breeder. However, his interest and abilities in mating have improved, and it is hoped that he will produce kittens in the near future.

Florida Panther #08F

This female was originally collared on 28 March 1984 in the FSSP. At that time her age was estimated to be 8-10 years old and she was in moderate physical condition (72 lbs.) with borderline anemia and a heavy hookworm infestation. She was neither pregnant nor suckling kittens, and since no kitten or yearling tracks had been found with her prior to her capture, she was assumed to be a barren female.

This female was recaptured in the winters of 1985 and 1986 and, at each capture, her physical condition was found to have deteriorated further. She stayed chronically anemic and parasitized and failed to show any evidence of active reproduction despite periodic association with a fertile male (Roelke et al. 1985 & 1986).

Examination of the feces from this female at each capture and the feces from other panthers occupying the FSSP indicated that raccoon and armadillo were the primary food items being consumed; deer and hogs are thought to be in very low numbers in the area (Roelke et al. 1986). The almost exclusive consumption of raccoon and armadillo coupled with this female's deteriorating physical condition and anemia strongly supported the hypothesis that an inadequate nutritional base was the primary reason that she failed to produce viable cubs during the 3 years she was followed. Diet, failing health, and her advanced age

(11-13 years) also suggested a low probability for any future reproduction in the wild.

Because of the above, the GFC decided to remove female #08F from the wild. Her potential as a viable breeding female in the wild was doubtful, and it was felt that removing her would not impact the wild Florida panther population. It was believed that by placing #08F in captivity, providing her with an adequate diet, and treating her parasitic condition, her overall physical condition would improve and possibly increase this panther's breeding potential. Although she was approaching the upper limit of her reproductive life in the wild, in captivity with proper care, several additional years of productivity might have been possible.

She was taken from the wild on 13 April 1987 and transported to the Wildlife Research Laboratory in Gainesville. At that time, the female weighed 66 lbs. (6 lbs. less than 1986), was in very poor physical condition, and was anemic (Table 4). She adapted to captivity well; she started eating six pounds of venison nightly within 36 hours of capture and exhibited little escape behavior.

In the first 53 days in captivity she received anthelmintics, vitamins, and, most importantly, an ample supply of venison. During this period she gained 12 lbs., an increase of 18% in body weight. At the same time, all of her hematological values increased: total RBC count increased from $7.9 \times 10^6/\text{mm}^3$ to $9.7 \times 10^6/\text{mm}^3$ (a gain of 18%) into the normal range; PCV increased from 33.5% to 38.8% (a gain of 15.8%) into the low-to-normal range; and HGB made a modest increase from 12.0 gm/100ml to 12.8 (a gain of 6%) but was still well below

normal (Figure 1). After a quarantine and adaptation period, she was moved to WOP for use in the captive breeding program in the fall of 1987. Unfortunately, no breeding behavior was exhibited that winter or spring despite the presence of a male nearby. The following June she was stimulated with reproductive hormones and examined laproscopically to determine if her ovaries were still functional. Reproductive physiologists concluded that she had atrophied ovaries and, at 12-14 years, was past her reproductive life. In August 1988, she died after a very short illness due to renal and hepatic failure complicated by adenomatous hyperplasia of the thyroid glands (Table 13).

Florida Panther #09F

On 8 January 1987, Florida panther #09F was immobilized in a routine capture and recollaring event. During the physical examination it was discovered that she had an infected, compound fracture of the rear foot, so the animal was removed to the Miami Metro Zoo for treatment and rehabilitation. Radiographs taken at the zoo revealed traces of lead from a bullet and osteomyelitis of the metatarsals. It was also determined during the physical examination that she was pregnant and appeared to have 3 fetuses. It was known that the stress of captivity might cause the panther to abort, yet the decision was made to treat the osteomyelitis and thus increase the chances for future litters.

#09F was held in captivity until 10 February 1987 when she was released to the wild. During her stay in captivity she did abort, but approximately six weeks later, telemetry signals indicated she was with a male. She conceived, and a litter was born in June 1987.

Since then, #09F has been documented to be pregnant in 1989 and 1990 and is currently believed to have kittens. If she had not been taken into captivity at the time of her injury, it is likely that she would not have been able to support the kittens that might have been born. It is also possible that she would have starved due to an impaired ability to hunt as a result of the injury.

Florida Panther #20M

This male was struck by a vehicle early in the summer of 1987, 3 months after his initial capture. He suffered severe abrasions and sloughing of skin over his carpus and forearm. His six-week treatment in captivity at the Miami Metro Zoo included twice-weekly bandage changes, curettage, and plastic surgery to close a 4-inch circular defect. The major problems in the treatment of this male were his inappetence and depression for the first 2 weeks followed by behavioral problems and damaged canines that necessitated dental therapy. While in captivity undergoing treatment, a cardiac murmur was diagnosed and evaluated (see Pathology section). Once released, this panther apparently lived a normal life and is believed to have sired a litter (D. Maehr, GFC, pers. commun.). His death, one year after his return to the wild, was probably related to the cardiac anomaly.

Florida Panther #21F

This female was initially captured in the ENP on 16 March 1987. She dispersed from her natal site in the "Hole-in-the-Donut" area of ENP into land just south of Homestead and Florida City, FL. She regularly crossed major roadways in her travels including 50+ crossings of US 1 and Card Sound Road (O. Bass, ENP, pers. commun.). She was struck by a car on Palm Drive east of

Florida City on 23 July 1988. Initially evacuated to the Miami Metro Zoo for treatment and stabilization, she was transported to the College of Veterinary Medicine in Gainesville for surgical repair of a fractured femur. Her internal fixation plate was removed 7 June 1989, and she was moved to WOP in January 1990 to participate in the captive breeding program. She came into estrus six weeks after arrival at WOP. The problems we encountered with this female involved very slow bone healing (probably due to inactivity and disuse) and intermittent anorexia and anemia. She tested positive for feline immunodeficiency virus (FIV) which could have contributed to her medical condition. Also, it has been discovered that she had become infected with Cytauxzoon felis following a transfusion of blood from an infected panther. This, by itself or with the FIV, may have been responsible for her anemia.

Florida Panther #23F

Female #23F became orphaned after radio-collaring at 6-8 months of age in the ENP. Ten days following separation from her family, she was removed from the wild and treated for dehydration and weight loss. After a month in captivity, she was successfully reunited with mother and sibling. However, 3 months later, she was orphaned again when the family was approached to examine the fit of the collar. After an unsuccessful attempt to reunite the family, it was decided to retain her in captivity at WOP. She was kept at WOP for 11 months in a relatively wild setting, and, during this time, she demonstrated her ability to kill small prey (domestic rabbits and deer fawns).

In May 1988, she was returned to the wild. After her release, daily radio-telemetry data indicated that she was active and made small daily

movements (O. Bass, pers. commun.). She gradually moved onto the small tree islands in the middle of the then dry Shark River Slough. In mid-June 1988 heavy rains caused the water level in the slough to rise quickly, stranding #23F on an island. After 13 days, it was decided that she should be rescued and taken back to higher ground. However, when captured, she was found to be in very poor physical condition and was removed from the wild for rehabilitation.

After another 8 months in captivity at Gainesville and White Oak Plantation, she was returned to the ENP in February 1989. At this time she was approximately 2 1/2 years old, fully grown, and sexually mature. After her release, she has spent the majority of her time in the mangroves and along the prairie/mangrove edges in the ENP. When treed 8 weeks after her release, she appeared to be in good physical condition and apparently was surviving primarily on a diet of raccoon (O. Bass, ENP, pers. commun.).

When captured in the spring of 1990 to change her collar, she was still very small (62 lbs.) but in good physical condition and thought to be pregnant. Even though this female had spent the majority of her life in captivity and had undergone numerous captures and releases, she had made a successful transition back to the wild.

Florida Panther #28M

A sub-adult, uncollared male was struck by a vehicle in late November 1988 near the Ft. Myers International Airport and suffered a severely fractured scapula and head trauma. He was transported to the Veterinary Medical College in Gainesville for treatment. He adapted well to captivity, and his fractures healed rapidly due to his young age (est. 18 months). He was radio instrumented

and released back to the wild on 15 March 1989. To date he appears to be behaving and traveling normally.

Florida Panther #35M

The male #35M was initially captured on 15 January 1990. The kitten was 10 months old and in good physical condition, though ten pounds lighter than his brother (#34M) captured one week earlier. The capture and recovery was uneventful. However, for the entire week following the capture, he remained in the general area of the capture location and did not attempt to rejoin his mother (#31F). At the end of 7 days, the decision was made to bring the cat into captivity since it appeared that he was not able to fend for himself.

On 22 January 1990, the cat was recaptured. Though the animal appeared weak, he was still capable of running from the dogs and climbing a tree. In darting the cat, one of the darts inadvertently hit the lower abdomen rather than the caudal thigh muscles. The dart hung in the abdomen for a few seconds, then fell out on its own. Long-acting penicillin, intravenous and subcutaneous lactated Ringer's solution, B-vitamins, and anthelmintics were administered, and the cat was transported to Gainesville. Following two days of treatment and increasing depression, the cat died of disseminant Escherichia coli septicemia (see Pathology section). The actual cause of the infection is still unresolved.

Florida Panther N89-64

A young adult, uncollared male was struck by a vehicle on 25 January 1989 on State Road 850 NW of Immokalee, FL. The panther incurred severe chest trauma with a pneumothorax. After initial stabilization and treatment for shock at roadside, he was transported to the Veterinary Medical Teaching Hospital in

Gainesville for treatment. After an initial encouraging response, he went into acute respiratory and cardiac collapse and died of a "shock lung" from the trauma approximately 12 hrs after his initial capture.

FLORIDA PANTHER LONGEVITY AND MORTALITY

Radio-Collaring of Panthers

Forty individual panthers have been captured and immobilized 89 times since late January 1983 (when veterinary medical involvement began) for a total of 44 panthers and 97 captures since the project began 9 years ago; 23 of these panthers are still alive today (Table 8). These panthers have been captured and immobilized a total of 97 times, only one of which resulted in death in early January 1983 (1.03%). For all collared panthers that have died from various causes, an average of 13.2 months passed between the last anesthesia and death. This length of time precludes the anesthetic procedure as a possible cause of death among these animals.

The question of whether the radio-collar is responsible for increased mortality of tagged panthers is more difficult to assess. Without an equal number of uncollared control animals that could be monitored through out their lives, we cannot compare the longevity of collared v.s. uncollared animals. In certain cases, however, the collar distinctly prolonged their lives by allowing us to rescue and rehabilitate them following injury or illness (Florida panthers #08F, #09F, #20F, #21F and #23F - see Rescue section).

The 43 free-ranging, collared panthers accumulated 920 months of collar life and were handled 96 times for an average of 2.3 captures per animal and a life-span of 21.9 months per panther from the initial capture to death or

present (if alive). Post-collaring longevity among panthers that have died or were otherwise removed from the wild is similar to that of those still alive, in the wild. The "dead" panthers lived in the wild an average of 18.9 months and experienced 1.90 captures each, and those still living have averaged 24.5 months with 1.95 captures.

The notion that the collar interferes with normal breeding behavior of panthers and prevents the females from conceiving can also be refuted. The concern is based on the incorrect premise that the male must bite the back of the female's neck for ovulation to occur. As of summer 1990, 13 documented pregnancies resulting in 11 litters have been conceived by 6 females wearing collars at the time of their conception (two females aborted at 45 and 60+ days). A twelfth pregnancy and birth was suspected from telemetry data but could not be confirmed (R.C. Belden, GFC, pers. commun.). At least 11 of the documented pregnancies were sired by 6 different males, all wearing collars at the time of conception. Further, the radio-instrumented female, #11F, conceived two weeks following her initial collaring and was impregnated by a male (#12M) who only one week earlier had also undergone immobilization and collaring. One of the three kittens from this litter, #19F, was captured and radio-collared at 9 months of age. At 18 months, she was re-captured to change her collar. She conceived her first litter within the following few weeks and raised 4 kittens to a minimum of 4 months of age (D. Maehr, GFC, pers. commun.). This success of a second generation of radio-collared panthers strongly suggests that collaring does not interfere with breeding.

Panther Mortality

Since 1972, a total of 38 panthers deaths have been documented and another four survived serious injuries only because they received medical attention. The fate of one additional uncollared panther after being struck by a vehicle could not be determined. The causes of mortality and injury for all 42 panthers, radio-collared (n=21 individual panthers; 24 total events) and uncollared (n=18), are listed in Tables 8 and 9, respectively. Panther deaths/injuries can be divided into five main categories and are listed in Table 10: road killed/injured (46.5%), illegally killed (16.3%), intraspecific aggression with or without associated septicemia (11.6%), other (16.3%), and unknown (9.3%). By far the most important causes of panther mortality, responsible for 65.1% of the documented deaths, are those caused by human beings (road kills and injuries, illegal shootings, and capture mortality) (Figure 2).

A comparison of the causes of documented deaths between the uncollared (U-CP) and radio-collared (R-CP) panthers (Figures 3 and 4) reveals a strikingly different pattern. Human related deaths are responsible for virtually all of the known U-CP deaths (95.0%) compared to only 39.1% of the R-CPs. However, it should not be inferred that the collar is responsible for the avoidance of adverse human encounters, rather, the collar gives us the ability to detect the cat's location in situations where their carcasses would otherwise go completely undetected; however, it is conceivable that the presence of a collar might deter an illegal killing for fear of prosecution. Obviously, uncollared panthers that die on the highway or even those taken illegally are much easier

to document and retrieve than those succumbing to the rigors of life in remote areas.

The phrase "documented mortality" needs to be stressed. These are the deaths for which we have tangible evidence, and the picture we have today may not represent the true situation for the population. For just as the collars have given us a more realistic understanding of the true impact of road kills on the population that could not be gleaned by examining uncollared cats alone (i.e 26.0% for R-CP verses 70.0% for U-CP), so might the inclusion of juvenile panthers in our sample change our perspectives. In most mammal species examined, both in captivity and in the wild, major mortality occurs in the first 6 months of life and most of that before 1 month of age. We know very little about this segment of the panther population for we have captured only 10 animals less than 1 year of age, and all of these were at least 6 months old at the time. Without documenting the number of kittens born to a given female and comparing this to the number surviving to at least 6 months of age, we have little knowledge of the complete mortality picture. Several disease agents have been identified that can effect the survival of young panthers (panleukopenia, calicivirus, and hookworms), but without specific knowledge of the mortality sustained by this age group, we can only speculate as to their significance.

The yearly panther mortality since 1972 is displayed in Table 11. During the past 5 years, 21 panthers have died compared to only 17 in the preceding 5 year period; 48.8% and 39.5% of total documented mortality, respectively. Whether this represents a real rise in panther mortality or is due to an increase in monitoring and public awareness coupled with an intensified carcass

retrieval network is not clear. During these same two time periods equal numbers of killed/injured panthers were documented ($n = 8$). Since highway mortality should impact both the collared and uncollared segments of the population, the equal number of road-kill deaths could indicate that the population is stable.

Our capture efforts have intensified yearly, and for the past 4 years, we have been focusing our attention on areas we feel are inhabited by the core, breeding panther population with the highest density of panthers. Also, starting in 1986 and 1988, 2 additional panther research projects were initiated in the ENP and BCNP, respectively. For the past 2 years, we have had 2 to 3 different teams of houndsmen and dogs working simultaneously, searching hundreds of thousands of acres for panthers sign. All of this has resulted in an increase over the years, in the number of panthers being monitored at any one time (1984 - 3, 1985 - 6, 1986 - 6, 1987 - 15, 1988 - 18, 1989 - 18, and 1990 - 22). The proportion of collared animals among all those dying since the initiation of the radio telemetry project suggests that most of the adults have now been collared. Since July 1985, 10 of the 12 (83%) dead panthers were wearing collars compared to only 6 of 16 (38%) between July 1980 and June 1985.

The core breeding population, which primarily utilizes the private lands north of SR 84 (which now includes the FPNWR), appears to be stable and at or near carrying capacity (D. Maehr, GFC, pers. commun.). There are currently 16 radio-collared sub-adult and adult panthers living in this 1,554 km² (600 mi²) area, with the resultant approximate density of 1 panther/ 103 km². These animals are healthy, and there has been successful reproduction documented

yearly. But this panther density and reproductive success exists only in a portion of their currently available habitat.

It is apparent that panther numbers have declined in areas where they were previously more abundant less than a decade ago, specifically south of SR 84. We believe that the 404 km² FSSP (plus southern Golden Gate Estates) now has a single, resident female panther (plus possibly one other female, D. Maehr, GFC, pers. commun.) and 2 part-time males compared to the 5 to 6 resident adult cats and 3 kittens that were there in 1981-83 (Belden 1986). Also, the eastern portion of the BCNP had a resident population of panthers in the late 1970's and early 1980's of 5-6 panthers (O. Bass, R. McBride, and R.C. Belden, GFC, pers. commun.). Six weeks of daily hunting in 1984 yielded only 1 old female and 2 males (Roelke, unpub. data). Currently, after 2 years of extensive hunting in the area, the BCNP project has identified and captured only 1 adult female animal who covers over 900 km² in her haunts, presumably in search of a mate (D. Jansen, BCNP, pers. commun.). In fact, there are only 3 documented panthers in the entire 2,024 km² (500,000± acres) of public land south of SR 84 in the BCNP, and only 2 others are known in the 2,429 km² (600,000± acres) habitable areas of the ENP and east Everglades (O. Bass, ENP, pers. commun.). This equates to a single panther per 890 km² (220,000 acres) on the federal land south of SR 84. Anderson (1983) reports puma densities for intensely studied areas ranging from 1 puma per 20 - 206.5 km²; from the extremely sparse population in west Texas to abundant ones in the eastern Rocky Mts. of Colorado (the mean for 23 studies was 1 puma per 37 km²). The exceedingly low density of panthers in the Everglades and

eastern Big Cypress ecosystems would suggest that something is gravely wrong with that environment and its ability to support panthers.

DOCUMENTED DISEASES AND PATHOLOGY OF FLORIDA PANTHERS

Significant Bacterial, Viral, and Parasitic Diseases

Bacterial septicemias

Bacterial septicemias: associated with aggression

Intraspecific aggression has been responsible for 5 of 23 (21%) radio-collared panther deaths (see Mortality section). Three of these deaths occurred at the time of the aggressive encounter. Two other panthers, however, did not die in the initial battle but did so from resulting wounds and sepsis. In one case, a female (#15F) with 1 month old kitten(s) suddenly abandoned the den site and was found dead one week later. It was inferred from her behavior that her injuries were incurred at the time she lost/or abandoned her litter (O. Bass, ENP, pers. commun.). On necropsy the muscle tissue under wounds on her neck and fore limbs were blackened, very similar to that seen with some of the clostridial infections (Clostridium novayi, C. chivei, or C. septicum). Bacterial culture was inconclusive due to overgrowth with post-mortem organisms. A second individual, #25M, received a bite wound to the lumbar/paralumbar fossa area of the lateral abdomen which appeared as a minor wound externally. Infection from this wound tracked from the damaged muscle tissue into the chest cavity to create a pyothorax and resultant death. Bacterial cultures were uninformative due to overgrowth of post-mortem organisms.

Bacterial septicemias: associated with trauma

Florida panther #39M was initially captured on 19 February 1990 and underwent a routine work-up. He was in good physical condition and estimated at 3-4 years of age. On 4 May 1990, his normal movement pattern was interrupted, and he remained within a 200-yard radius for many days. On 16 May 1990, the cat was approached from the ground, and he moved only slightly, just keeping out of sight. The decision was made to recapture the animal for examination and treatment, however, on the appointed morning, 18 May 1990, the cat was found dead with no sign of struggle. The panther was extremely thin and dehydrated, and an opaque, pinkish/tan fluid was withdrawn from the chest cavity in an attempt to collect whole blood. The cat was transported to Gainesville, FL. for necropsy.

Initial examination revealed 2-3 liters of the exudate in the thoracic cavity. Several fragments of saw grass (Cladium jamaicense), 4-6 cm in length, were found floating in the thoracic cavity or imbedded in the pleura. The exudate was also present among the muscle bundles of the subcutis of the cranial and lateral thorax and extended into the muscles of the right foreleg.

The final diagnosis of the cause of death was a severe pyothorax. The initial insult, most likely a penetrating chest wound, probably occurred 2-3 weeks prior to the animals' death. Streptococcus equi/equisimilis and E. coli. were cultured from the chest exudate (Table 12).

On initial capture in February 1990, analysis of whole blood for total mercury indicated that this male had significant amounts of the metal in his body. The whole blood level was 1.75 ppm (wet weight). This is above the 1.4-

1.7 ppm "toxic level of concern" (see Mercury section). In human beings with that level of mercury contamination, there is noticeable visual impairment, and the beginnings of subtle neurologic defects can be detected. These types of clinical, "symptomatic" observations are difficult to evaluate in animals, particularly wild ones. There is the remote possibility that the mercury may have compromised this cat's vision and/or proprioception, thus causing him to misjudge his movements and run into a sharp object.

Bacterial septicemias: idiopathic in origin

On 15 January 1990, Florida panther #35M was initially captured and collared. The capture and recovery were uneventful, however, the 10 month old kitten remained in the area of his initial capture for 7 days until the decision was made to recapture the cat and bring him into captivity. It was felt the cat was unable to fend for himself.

The second capture on 22 January 1990, resulted in a dart inadvertently hitting the cat in the lower abdomen rather than the intended caudal thigh. After administration of fluids, anthelmintics, and antibiotics, the cat was transported to Gainesville, FL.

Initial examination upon arrival in Gainesville showed the cat thin and still ataxic from tranquilization. The following morning, the cat was increasingly depressed and lethargic. Closer examination revealed a swollen, tender mass on the ventral abdomen. The cat was also febrile and dehydrated. Intravenous antibiotics and fluid therapy was initiated, yet, the next morning, the cat's condition had deteriorated. His temperature was depressed, and he

could not rise on his own. At this point the cat was immediately transported to the Veterinary Medical Teaching Hospital for evaluation and treatment.

Radiographs indicated a probable peritonitis (gas and fluid were seen). When preparing the abdomen for exploratory surgery, the character and extent of the ventral mass could be appreciated. The skin was edematous and had a purple cast, and the affected area extended from the thoracic inlet to caudal abdomen and was approximately 8 inches across. There was a red/purple line strongly delineating the edge of viable tissue. With a presumptive diagnosis of Clostridium sp., the surgeons contemplated removing all the devitalized skin, but the huge, resulting defect would have been extremely difficult to manage in this cat. They elected to treat him with high doses of antibiotics and let the tissue declare its own "dead" margin before excising it. Exploratory surgery of the abdomen did not reveal any evidence of peritonitis, however, all the mesenteric lymph nodes were markedly enlarged. Biopsies for culture and histopathology were taken. The sub-cuticular area under the purple skin was dark in color and foul smelling.

Following surgery the panther went into cardiac arrest while recovering from anesthesia and died. Post-mortem examination did not further enlighten us as to the cause of death other than to confirm that lymph nodes all over the body were enlarged and wet.

Bacterial culture of lymph nodes and sub-cuticular swelling yielded a pure culture of E. coli. All vaccines, fluids, and anthelmintics used in the field were cultured for bacteria and found to be sterile.

This was a very peculiar case in that #35M was overwhelmed by this bacterial infection. Even if the sterile dart to the abdomen did drag some hair into the subcutaneous area, a normally functioning immune system should have been able to clean up the infection. One possibility is that he had some other, yet undiagnosed, underlying problem or the stress of the previous week had compromised him.

Intestinal pathogens

Routine cultures of feces from healthy panthers resulted in the isolation of several different potentially pathogenic bacteria; Campylobacter sp., Edwardseilla tarda, Plesiomonas shigelloides, and Salmonella arizonae (Table 12). These are most commonly associated with enteritis, but in compromised animals they can cause septicemia and/or wound infections.

Blood parasites

Cytauxzoon felis is a protozoal parasite with an erythrocytic, piroplasm stage and a schizogonous stage that occurs within the cells of the monophagocyte system. It causes a lethal infection in the domestic cat, and infected bobcats (Felis rufus) serve as reservoir hosts. In a routine survey of wild Florida panther and bobcats in 1984-85, this organism was found in one bobcat from Alachua county, but did not appear to exist in either wild felid in southern Florida. Consequently, we were quite surprised to discover that a blood sample from an injured, captive Florida panther was capable of killing a domestic cat due to cytauxzoonosis following inoculation with the panther's white cells. The domestic cat was part of a project to attempt to isolate FIV from a sero-positive panther.

Upon retrospective examination of archived blood smears, it was learned that the detectable number of protozoan parasites in the infected panther was very low and, consequently, easily overlooked. We determined that this particular female acquired the infection from a transfusion during her initial orthopedic surgery. The blood donor was traced to White Oak Plantation where that animal acquired the infection. Ticks are the vectors for this parasite, and the White Oak animal probably became infected via a tick from the wild bobcats in the area, several of which have tested positive.

An examination of blood smears from wild panthers in the spring of 1989 and 1990 indicates that the parasite is present in approximately 50% of the animals examined. We know very little about the pathogenesis of this disease in the panther, but its effects are definitely not as grave as those seen in the domestic cat. However, it is capable of causing illness in certain individuals. A male cougar at WOP was placed into a pen following the removal of the positive donor panther. This new male became infested with ticks and 14 days later became febrile, dehydrated, and anemic and had to be given supportive therapy. This male has now completely recovered. Another panther (the transfused cat), however, has chronic anemia and periods of anorexia and poor weight gain. Her situation is complicated by a dual infection of FIV that may be compromising her ability to deal with the parasite.

Not only must we be concerned about how this parasite affects Florida panthers, but as cats are brought into captivity for rehabilitation or captive breeding, we must not infect other potentially more susceptible exotic feline

species in the respective zoo collection. Like the domestic cat, there may be other species that could be severely impacted.

Viral infections - Rabies

Florida panther #33M, an unvaccinated 3 year old male, was found dead on 23 November 1989. He had been alive the previous morning and had moved approximately one half mile within the 24 hours before dying. In the area where the cat was found, a large circle of grass had been torn up, and several small piles of grass, including one between the cats front legs, were noted. The panther was in good physical condition and had been behaving normally prior to his death.

Gross diagnosis revealed no significant lesions. However, microscopic examination showed moderate diffuse encephalitis due to rabies virus. All other lesions were considered incidental (see Sero-epidemiology section for detail).

Pathology

Vaginal hyperplasia/fibropapillomas

Since 1986, several females have been documented to have growths in their vestibules and vaginas. Histopathologic examination of the biopsies of this tissue has been variously described by pathologists as fibromas, fibropapillomas, or hyperplasia. In severe cases, the growths can protrude from the vulvar lips and completely encircle the vestibule. They are covered with villi or finger-like projections that range from 0.5-3 mm in length. There is concern that these growths could interfere with conception by hindering penile penetration during copulation and/or impeding the transport of spermatozoa through entangling them in the pockets or recesses of the villi. This could be

which
over

particularly effective against males with marginal quality semen. Females #08F and #18F showed advanced cases of this condition. Neither female has been documented to reproduce during the combined 6.5 years of monitoring despite regular association with males.

Hyperthyroidism

Florida panther #08F was estimated to be 13-15 years old at her death on 20 August 1988. She had been removed from the wild on 13 April 1987 due to declining health (see Rescue section). Her physical condition had improved markedly during the first months she was in captivity. Sixteen months post capture this female became anorectic and depressed and died after a very short illness.

At necropsy, the pathologists determined that she died of renal and hepatic failure. However, she also had markedly enlarged thyroid glands which turned out to be adenomatous hyperplasia. This condition has only recently been documented in the domestic cat (early 1970's) and has been suggested to be related to commercial cat diets. Obviously, this wild panther has a dramatically different diet than most domestic cats, and an investigation of her condition might shed light on the syndrome.

By utilizing banked serum from this female six weeks prior to death, we were able to confirm that at her thyroid hormone levels were at least two times above the established normal levels for the domestic cat. An analysis of all the other healthy wild panthers revealed that they had levels very similar to the domestic cat. By examining frozen serum taken from #08F since her initial capture in 1984, it was determined that her thyroid levels had been slowly

rising, were in the abnormal range the day she was removed from the wild, and were not a consequence of her stay in captivity (Table 13). Whether her endocrine disorder was related to her poor physical condition and lack of reproductive performance or to her renal and hepatic pathology is undetermined at this time.

Another factor that could possibly be involved is mercury contamination. This female had consumed primarily raccoons and armadillos and, when removed from the wild, had elevated mercury levels in whole blood (1.17 ppm). Sixteen months later she still had 20.0 ppm mercury in her liver (see Mercury section).

Congenital Anomalies

Cardiac Defects

Florida panther #20M was struck by a vehicle and removed from the wild for treatment of injuries early in the summer of 1987. While in captivity a cardiac murmur was detected and evaluated. Cardiologists performed ultrasound and an EKG and felt that the murmur was probably due to a valvular or septal defect, congenital in origin, and that it could limit his life span. The panther died one year after his return to the wild.

At necropsy the pathologists found a one centimeter defect in the septum between the atria of #20M's heart. Although the heart did not have an abnormal shape, changes in his lungs were supportive of a vascular flow problem, and it is felt that the heart defect contributed to his death. Additionally, he had damaged his canines on the concrete while in captivity, and, despite root canals and dental procedures, at death his canines were very blunt and shorter than when released from the zoo. This may have compromised his hunting ability which

could have contributed to the pronounced weight loss noted at necropsy (138 lbs. down to 105 lbs.).

This spring, another juvenile male, #34M, was noted to have a grade II (I-IV) holosystolic murmur, most pronounced on the left heart base. Presently the animal appears to be in good health.

Cryptorchidism

Cryptorchidism, one retained testicle, has been documented in 12 of 27 (44.4%) male panthers examined since 1981 (Table 2). This is a highly unusual trait that has not been documented in any other wild cougar and is probably the result of inbreeding. In necropsied specimens, the retained testicle was located just inside or outside the abdominal cavity within the inguinal canal. This anomaly can effect either the right or left testicle, and those retained are generally atrophied and sterile due to the high body temperature. In all 12 males with this trait, only one testicle has been affected.

The prevalence of cryptorchid males in the panther population is increasing at a striking rate; for males born between 1975-1980, 1980-1985, and 1985-1990, the incidence was 1 of 7 (14.3%), 3 of 8 (37.5%), and 8 of 12 (66.6%), respectively. The odds of seeing this trait increased exponentially over time ($p=0.019$) by an estimated 28% annually (95%CI: 1.84%, 60.9%). The measurable increase in the incidence of this reproductively unfavorable trait is likely due to genetic drift in the precariously small population.

SERO-EPIDEMIOLOGY OF FLORIDA PANTHERS AND OTHER WILD CARNIVORES

Ninety-seven samples obtained from 51 wild Florida panthers collected between 1978 and 1990 were screened serologically for 11 infectious disease

agents known to be important to felidae and/or reported previously as endemic to other wildlife species in Florida. A summary of the disease agents, serologic test methods, source and type of antigens used, number of samples tested, positive antibody thresholds, and references for the detailed test procedures are presented in Table 14.

All samples tested were negative for antibodies against feline viral rhinotracheitis virus (FVRV) and pseudorabies (PRV). All the animals tested were negative for feline leukemia virus (FeLV) p27 antigen as determined by enzyme-linked immunosorbant assay (ELISA). A variable number of panthers were positive for Brucella sp., Toxoplasma gondii, feline calicivirus (FCV), feline immunodeficiency virus (FIV), feline enteric corona virus/infectious peritonitis virus (FECV/FIPV), feline panleukopenia virus (FPV), feline syncytia-forming virus (FSFV), and rabies virus (Tables 15 and 16).

Feline Panleukopenia Virus

The most significant documented infectious disease agent to which the panthers were exposed was FPV or a closely related parvovirus. Virus neutralizing antibodies to a parvovirus antigenically related to feline panleukopenia were detected in the sera of 32 of 50 (64%) panthers.

More panthers in the FS and Big Cypress Swamp (BCS) physiographic area (Figure 5, area I) had evidence of prior infection with FPLV than did panthers in ENP (Figure 5, area II); 33 of 37 (89%) from the FS/BCS were positive, whereas only 3 of 9 (33%) from the ENP were positive (Table 16). The seroprevalence of FPV-positive antibody titers was compared between these two areas and found to be significantly different ($p=0.006$) (Table 17). Seroprevalence was

not affected by the sex of the panther ($p=0.141$), but was influenced by age ($p=0.027$). There was a 3.37 times greater probability of panthers being seropositive (infected) with each successively older age class.

Within the FS/BCS ecosystem, 56% (10 of 18) of the panthers that reside primarily in the FS (both north and south of SR 84) had high FPV antibody titers ($\geq 1:1,000$) whereas only 38% (5 of 13) of those residing primarily in the BI/BCNP and the adjacent private lands to the north and east had high FPV titers.

Feline panleukopenia (FPL), also known as viral enteritis or feline distemper, is caused by the extremely environmentally resistant FPV. FPL is a highly contagious, devastating, viral disease causing mortality chiefly in young kittens, especially with stress or co-infection with other agents or parasites (Scott 1990). All members of the family Felidae and many members of the families Procyonidae and Mustelidae are susceptible to FPV (Goss 1948; Scott 1990). FPV has been isolated from a number of exotic felids including lions, snow leopards and tigers, and from raccoons and coatimundis (F. Scott, Cornell Univ. Col. Vet. Med (CUVM), pers. commun.). Of notable importance to this study are reports of the occurrence of the disease in captive cougars (Bittle 1981, Hyslop 1955, Torres 1941, Wallach and Boever 1983), in wild bobcats in Florida (Wassmer et al. 1988) and seropositive bobcats in New York (Fox 1983). To our knowledge there have been no published reports of the occurrence of this virus in free-ranging cougar or panther populations (Anderson 1983).

Infection is thought to occur by ingestion of the virus in feces, vomitus, or urine from infected individuals (Cotter 1980). Other potentially suscepti-

ble wild carnivores which occupy the same habitat as the Florida panther and could serve as reservoir hosts for parvovirus are the bobcat, mink (Mustela vison), feral domestic cat (Felis catus), grey fox (Urocyon cinereoargenteus), raccoon, red fox (Vulpes vulpes), and river otter (Lutra canadensis) (Roelke et al. 1985, Barker et al. 1985, Layne 1974). The virus is extremely hardy and can survive for more than a year at room temperature (Cotter 1980, Poole 1972). Therefore, in addition to direct contact with a virus-shedding carnivore, habitat contamination may be a "reservoir" source of the virus.

The higher prevalence of antibodies to FPV seen in the FS/BCS compared to the ENP is difficult to explain, but it may be the result of certain differences in the two habitats. For example, the heavily vegetated, mixed hardwood swamp of the FS and the presence of abandoned logging roads above the water level might encourage the use of common travel routes by various carnivores. This would increase animal-to-animal and fecal-to-animal contact. In addition, the dense cover may protect the virus deposited in feces/spoor from inactivation by sunlight. This is in sharp contrast to the road free, open sawgrass and cypress prairies of the ENP habitat. Alternatively, the "patchy", disparate, non-uniform distribution of FPV antibody response may be due to differences in the other susceptible host species (both numbers of individuals and viral-shedding capability of the respective species) that inhabit the area and may influence the quantity of infectious material in the ecosystem.

The high virus neutralizing (VN) antibody titers ($1:\geq 1,000$) to FPV documented in the panthers and maintained over subsequent years in serially sampled individuals within the FS is consistent with findings in domestic cats where an

infection with a virulent virus results in life-long immunity with high VN antibody titers (Scott et al. 1970b). However, these persistent, high titers may suggest that the virus is ubiquitous in that environment and that those animals are continually encountering the virus, resulting in higher antibody titers similar to that seen with repeated vaccination (Scott 1971a). Alternatively, there may be differences in the virulence and/or antigenicity of the strain of FPV present in the respective locations, resulting in differences in antibody response to the viral challenge. Since the majority of adult panthers and bobcats living in these "hot spots" are seropositive and have antibody levels that are protective (VN antibody titers $\geq 1:10$ are considered protective in domestic cats), the probability of a catastrophic epizootic event occurring due to FPV is low. However, in areas distant from the FS/BCS where the prevalence and intensity of antibody response to FPV is low or non-existent, such as ENP, there is a greater potential for the disease to spread through the unprotected population resulting in high mortality and even local extinction. This latter scenario may have contributed to the epizootic of FPL in the wild bobcat population at Archbold biological station (near Lake Placid, Glades County, Florida) that killed 11 of 18 radio-collared animals over a 3 month period in 1979-80 (Wassmer et al. 1988).

To date, no documented Florida panther deaths have been attributed to FPV or a closely related parvovirus. This does not diminish the potential importance of this virus to the free-ranging panther population. The majority of the panthers sampled have been post-exposure, antibody-positive, surviving sub-adults and adults. The group of panthers at greatest risk are the un-

protected, sero-negative animals, particularly the neonate and juvenile cohort. The least is known about this age class, but mortality from birth to 6 months of age is estimated to be 50-70% (Roelke, unpublished data). What influence FPV may be exerting on this early mortality is unknown at this time. Many factors including the immune status, differential genetic resilience to disease, nutritional status, environmental contaminants, and other concurrent infections could act together within the individual to influence the outcome of an exposure to FPV (Carlson and Scott 1977, Carlson et al. 1977, and Pollock 1984_{a,b}).

The bobcat is presumed to be susceptible to the same disease agents as the panther, and as such, it is a very useful animal to use as a "sentinel" to indicate the presence and prevalence of certain infectious diseases. One hundred thirteen bobcats collected between 1984 and 1990 in southern Florida were examined for several viral, parasitic, and bacteriologic pathogens in a similar fashion as the panthers (Table 18). Thirty-six (44.4%) of these were positive for parvovirus. The sample sizes of bobcats taken from the different areas vary by year, however, in Collier County, it appears that the prevalence of antibodies to parvovirus is much higher in those bobcats living in the FS and BI area (73%) than in adjacent areas east and west (25% and 12.5%, respectively) (Table 19 and 20). This distribution pattern is very similar to that seen in the panther. Table 21 lists the results of tested bobcats by county for animals collected throughout over the state.

One hundred fifty-five other wild mammals of Florida (primarily carnivores) were tested for parvovirus antibodies and included 86 raccoons, 38 otter, 5 feral cats, 12 grey fox, 9 black bear (Ursus americanus), 2 mink, and

3 opossum (Didelphis virginiana) (Table 22). Table 23 compares the prevalence of parvovirus in different regions of the state for bobcats, raccoons, and grey fox. In total, 310 samples have been examined for parvovirus, and 41.5% test positive for this virus across all species and areas represented. It would appear that this virus (or family of viruses) is ubiquitous in the free-ranging populations of these mammals and indicates that they all may be involved with the spread of parvovirus.

Feline Calicivirus

Florida panthers were found to have been exposed to another potentially pathogenic virus, feline calicivirus (Table 15). Nineteen of 50 (38%) panthers had VN antibodies to this virus. There was no significant difference in the seroprevalence of FCV antibody titers between the major geographic areas (FS/BCS and ENP) ($p=0.184$), the age classes ($p=0.93$), or the sexes of the panthers ($p=0.066$) (Table 17).

Feline calicivirus is one of the primary viruses responsible for feline viral respiratory disease which can cause severe oral lesions, pneumonia, and death in both domestic cats and many species of non-domestic felids (Ford 1989, Fowler 1986:800-806; 831-841). Although mortality is generally low, virulence can vary with the strain of virus and the age of the host, with most mortality occurring in young kittens less than 10 wk of age. Unlike FPV, this virus does not survive for long periods outside the animal host and must rely on direct animal-to-animal contact via saliva and aerosolized respiratory fluids for transmission to occur. The majority of recovered domestic cats become chronic

carriers, and many can shed the virus from their oropharynx for 2 years or more (Ford 1989).

Since there was no significant difference in the prevalence of FCV by age, sex, or location, the virus may be present throughout the panther population, with transmission similar to the domestic cat; a persistently infected mother-to-offspring pathway is a likely route for panther exposure and not from the environment. However, social interactions between adults or between non-maternal adults and kittens may also facilitate transmission. One adult male panther sero-converted during a 2-year sampling interval during which he consorted at regular intervals with a sero-positive female and was implicated in the death and consumption of her young kittens. The significance of this virus to Florida panthers is unknown at this time, but its role in neonatal morbidity and mortality should not be overlooked.

Thirty-one percent of 81 south Florida bobcats tested had antibodies to calicivirus (Table 18). As in the panther, the prevalence of this virus does not appear to vary with respect to the location of the bobcat in Collier County as did the parvovirus.

Feline Viral Rhinotracheitis Virus

To date, no panthers have demonstrated positive antibody titers to FVRV (prevaccinally), however, several have had detectable titers 1 to 2 years following vaccination. Since a limited number of wild bobcats from the same ecosystem were seropositive for FVRV (Table 19), we can not be sure whether the positive panther titers are the result of natural exposure or from a vaccinal response.

Pseudorabies Virus

Pseudorabies virus (PRV) is an infectious, viral disease that involves the central nervous system of many warm blooded mammals (Trainer 1981) and has been demonstrated to cause 100% mortality in experimentally infected domestic cats (Horvath and Papp 1967). The clinical course of the disease in domestic cats is extremely rapid (less than 48 hours), and consequently, this peracute death does not allow time for a serologic response to occur (Hand 1989). If the Florida panther succumbs to the virus as rapidly as the domestic cat, detecting the clinical phase and/or retrieving a carcass fresh enough to make an accurate histological and virological diagnosis in the wild would be very difficult. Therefore, the fact that all the sampled panthers were seronegative (Table 15) could indicate that tested individuals had never been exposed to the virus rather than that the virus was absent in their environment.

Nettles and Erickson (1984) and Gibbs (Univ. of FL Col. Vet. Med. (UFVM), pers. commun.) have reported serologic evidence of PRV in feral hogs from Collier, Glades, and Hendry counties (documented panther range) with seroprevalences for positive antibody titers ranging from 30% to 65% depending on the location. Asymptomatic, experimentally infected wild hogs have been shown to shed PRV in saliva and nasal discharge with subsequent infection occurring in contact animals (Tozzini et al. 1982). In areas where hogs are abundant, they are a primary prey item of the Florida panther (Belden 1986, Roelke et al. 1986). It would, therefore, be possible for the panthers, like domestic cats, to contract the virus by consuming flesh from infected and/or shedding hogs (Gustafson 1981). This could be a highly plausible explanation

for the consistent finding of low numbers of panthers in areas of high hog density and high PRV seroprevalence such as Glades County (Belden 1978, Roof and Maehr 1988, R.C. Belden, GFC, pers. commun., P. Gibbs, UFVM, pers. commun.). The virus could be the limiting factor in this northern extension of panther distribution in southern Florida (Roelke 1988).

One hundred sixty-six additional carnivore sera were screened for PRV (Table 24). Three of 57 (5.3%) raccoons and 2 of 20 (10%) bears were positive. The raccoon results are of importance to the panther for it documents yet another potential route of exposure to PRV for those panthers that might consume a virus shedding raccoon.

Feline Immunodeficiency Virus (FIV)

Serologic evidence of FIV infection was detected in 10 of 39 (26%) individual panthers examined between 1983 and 1990 (Barr et al 1989). Antibody sero-conversion was detected in 1 individual, a mature female which converted from negative to positive on the third year of sampling. A sub-adult female, the offspring and sibling of two positive panthers, had equivocal test results on the first sampling. Subsequent immunoblot examinations showed low and fluctuating levels of antibody, but ELISA results were negative (Table 25). The four other panthers deemed to be positive for FIV antibodies when first examined and the mature female which became positive during this study maintained their seropositive status on subsequent evaluations for at least the 6 month to 2.5 year interval that they were monitored.

Feline immunodeficiency virus is a recently recognized pathogen of domestic cats which causes an immunodeficiency-like syndrome (Pedersen et al.

1988, Yamamoto et al. 1989) usually after months to years of clinically inapparent infection. To date, we have not been able to attribute any obvious illness or death to the presence of the FIV infection, yet many of the disease signs observed are consistent with those documented in domestic cats infected with FIV. Four of the 5 seropositive panthers that lived in the FS/BCS area have either died and/or had reproductive problems. One panther (#08F) suffered in the wild from chronic anemia, weight loss, and reproductive failure, all of which were thought to be due primarily to a poor nutritional plane. She subsequently died in captivity of chronic renal and hepatic failure complicated by adenomatous hyperthyroidism. Female #18F appeared to be in good physical condition yet was reproductively unsuccessful for the past 3 years, possibly because of an exuberant vaginal papilloma. Male #25M died of a fulminating septicemia following a bite wound to the flank inflicted by another panther, and male #07M appeared healthy when he was killed by a vehicle.

Conversely, the family of 3 seropositive panthers in the ENP are all alive, and the two remaining in the wild are apparently healthy; female #14F has successfully produced a litter with at least two kittens surviving past 6 months of age in 1989, and male #16M has sired two different litters in 1988 (O. Bass, ENP, pers. commun.). The third panther from ENP, female #21F, is recuperating in captivity from a fractured femur suffered from a collision with a motor vehicle and is infected with Cytauxzoon felis. This panther has had problems with sporadic episodes of anorexia and weight loss, low grade anemia, and slower than expected bone healing. It is difficult to attribute these clinical signs to FIV considering that although she was seropositive when originally sampled

in the wild, she has remained seronegative for FIV antibodies by ELISA (but had equivocal IFA and Western blot results) while in captivity, and attempts to isolate the FIV virus have been unsuccessful (M. Barr, CUVN, pers. commun.). However, the dual infection with FIV and C. felis could be responsible for the anemia.

From our limited data, two possible routes of FIV transmission are suggested. First, a familial route is possible based on the association of a seropositive adult ENP female panther and her 2 seropositive, dependent, 14-18 month old offspring in 1987; however, a 10 month old offspring in 1990 was negative. For those positive offspring, whether the transmission of the virus might have occurred by trans-uterine, trans-mammary, or direct contact is unknown at this time. A second possible route is via fight wounds and/or copulation. A seropositive male, #07M, moved into the territory of a seronegative female, #08F. Over the next year, radiotelemetry data indicated that he had repeated close contact with this female at regular intervals (presumed breeding activity). At her subsequent recapture, fresh fight wounds were noted, and she had seroconverted to a positive antibody titer. Over the ensuing 2.5 years until her death, her antibody titer continued to rise. Conversely, another seronegative female partner of this same male has failed to seroconvert despite both copulation and severe bite wounds probably inflicted by the same male. Further, a male (#17M) known to mate with a seropositive female (#18F) has also failed to seroconvert despite numerous documented contacts and fight wounds (noted on both the male and female at capture) over a 2 year interval. The significance of this virus and its potential immunosuppressive qualities in

the inbred Florida panther population is unknown at this time and should be investigated.

Feline Enteric Coronavirus/Feline Infectious Peritonitis Virus

Sera were tested for FECV/FIPV by two different assay techniques, the IFA and the KELA. By IFA, 7 of 30 (23%) samples were positive for coronavirus antibodies while 0 of 32 were positive by KELA (Tables 15, 16, and 26).

The detection of panthers seroreactive to the FECV/FIPV group by the IFA assay indicated that this assay is very sensitive for the coronavirus group-specific antibody. Since the antibody may be cross-reacting to other coronaviruses of canids (canine coronavirus) and swine (transmissible gastroenteritis virus), the presence of low antibody titers may indicate exposure by way of food ingestion rather than natural infection with a feline coronavirus. The lack of response as measured by the KELA indicates that this assay may be very specific for FIPV and, as such, may overlook other coronavirus seroreactivity at lower dilutions.

Feline Syncytia-forming Virus

FeSFV is present within the Florida panther population as well as other wild F. concolor populations and wild Irimote cats (Felis irimotensis) of Japan (Mochizuki et al. 1990) but is not present in the sampled bobcats from southern Florida (Table 27). Approximately 33% of the Florida panthers and 100% of Colorado mountain lions were found to be infected with FeSFV. This virus is quite common in healthy as well as sick domestic cats (Gaskin and Gillespie 1973) and has been reported in conjunction with diseases such as FIP (Scott 1971b), chronic progressive polyarthritis (Pedersen et al. 1980), and

respiratory infections (Ellis 1985), but a pathogenic role has yet to be established.

At this time the recognized importance of this virus to the Florida panther is that it destroys the fibroblast tissue cultures of infected individuals (Table 28). These primary skin cultures are important for growing cellular material for DNA isolation used in ongoing genetic studies. Once the skin biopsy material is away from the host's virus-neutralizing antibodies, the virus is able to grow unchecked which results in the destruction of the desired cells and the inability to maintain the cell cultures. This destruction of the cultures is quite costly in lost time, effort, and transportation costs, as well as necessitating repetition of the surgical procedure to obtain another sample, which is often not possible with free-ranging, wild animals. One way to deal with this problem is to develop an anti-FeSFV hyper-immune serum in which to grow the cells during the initial passages of cellular growth. Collaboration with Dr. J. Gaskin, Univ. of Florida, has resulted in adapting the panther virus to domestic rabbit cells in tissue culture. These will then be used to stimulate the rabbits to produce the hyper-immune serum which can then be periodically harvested. This project is still in progress.

Rabies Virus

Collaborative research with the Rabies Branch of the Wistar Institute of Anatomy and Biology has resulted in the examination of 38 naive panther sera as baseline for the presence of rabies virus-neutralizing antibodies in the wild population. Twenty-seven (71.1%) were seronegative (≤ 0.2 IU/ml) and 11 (28.9%) had titers ≥ 45 (0.6 IU/ml), including two juveniles with titers of 135 (2.0

IU/ml) (Table 29). Since many of the positive panthers lived for months to years after the samples were collected, the titers do not represent active infection, but rather, prior exposure to a non-lethal dose of virus, most probably from consuming a rabid animal. Rabies research at the Wistar Institute indicates that animals must be exposed to repeated, non-lethal doses of virus to mount a detectable response, whereas animals that receive a lethal dose rarely develop detectable antibodies.

All panthers captured in southwestern Florida by the GFC were vaccinated against rabies virus with commercially available, killed-viral products, Bio-Rab® (1985-1987) and Immrab® (1987-1990). The ENP and BCNP projects elected not to vaccinate their captured panthers. While the potency of these biologicals is proven for a minimum of three years duration in domestic dogs and cats, the potential efficacy for wild and exotic species is unknown. Pre and post vaccinal sera, collected at least 10 days apart, were available for 16 panthers. All seroconverted to primary exposure, and antibody titers rose markedly upon booster vaccination.

During the course of this study, one unvaccinated, adult male (#33M) was found dead in the field during November 1989 and was confirmed rabid at necropsy. Antigenic characterization by monoclonal antibody analysis of the rabies isolate obtained from this rabid panther confirmed its identity as similar to the major rabies viral subtype associated with the southeastern and mid-Atlantic raccoon enzootic region of the USA. Panthers are documented to regularly consume raccoons, so it is quite likely that was the source of rabies

for this male. A rabid raccoon was collected in BI/BCNP in January 1986, less than 20 miles south of where the panther died.

This study demonstrates the capacity of commercial, inactivated rabies virus vaccines to induce rabies-specific virus-neutralizing antibodies in a majority of parenterally vaccinated Florida panthers. Furthermore, these observations strongly suggest that rabies may be an important health threat to free-ranging panthers.

Infectious Disease Agent Interaction

There is considerable difficulty in identifying crisp examples of disease processes effecting free-ranging species, but many of the viral and parasitic agents found in the wild Florida panther population could work together in subtle ways to influence the survival of this endangered animal. For example, the ubiquitous tropical hookworm, Ancylostoma pluridentatum (Forrester et al. 1985) may exacerbate the pathogenicity of feline parvovirus by enhancing mitotic activity of intestinal epithelial tissue (Carlson et al. 1977, Carlson and Scott 1977). Similarly, immunosuppression due to FIV could allow otherwise more benign and well tolerated agents such as calicivirus or Toxoplasma gondii to recrudesce in carrier panthers and result in a much more serious, if not fatal, outcome (as has now been documented with HIV/AIDS and T. gondii in humans [Frenkle 1990]). Innate genetic vitality can dramatically affect the outcome of an encounter with an infectious disease agent. The FECV/FIP has been demonstrated to have devastating effects on cheetahs which lack the breadth of genetic diversity seen in other species of cats (O'Brien et al. 1985). So might the Florida panther, with its limited population size, be compromised in its

genetic diversity and disease resistance compared to other sub-populations of cougars and be more susceptible to FECV/FIP or other agents.

Wild, good quality panther habitat is dwindling rapidly under constant pressure from human activity. The nutritional and social stress caused by the degradation of habitat along with the compound effect of environmental contaminants such as mercury further compromise the animals' ability to handle infectious diseases. In addition to a waning habitat resource, the utility of the remaining land may be decreased for panthers by the presence of infectious diseases. This could be the case with pseudorabies virus in feral hogs which has the potential to delineate the range of Florida panthers much as the tsetse fly prevented the movement of domestic cattle into tropical Africa (Rogers and Randolph 1988).

All of these factors render this endangered subspecies exceedingly vulnerable to sporadic or catastrophic mortality caused by the various infectious disease agents that could drive the species to extinction.

MERCURY IN THE FREE RANGING FLORIDA PANTHER

Mercury contamination of largemouth bass (Micropterus salmoides) and alligators (Alligator mississippiensis) in various watersheds throughout the state of Florida has recently come to light as a human health issue. The entire Everglades watershed in southern Florida has been closed to the hunting of alligators and health advisories have been issued to curtail the consumption of bass due to the elevated mercury residue in the flesh of these species. Mercury is bio-accumulated through the food chain as toxic methyl mercury and is seen at greatest levels in the longer lived species at higher trophic levels.

The mercury problem began to focus on the Florida panther in the summer of 1989 with the death of a young female near the ENP. Florida panther #27F, a four year old female, was found dead on 23 July 1989 in the northern Shark River Slough, just to the east of the ENP. A necropsy performed on this animal found no obvious cause of death. In September, the United States Fish and Wildlife Service was enlisted to perform an initial contaminants screen for pesticides and heavy metals. Results for all organochlorines and carbamates were negative, however, both mercury and selenium levels in the animal's liver were measured at 98 ppm and 22 ppm, respectively (all values are reported as wet weight). A second, independent laboratory measured mercury level in the liver at 110 ppm. Liver has been the primary organ of interest because of the comparability of these data with published literature.

Whether #27F actually died of mercury toxicosis can not be answered conclusively. Histopathologic examination of the brain was not possible due to advanced autolysis. However, naturally exposed feral cats at Minimata Bay, Japan (Eisler 1987), died with liver mercury levels as low as 37 ppm (range 37-145). Consulted toxicologists felt that it was likely that #27F died as a result of mercury toxicosis.

As a result of the concern raised by the data from #27F, blood, tissue, and hair samples were submitted for analysis, taken from dead panthers that had been archived over the years and from panthers live-captured for radio-telemetry studies were submitted for analysis. All available data are presented in Tables 30, 31, 32, and 33. When the liver mercury data were examined by location and age of the panther there were striking differences noted (see

Figure 6). The mean liver mercury level for the younger group of panthers (less than 8 years old) living in the eastern versus western region of southern Florida was significantly higher ($p = 0.024$, geometric mean (GM) east = 25.8 vs west = 0.304; 5 df). Similarly, if only the western group is considered, the old cats have significantly higher liver mercury levels than do the young cats ($p = 0.029$, GM old = 14.6 vs young = 0.304, 5 df) and the mercury burden is much higher among old cats living in the FSSP than the one living to the north of SR 84 (19-20 ppm vs 7.8 ppm). Further, it should be noted that we have not sampled any older panthers in the eastern portion of the range, due either to a random chance or an actual absence of older animals there.

In order to compare mercury levels from dead panthers which were derived from liver samples with mercury levels in living animals for which no organ tissue is available, we examined hair obtained at the time of death from a small number of panthers. The regression analysis for 6 pairs of samples (liver and hair) was almost significant at the 0.05 level ($t = 2.77$, $p = 0.051$, $r = 0.8105$). Figure 7 displays the regression model. The black dots are the data points used to calculate the regression and the asterisks are the predicted liver mercury concentrations for 5 living cats. The 95% prediction interval is displayed as a pair of concave lines. With this information and continued testing to verify this relationship it may be possible to accurately predict liver levels through hair analysis. In addition, blood levels may also serve as a way to evaluate the mercury burdens in living animals without using invasive techniques such as liver biopsies. The initial test results on whole

blood samples show the same relative pattern of contamination by age and location as did the liver values (Figure 8).

The most probable source of mercury contamination in panthers is via the food chain. Within the ENP, Florida panthers #14F, #15F, and #22F, living in Long Pine Key (LPK) (also known as the Hole-In-The-Donut area), feed primarily on white-tailed deer which are relatively abundant. The frequency of deer kills in this area averages 1 every 7-14 days. Other prey items such as raccoons, rabbits (Sylvilagus sp.), and armadillos are taken less often and make up approximately 20% of diet (O. Bass, ENP, pers. commun.). Liver mercury level for #15F was 13.0 ppm, and whole blood for all 3 cats in 1986-88 was 0.21- 0.23 ppm. Panther #14F is presently the sole surviving adult female in the LPK area; despite a diet primarily of deer, her whole blood mercury level has increase 5-fold in the last 2 years, from 0.23 up to 1.1-1.41 ppm.

Florida panthers #16M and #27F lived in the area northeast of LPK, known as the East Everglades (EE). At initial capture panther #27F's whole blood level was 1.7 ppm. During the following 15 months of monitoring, she fed only on small prey. Of twelve kills recovered, all were raccoon. At the time of her death, her liver mercury was exceedingly high, 98-110 ppm, and hair was 130 ppm. Panther #16M, as a sub-adult, fed on raccoons, otters, and marsh rabbits (S. palustris). At this time, his hair mercury was 82 ppm and his calculated whole blood level was 1.83 ppm. As he matured, there was a shift from killing smaller to larger prey. At present, #16M primarily feds on deer, hog, and alligators, and his blood level in February 1990 was 2.9 ppm; the elevation is probably due to the consumption of alligators. The EE has a low deer density and panthers

in this area depend more on smaller prey to maintain themselves. We believe that mercury is bio-accumulated up the trophic levels in the aquatic food chain. In the Everglades watershed, this dependance on small prey (raccoons, otters) and alligators is the most probable source of mercury contamination for the Florida panthers. Mercury was found to be less than 1 ppm in liver samples from approximately 100 southern Florida white-tailed deer (D. Forrester and S. Sundlof, UFVM, pers. commun.).

Food consumption by panthers in the western portion of their range (BCS ecosystem) shows a similar pattern of regional differences as related to the availability of prey species. Those panthers living in the FSSP historically consumed many more raccoons than panthers living north of SR 84 in the N. FS, BI/BCNP, and adjacent private ranches where deer and hogs are the primary food items. The mercury levels in the north vs south FS follow a similar pattern shown in the Everglades system wherein those animals consuming primarily small prey have considerable higher levels of mercury (FSSP: liver 19-20 ppm, blood 0.31-1.7 ppm) than those consuming large prey (N. FS: liver 0.05-7.8 ppm, blood 0.02-0.35 ppm).

Florida panther reproductive success appears to be closely associated with types of major prey items available. In the those areas where deer and/or hog are the primary food item, the panthers are reproductively successful. In the LPK of the ENP and the northern BCS, litter size ranges from 2-4 and adult females have been documented to rear young to ≥ 6 months of age at a rate of 1.04-1.09 kittens per female year (documented number of young $\div$ total accumulative time, in years, that radio-collared females were monitored). In

contrast, in the FSSP where predominantly more small prey are consumed, the female panthers are not as productive, with litter sizes of 1 and an estimated 0.38 kittens produced per female year. This low productivity probably is the result of poor nutritional status. However, this may be compounded by chronic mercury toxicity which could cause abortions, stillbirths, and congenital anomalies resulting in early neonatal death and infertility problems in the males (Figure 9).

The significance of mercury and the potential long term untoward effects in certain sectors of the wild population should not be minimized. With so few existing Florida panthers, every factor that results in the depression of reproductive fitness and/or mortality can help drive the population to extinction. This problem needs further research to determine the mercury levels in various prey species from different locations as well as to understand more about the physiological effects of mercury on the individual panthers.

A working group under the direction of the Florida Panther Interagency Committee's Technical Subcommittee was convened in November of 1989 to review existing data and evaluate potential impacts of mercury in the environment to Florida panthers and provide recommendations for potential management actions. This meeting resulted in a detailed document which recommended guidelines for further actions which include dealing with individual panthers whose mercury levels rise above "levels of concern" (USFWS 1989). Mercury toxicosis is documented to occur in the domestic cats with whole blood levels of 14-17 ppm and liver levels of 72-74 ppm (range 35-145). Toxicologists advised that a

level of concern for the panther would be at 10% of toxicosis, i.e. 1.4-1.7 ppm in whole blood and 7.2-7.4 ppm in liver tissue.

REPRODUCTION

Male Reproduction

Twelve males have been electro-ejaculated since 1986, to obtain semen for evaluation. Seminal traits from every male examined were surprisingly similar and were characterized by low volume, low concentration ($3-15 \times 10^6/\text{mm}^3$), poor motility, and a very high proportion of abnormal spermatozoa ($X = 92.9\%$) (see Table 34). Large cats, in general, tend to have a high percentage of abnormal sperm and the few wild Texas cougars and captive cougars examined seem to follow this pattern with 60-75% total abnormal forms (Wildt et al. 1986b, Wildt et al. 1988, Howard et al. 1984).

However, the Florida panthers represent an extreme case of aberrancy, for 75% of the sperm exhibited severe deformity and were classified as having primary abnormalities. This proportion of primary abnormal sperm is much higher than either the wild Texas cougars or captive cougars (20-25%) or even the cheetah with its well documented, poor sperm quality (27%) (Wildt et al. 1983) (Table 35, Figure 10). Primary abnormalities are defects that are thought to occur during spermatogenesis and are highly influenced by genetic determinants. External influences such as copulatory activity, nutrition, or disease tend to result in secondary abnormalities.

The panther's major type of defect is one involving malformation of the acrosome (head) of the sperm (48%). This is a very unusual type of defect, and in all probability, would render the spermatozoa incapable of fertilizing an egg

(D. Wildt, Nat. Zoo. Park, pers. commun.). The fact that only 3-7% of the sperm are normal could easily result in lowered male fertility, and repeat matings would be necessary for conception or occur.

The implications of the magnitude of abnormal spermatozoa to the panther population are far greater than just missed matings. If we can extrapolate from the cheetah, the high percentage of abnormal sperm is related to a high degree of monomorphism in the genetic makeup of that species (O'Brien et al. 1983). This apparent inbreeding in the cheetah is associated with increased neonatal mortality and an increased susceptibility to diseases (O'Brien et al. 1985). Both of these could have severe ramifications for the future management of the Florida panther.

In addition to the seminal defects described above, the males also suffer from a high rate of cryptorchidism. Thus far, 12 of 27 (44.4%) males examined since 1981 have expressed this trait (Table 2). In domestic animals this trait is thought to be genetically controlled (see pathology section). This trait, coupled with the significant percentage of abnormal spermatozoa and the high incidence of cryptorchid values, may indicate that the population is already highly inbred, and the implications to the panther population may be great.

Given the very small effective breeding population of the Florida panther, every opportunity should be made to retain as much genetic material as possible. One way to augment this is to bank (freeze) gametes and embryos for future artificial breeding research. A Florida panther semen bank has been established utilizing the protocol developed by the National Zoo for freezing exotic feline semen. Florida panther semen is extremely fragile, and the standard sperm

freezing protocols do not yield high quality post-thaw semen. This aspect needs attention if we hope to be able to utilize banked genetic material in artificial breeding strategies.

The major impediment to collecting and freezing semen from male panthers has been the lack of access due to the current recapture schedule. The quantity of equipment and supplies necessary to freeze semen (generators, microscopes, centrifuges, dry ice) are not on hand at the initial capture of new, uncollared males and must be brought in on the subsequent re-collaring currently scheduled for 2 years later. Unfortunately, the majority of the males do not survive until their re-collaring date. The mean survival time post-radio-collaring is 13.5 months. Good quality semen for freezing has only been obtained from 3 radio-collared males (Florida panthers #12M, #26M, and #39M). Semen from several other males has been collected and frozen, but due to immaturity, infertility, or post mortem collection, prospects for its utility is dubious.

Female Reproduction

Despite the exceedingly low number of normal spermatozoa present in any given male's ejaculate (3-7%), the low concentration of sperm, and the high incidence of the cryptorchid trait, female panthers are still becoming pregnant. We have documented 23 pregnancies in a variety of ways: actual palpation of fetuses during physical examination (n=4), ultrasound analysis (n=1), necropsy results (n=2), capture or visual sightings of kittens with the respective females (n=5), kitten remains in panther feces (n=1), and radio telemetry data indicating denning behavior 90± days following association with males (n=10). Of these,

only 10 (43%) have resulted in one or more offspring surviving beyond 6 months of age (3 of the litters are still only 1-3 months old).

The productivity of females varies by location, and like physical condition and hematology values, appears to be related to the type and abundance of prey in the respective habitat. The FSSP has the lowest documented productivity with high mortality of entire litters (5 of 7) and litters of single kittens (2 of 2) in those that do survive. This is contrasted to the NFS (and adjacent ranches) and the ENP where the majority of the litters have survived with litters ranging from 1-4 kittens (Figure 9, data as of January 1, 1990).

In addition to a strictly nutritional basis for the poor reproductive success of females in the FSSP, they may have been further compromised by chronic mercury contamination (see Mercury section). Mercury can disrupt fetal development by causing abortions, stillbirths, and congenital anomalies resulting in early neonatal death.

Another female reproductive problem in the ENP relates to the absence of an unrelated adult breeding male since the fall of 1986. This problem was only partially remedied when the 1986 male offspring (#16M) of female #14F reached sexual maturity (approx. 30 months old) and bred with #15F in the spring of 1988. Female #14F was finally bred by her son a year later in the spring of 1989 when he was 3.5 years old. He has since emigrated from the ENP. An unrelated male panther, #39M, was captured in February 1990, but has subsequently died without breeding with the resident females. This currently leaves the 1989 inbred son of #14F (#42M) as the only male east of Shark River Slough in the ENP and EE.

In vitro Fertilization Research

On 31 May 1988, a new phase in the Florida Game and Freshwater Fish Commission's ongoing effort to save the Florida panther was initiated. An international team of researchers from the National Zoological Park, Metro Toronto Zoo (Canada), College of Veterinary Medicine at Gainesville, and the GFC joined forces and talents to apply the specialized techniques of *in vitro* fertilization (IVF) to the cougar.

Panther semen is characterized by an extremely high proportion of abnormal spermatozoa, especially sperm with head abnormalities as mentioned above. This raised many questions about the fertility and ultimate breeding potential of male panthers, particularly when artificial breeding techniques are employed:

- 1) can panther spermatozoa withstand *in vitro* manipulation,
- 2) will the high percentage of abnormal panther spermatozoa limit its ability to fertilize oocytes,
- 3) will the viability of fertilized embryos be affected by the sperm quality, and
- 4) will the female cougar respond to gonadotropins similar to the domestic cat and thus serve as an appropriate model for the Florida panther?

In order to address these questions, Florida panther spermatozoa must be evaluated within the context of their interaction(s) with oocytes. IVF technology offers an excellent opportunity to address these questions.

Recent advances in feline reproductive technology and IVF at Dr. Wildt's laboratory at the National Zoo prompted us to examine the cougar as a potential reproductive model for the Florida panther. The ultimate goal of this work

would be to augment the captive breeding effort by producing panther kittens artificially, either by artificial insemination (AI) or by IVF.

Eight female cougars, including one aged Florida panther (#08F), were primed with reproductive hormones, PMSG (pregnant mare serum) and HCG (human chorionic gonadotropin), to stimulate follicular development and oocyte maturation. Oocytes were then collected by aspiration utilizing a fiberoptic lens (laparoscope) introduced through a small incision in the abdomen to observe the ovaries. Seven of the eight females responded to the hormones yielding 141 eggs (Miller et al. 1990). The mature oocytes (75) were inseminated with semen collected from three males by electro-ejaculation, including a captive Florida panther male. The fertilization rate for all the mature oocytes was 48.5%, and ten cleaved embryos (actively dividing) were produced. The embryos, fertilized by three different males, were surgically returned to two of the original donor females in the hope that these recipient females would act as surrogate mothers for the "test-tube" embryos. This successful laparoscopic collection of oocytes from female cougars and the subsequent fertilization and production of embryos represents the first time that the technique of IVF has been successfully accomplished in a large felid (Miller et al. 1990).

Our first attempt at IVF did not result in any kittens, however, the work was still considered highly successful. We learned that the cougars' reproductive physiological response to gonadotropin stimulation was similar to the domestic cat, and oocytes fertilized *in vitro* developed into viable embryos. Further, we were able to demonstrate that males with very poor semen quality and behavioral breeding problems, such as our captive Florida panther male PCO 10,

are still capable of fertilizing oocytes in an *in vitro* environment. We also learned that the panthers' spermatozoa has low viability and dies readily during routine handling using semen protocol established for other felids.

POPULATION GENETICS RESEARCH

The remnant population of Florida panthers existing in the remote cypress swamps of south Florida is particularly vulnerable to catastrophes such as disease or hurricanes that could drive the subspecies to extinction. But even if they survive at their current population level, they are likely to become further compromised and lose genetic diversity and heterozygosity due to inbreeding. It has been estimated that for a finite population of large carnivores to retain at least 99% of the initial genetic diversity over 100 generations, there must be at least 300 individual animals maintained (Seal and Lacy 1989). Therefore, with even the most optimal breeding strategy for the 30-50 living Florida panthers in the wild, the potential for loss of genetic diversity over a relatively short time is substantial.

Recent research on other endangered felids has demonstrated an array of novel reproductive, endocrine, and genetic characteristics (Wildt et al. 1986a). Interestingly, the ejaculates of the cheetah (Wildt et al. 1983) and clouded leopard (Wildt et al. 1986a) contain high proportions of abnormal spermatozoa. In both species, ejaculate characteristics may, in part, be the result of an extreme lack of genetic variation (O'Brien et al. 1983 and 1985), with the cheetah exhibiting greater than 10 times less genetic variation than eight other species of felids (Newman et al. 1985). Additionally, the cheetah has remarkable genetic uniformity at the major histocompatibility complex, a

high infant mortality rate, and a hypersensitivity to certain viral disease agents (O'Brien et al. 1985), thus, genetic monomorphism may be significantly influencing their reproductive potential.

Available Florida panther data were analyzed by the Captive Breeding Specialists Group (CBSG) of the International Union for the Conservation of Nature and a Viability Analysis and Species Survival Plan (SSP) was produced (Seal and Lacy 1989). The CBSG reported that the wild panther population is in decline at a rate of 6 - 10% per year, with a concomitant loss of genetic diversity of 3 - 7% per generation. Further, they predict that, without intervention, the subspecies will be extinct within 25-40 years due to genetic and demographic factors (computer simulated probability of extinction ranged from 0% -100% by varying the reproductive age and success, habitat loss, mortality and genetic factors).

There are numerous morphologic indicators to suggest that the Florida panther has already experienced a fair degree of inbreeding and concomitant genetic loss, particularly in the BCS population. These include the peculiar "kinked-tail" and the mid-thoracic cowlick traits so prevalent in the BCS population (Belden 1986, Wilkins 1990), the extremely high abnormal sperm count with the predominance of primary defects (Roelke et al. 1986), the cryptorchid trait displayed in 12 of 27 males, and the finding of a congenital heart defect in one dead male and a grade II/IV holosystolic murmur in another living sub-adult male.

Before informed management decisions could be made with regard to the maintenance of existing heterozygosity or perhaps the introduction of new

genetic material from another cougar population, a data base had to be established. We needed to determine the current genetic status of F. c. coryi and compare it to other free-ranging, presumably heterogenic populations. A population genetics study of Felis concolor was initiated in the fall of 1986, and blood samples from 82 different individual cougars and panthers have been subjected to isozyme (allozyme) electrophoretic analysis. Utilizing established non-domestic feline protocol (Newman et al. 1985), 41 different allelic loci have been resolved for seven North American subspecies.

The species, F. concolor, appears to have abundant biochemical genetic variation compared to the other great cats. Of the 41 nuclear genes that have been examined by electrophoretic techniques, 11 of the loci are polymorphic (26.8%)(Table 36). This percentage is high for the cat family and is rivaling the domestic cat for diversity. If an additional 9 loci are examined (standard profile at NCI is 50 loci, O'Brien 1980) and found to be all monomorphic, the cougar would still have 22% of their loci polymorphic. By comparison, the published values for lions (Panthera leo) are 12% (Newman et al. 1985) to 14%-15.2% (O'Brien et al. 1987), cheetah (Acinonyx jubatus), 0.0%; tiger (Panthera tigris), 10%, leopard (Panthera pardus), 8%, and ocelot (Leopardus pardalus), 20.8% (Newman et al. 1985).

If each wild subspecies of cougar is examined separately, the percent polymorphism is considerably lower than for the species as a whole. Of those subspecies represented by six or more individuals, the Florida panther exhibits the smallest proportion of polymorphic loci at 7.5% compared to Texas (F. c. stanleyana) with 10% and Arizona (F. c. azteca) with 17%. The captive zoo

population had the highest percentage of polymorphic loci with 22.5% (hybrid subspecies soup). Table 37 lists the relative gene frequencies for each polymorphic allele for each population. Heterozygosity levels follow a similar pattern with the Florida cats the lowest at 0.019 and Arizona cats the highest at 0.069. These low values indicate that the Florida panther is inbred and has lost approximately half of its genetic diversity.

In wild North American cougar populations there were three unique polymorphic loci that were each found only in one population, making them potential markers for those populations: Es_2 (Esterase-2) in Western Oregon, GPI (Glucose phosphate isomerase) in Arizona, and APRT (Adenosine phosphoribosyl transferase) in Florida (Table 36). The Es_2 B allele is extremely rare and occurred in only one of ten individuals, whereas the B alleles of GPI and APRT occurred in 3 of 6 and 9 of 24 individuals, respectively. In Arizona there was no particular geographic distribution detectable within the state given the small sample size. However, the distribution of the APRT in southern Florida was strongly partitioned between the BCS ecosystem and the ENP. Every animal examined in the ENP was carrying at least one B allele (OAA:5AB:2BB), whereas only 2 of 24 panthers in the BCS were each carrying a single B allele, and all the others had the common North American A form (22AA:2AB:0BB) (Figure 11).

Prior to the 1986/87 capture season every panther examined from the BCS had a kinked-tail, and over 75% exhibited the mid-thoracic cowlick documented by Belden (1986). In the winter of 1986/87, six panthers were captured in the ENP; none had a kinked-tail and only 1 had the cowlick (Figure 12). In February 1988, the first BCS straight-tailed male was captured (Figure 13). This capture

was followed in the spring of 1990 by 4 additional straight-tailed panthers (1M:3F) in the BCS and two kinked-tailed ones in the ENP (Figure 14).

The geographic partitioning of the morphologic traits coupled with the electrophoretic gene-frequency data and the novel APRT locus raised numerous questions regarding the apparent isolation and/or differences between the adjacent populations. Hypotheses and interpretations ranged from the suggestion that differences in the two populations were merely the result of isolation and genetic drift affected by the Shark River Slough to the suggestion that there was introgression of new genetic material. There is documentation to support the latter hypothesis. The Everglades National Park released 7 captive raised cougars into the park between 1956 and 1966. These animals came from Everglades Wonder Gardens in Bonita Springs, Florida owned by the Piper family and originated from a litter of BCS kittens in the 1940's. A previous employee of the Pipers maintains that a tamed female from the east coast of Florida was introduced into that captive panther population in 1958 (Vanas 1976) and that she possibly came from South America (J. Vanas, Naples FL, pers. commun.).

Electrophoretic data support the introgression allegation in that the Piper cougar descendants examined in this study exhibited 5 polymorphic loci rather than the 3 found in the parent, present-day BCS population. Two of the Piper cats' polymorphic loci have not been found in any other cougar examined in North America, neither wild nor captive. Further, every Piper animal examined carried at least one B APRT allele in common with the ENP population. Recent, additional samples from wild South American pumas have demonstrated that the APRT B allele is found at least in the Chilean and Brazilian puma (O'Brien

et. al 1990; S. O'Brien, NCI, pers. commun.). These data further implicate the released animals as a source of new genetic material in the ENP population.

In order to validate this hypothesis, a more thorough genetic analysis of the Florida panther population was initiated using restriction-site polymorphisms of mitochondrial DNA (mtDNA). Total cellular DNA was extracted for analysis from the Florida panther populations, the Piper animals, and representative individuals from seven North American and three South American subspecies. This analysis by Dr. Stephen O'Brien of the National Cancer Institute, has revealed two broad groups or clades of mtDNA types. With an exception, one clade occurs in North America and the other in South America. Within North America there are 3 closely related mtDNA haplotypes: one in E. Oregon, one for all of the central United States, and one in the BCS of southern Florida (mtDNA A). The haplotype found in the ENP (mtDNA B) is more closely aligned with the South American forms than with any in North America (see Figure 15) (O'Brien et. al 1990).

The mtDNA haplotypes, like the APRT and tail morphology, are strongly partitioned east and west of the Shark River Slough. Every panther in the ENP has the B haplotype and 22 or 25 of the BCS animals have the A haplotype (see Figure 16). Although the number of the individuals carrying the ENP haplotype is fairly high (10 of 32), it probably represents the mtDNA from only one individual who bred with historic *F. c. coryi* in captivity prior to the release of her offspring into the ENP with subsequent matings to wild *coryi* individuals.

Despite the introgression, the number of polymorphic loci and amount of heterozygosity in the ENP population is equivalent to that of the Big Cypress

group (3 vs 3 and 0.020 vs 0.019, respectively). Also, the magnitude of the deleterious seminal traits previously documented in the BCS population is just as high, and in fact, no difference can be detected between males with mtDNA A and those carrying the introgressed mtDNA B form.

This similarity suggests that although ENP panthers may be carrying different mitochondrial DNA types, there has been considerable back crossing with historic F. c. coryi. However, one deleterious trait appears to have been altered by the introgression, the incidence of cryptorchid males. As mentioned earlier (see Reproduction and Pathology sections), the observed frequency of the trait among all male panthers was 44.4% (12 of 27). However, if the males are partitioned on the basis of their mtDNA type, the results are dramatic: 63% (12 of 19) of the mtDNA A males versus 0% (0 of 5) of the mtDNA B males were cryptorchid ($p < 0.005$). Therefore, the remnant, population of historic coryi may have already benefitted from this level of introgression.

These results from the genetic research may affect how we manage the population from this point forth and could have far reaching recovery implications for the panther and other endangered species.

CONCLUSIONS

Through the course of this study a number of factors have been identified that can reduce the fitness of a given panther. Any one of these in an otherwise healthy ecosystem with a large number of genetically diverse individuals would be inconsequential to the population. However, with a remnant

population of 30 - 50 adult individuals, the loss of even one animal can affect the long term survival of the population.

The obvious causes of human-related mortality (road-kills and illegal-kills) can be dealt with by road construction techniques or legal means. However, there are other, more insidious factors at play. Several potentially lethal infectious disease agents have been identified that can affect the free-ranging population: rabies virus, FPV, FCV, FIV, and PRV. These viral agents can act synergistically with the various parasites, Toxoplasma gondii, Cytauxzoon felis, and the hookworm, Ancylostoma pleuridentatum, which also affect in the panther. Further, panthers in certain locations are compromised by living in an environment that deprives them of the nutrients necessary to adequately bear and raise young or to keep their own immune system functioning properly. This lack of an abundant source of preferred ungulate prey forces them to choose alternate prey items that may contribute to mercury contamination. Underlying all of these potentially deleterious factors is a population whose genetic integrity has been compromised through inbreeding to the point that it exhibits half the diversity and heterozygosity measured in other wild populations. This inbreeding can further adversely effect the population by causing an increase in neonatal mortality and a lowered resistance to certain viral disease agents (O'Brien and Evermann 1988). I believe that all of these factors are acting in varying degrees on different individuals and are major contributing factors in the extinction process affecting the Florida panther.

As dismal as the above scenario sounds, there are still numerous mitigating actions that can be taken to help ensure the panther's survival (see Recommendation section). We have learned that in certain areas of the panther's range, the animals are healthy, weigh more than average, have normal hematological values, and are reproducing and raising normal sized litters. In these areas, primarily on the private ranches north and east of BI/BCNP, deer and hog populations are protected from hunting or are hunted at very low intensity and exist at far greater concentrations than on the adjacent public land. This prey density is probably the single most important factor in determining panther health, for a sound nutritional base is the foundation on which the rest of the body functions. These privately owned ranches and the newly acquired FPNWR are responsible for the present core breeding population and continued existence of panther in south Florida. These lands must not be lost, for with them the panther would also be lost.

RECOMMENDATIONS

There are immediate measures from the medical management and biomedical research perspective that must be taken to promote both individual panther health and population vitality. The following is a list of specific management and research recommendations based on the last 7 years of biomedical research.

- 1) The nutritional health of panthers should be improved by managing lands to maintain and enhance the availability of preferred prey species, thereby providing prey of good nutritional quality yet free from environmental

contaminants and infectious disease agents. This is particularly critical for the public lands south of SR 84 which currently have an extremely low panther density (9-11 panthers/1,200,000± habitable acres) and could undoubtedly be managed to support more individuals.

The healthiest and most reproductively successful panthers live in areas with abundant populations of deer and hog which they readily consume. This herbivore diet has resulted in panthers with very low mercury tissue levels and, with the exception of PRV from hogs, exposure to few infectious disease agents. Conversely, panthers that consume large numbers of raccoons, armadillos, and/or alligators are the least reproductively successful, have the highest tissue levels of mercury, and are exposed to several lethal pathogens in their diet, particularly from the raccoons.

- 2) All panthers should receive timely medical treatment aimed at the long term survival and enhanced reproductive potential of the individual. This would include the treatment of fractures, abscesses, gunshot wounds, and other medical problems.

The veterinary medical team should be notified as soon as a medical problem with a given individual is suspected, and plans to rescue that panther should be activated promptly when there is still a chance of saving the cat. It would be far better to respond to a false alarm than to wait too long and retrieve only a carcass instead of a living panther.

- 3) All panthers should be vaccinated with killed viral vaccines for FPV, FCV, FVRV, and rabies virus at each immobilization. Further, where possible, all newly captured panthers (particularly young cats ≤ 1 year of age) should receive booster immunizations approximately 4 weeks following the initial dose (2-6 week maximum range). This could be accomplished easily without immobilization by treeing and dosing via dart injection.

This would enhance the probability of survival of all panthers by protecting them from several identified viral pathogens. No immunized panther has died from any of the respective pathogens despite the documented presence of these agents in their environment. Conversely, a male panther that was intentionally not immunized died 6 months following his initial capture of rabies virus.

- 4) All adult female, juvenile and sub-adult panthers, and selected adult male panthers should receive parenteral anthelmintics at each immobilization. This treatment would be aimed at ridding the animal of internal parasites, primarily hookworms and intestinal flukes, Alaria marciana.

Hookworms can cause mortality in neonates by producing a profound anemia due to intestinal blood loss. In most species of hookworm, larvae pass from the mammary gland to the neonate via the milk. Treatment of the dam with anthelmintics can reduce the number of larvae and thereby potentially reduce neonatal mortality due to this pathogen. The same transmission pathway has been documented for the intestinal fluke, which can cause enteritis in domestic kittens. In older animals, the hookworm can contribute to anemia and poor physical condition, thus treatment could improve their health.

- 5) Panthers should continue to be monitored for the presence of infectious disease agents with both serologic and culture isolation techniques. Further, research on specific identified disease agents that pose the greatest threat to panther survival and productivity should be supported.

Specifically, important potential pathogenic disease agents currently include FCV, FECV/FIPV, FIV, FPV, PRV, rabies virus, hookworms, and Cytauxzoon felis. The only data concerning routes of transmission, pathogenicity, modes of protection, and treatment for most of these agents has come from the domestic cat and limited information on non-domestic felids from zoos. In order to best serve the panther, we need to understand how these agents are operating in the free-ranging panther population. To this end, collaborative investigation with established researchers that has been initiated should be

continued and new ones encouraged. Research has begun for several of agents, however, PRV has not received any attention beyond a serologic survey, and this needs to be addressed. PRV has the real potential of limiting the range of panther by the spread of this virus from infected hogs. Recently, a vaccine has been developed for protecting pigs which has possible application for use in panthers. This needs to be evaluated.

- 6) All panthers should be tested for mercury at each capture or at necropsy. Additionally, the recapture interval for any living panther found to have elevated whole blood or hair mercury levels should be shortened to ≤ 1 year in order to facilitate a timely reassessment of the animal's health.

This increased monitoring scheme would accomplish at least 2 goals; first, more baseline information would be generated, particularly about possible seasonal effects on dietary consumption of mercury, and second, a panther could potentially be rescued for detoxification and treatment if excessive levels were detected soon enough.

- 7) Mercury in the panther's diet should be investigated to determine the source, magnitude, seasonality, and variation by locality. Further, the physiological effects of varying levels of mercury need to be ascertained so that informed management recommendations can be made to reduce the level of mercury consumed by panthers.

This should entail testing prey, particularly non-ungulates, from various locations and seasons within the panthers' habitat (spring raccoon sampling has already been initiated). Additionally, monitored panthers must be carefully assessed for behavioral, reproductive, and pathological changes possibly attributable to elevated mercury levels.

- 8) Every newly instrumented male panther, ≥ 18 months of age, should be recaptured at the end of his first capture season so that semen can be collected for cryopreservation.

Semen is not routinely frozen on the initial immobilization of newly captured males due to the logistics of having the requisite equipment and reagents on site. Securing semen within the first few months after collaring would assure that at least one sample would be preserved should that male die prior to his next scheduled capture, 1-2 years later. Of the 17 males captured at ≥ 18 months, 8 (47%) died within 3-9 months of capture.

- 9) The recapture interval for all previously collared males panthers, ≥ 18 months of age, should be shortened from 2 to 1 year for the purpose of electro-ejaculation and freezing semen. It would probably be necessary to collect and freeze semen approximately 2-3 times to obtain an adequate sample.

The current 2-year re-collaring interval has not been effective for the collection and freezing of semen from males since the majority of them did not survive the recollaring interval; 10 of 17 (56%) males died before their 2 year inter-collaring interval had lapsed. Therefore, good quality semen has been frozen from only 3 males in the past 5 years. A yearly recapture interval would potentially allow us to collect and freeze good quality semen from males who were sterile or had poor quality semen due to immaturity or ill health on their first collection.

- 10) The collection of blood and tissue samples from all panthers for genetic analysis should continue. Investigations of the genetic characteristics of the Florida panthers should be continued.

This will be particularly critical in order to identify familial relationships among individuals that will be important to the captive breeding program and to monitor the genetic health of the population as management actions are taken to mitigate inbreeding.

- 11) The current level of genetic diversity in the population needs to be preserved and stabilized. This can best be accomplished by immediately starting an aggressive captive breeding program that will limit inbreeding and optimally outbreed individuals within the population.

The results of this study indicate that the Florida panther is losing genetic diversity at an alarming rate. A captive breeding program must begin without delay, for the longer it takes to secure the requisite genetic representation in captivity, the more impoverished that representation is apt to be. Since January 1989, 5 of the 16 (31.3%) founders identified in the SSP have died.

- 12) Reproductive technology studies utilizing artificial insemination, gamete and embryo banking, and IVF are essential to augment a successful, timely captive breeding program, and these should be supported. Once these techniques are perfected, genetic representation from the entire population could potentially be obtained by the collection and preservation of gametes from every individual as insurance against loss of the wild population.

The National Zoo has recently successfully produced 3 tiger kittens by IVF and 16 litters of domestic cats by AI. Initial IVF studies on the cougar, indicate that these reproductive techniques hold great promise for use in the Florida panther. There is an easily obtainable source of captive-raised female cougars in Florida to serve as models for the refinement of IVF and AI techniques and to act as surrogate females for Florida panther IVF embryos.

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Table 1. Florida panthers captured, immobilized, or examined between 1981 and 1990.

ID #	SEX	CAPTURE DATE	EST AGE AT CAPTURE	EVENT/LOCATION/COMMENT
<u>PRIVATE LANDS- NORTH: BETWEEN LAKE PLACID AND PALMDALE (GLADES & HIGHLANDS CO)</u>				
# 24	M	01-30-88	3-4 yr	Immobilized; Radio-instrumented, captured on Hendry Ranch, east of SR 27, 15 m. N. of Palmdale, Fl. (Carcass remains collected 8/22/88, died of unknown causes 8/13-16/88)
		08-22-88	3-4 yr	Carcass remains collected consisted of hair and bones; died of unknown causes (probable date of death 8/13-16/88).
<u>PRIVATE LANDS- NORTHWEST: FORT MYERS AND NORTH OF CORKSCREW SWAMP SANCTUARY</u>				
# 28	M	11-29-88	18-24 mo	Hit by car near Ft. Myers International Airport, fractured scapula and head trauma. Transported to Gainesville Veterinary College for treatment (see captive section below).
		03-15-89	22-28 mo	Released to the wild in Corkscrew Swamp Sanctuary.
		03-13-90	3 yr	Attempted capture: inaccessible, private land
		03-16-90	3 yr	Attempted capture: inaccessible, private land
		03-20-90	3 yr	Attempted capture: inaccessible, private land
		05-04-90	3 yr	Attempted capture: inaccessible, private land
N89-64	M	01-25-89	3-4 yr	Hit by car young adult male on SR 850 north of Corkscrew Swamp Sanctuary NW of Immokalee. Cat suffered severe chest trauma with a pneumothorax. Air lifted (via helicopter) to Gainesville Veterinary College for treatment. Cat died of a "shock lung" approximately 12 hrs after initial capture (other ID # are N89-64).
<u>NORTHERN FAKAHATCHEE STRAND, BEAR ISLAND UNIT OF BCNP & ADJACENT PRIVATE LANDS WEST, NORTH, & EAST</u>				
No #	M	01-20-85	Older Ad.	Treed on Barfield lease, not immobilized.
No #	F	02-14-85	Adult	Treed on western boundry of Bear Island off of the Bear Island Grade. A large framed female.
No #	F	03-04-85	Young Ad.	Treed on Barfield lease, probably pregnant.
No #	F	05-04-86	Young Ad.	Treed on Barfield lease, lactating.
# 04	M	01-22-84	10-12 yr	Immobilized; changed collar, very good condition. Near tomato fields just south of SR 856. Has recently moved "full" time north of SR 84 from the Fakahatchee Strand SP (see below).
		04-18-85	11-13 yr	Road-killed SR 84.

Table 1. (continued)

Capture Summary FY 81/90 p.2

ID #	SEX	CAPTURE DATE	EST AGE AT CAPTURE	EVENT/LOCATION/COMMENT
<u>NORTHERN FAKAHATCHEE STRAND & BEAR ISLAND & PRIVATE RANCHES (continued)</u>				
# 05	F	02-23-82	7-8 yr	*Captured, immobilized, and radio-collared. Late pregnancy at time of capture. Apparently aborted or lost the litter. Rebred and birthed June 1982, raised 2 female cubs to at least 16 mos. old. Had buck shot imbedded in skin when captured.
		11-18-83	9-10 yr	Found dead, only hair and bones remaining. Found buck shot in debris similar to the type found in her skin on the original capture.
# 10	M	01-27-87	17-19 mo	Retrieved carcass; cannibalized. He had recently dispersed from his natal site and #09F in the Fakahatchee Strand State Preserve (see below).
# 11	F	01-21-86	4-6 yr	Captured and immobilized on Gilette Tram, in SE Bear Island. Female was making lots of "scrapes" for two days before capture. Became impregnated two weeks post collaring by #12M.
		02-09-87	5-6 yr	Treed; Captured kitten #19 F (sired by #12M)
		01-07-88	6-7 yr	Immobilized; Changed radio-collar, captured on Prices' land east of Sunniland (mother of #19 F), evidence of two un-collared kittens present with her.
		01-27-89	7-8 yr	Treed with collared kitten #29; attempting to locate additional uncollared kittens, none found.
		01-02-90	8-9 yr	Recaptured and collar changed. Captured on the FPNWF. Cat was healthy, but slow to recover due to either age, or additional doses of ketamine. Also, was in last term of pregnancy and apparently aborting (low progesterone) Rebred in end of January and gave birth in late April (D.Maehr).
# 12	M	01-28-86	4-5 yr	Captured, immobilized, and radio-collared on western boundary of Bear Island. One week following capture he was with and impregnated #11F.
		01-31-88	6-7 yr	Immobilized; Changed radio-collar, collect semen for freezing. Sire of #19 F and un-collared kitten(s) of #09 F & #11 F)
		01-08-88	6-7 yr	Treed; near Doctors Hammock NE of Bear Island, looking for un-collared female (see below under Fakahatchee Strand State Preserve).
		01-15-89	7-8 yr	Recaptured and changed collar. Captured on future USF&WS panther refuge land west of SR 29. Collar had been damaged by what looks like a canine puncture through the radio package (possibly by the male that #12 was thought to have killed last summer - #25 M). Cat was distinctly in poorer condition than on previous captures with a rough hair coat and a peculiar disseminated skin disease of undetermined etiology.
		05-05-89	7-8 yr	Treed; race started in the northern end of the Fakahatchee Strand SP hoping it was an uncollared female, trailed cat across SR 84 and captured several miles north of mm 20.

Table 1. (continued)

Capture Summary FY 81/90 p.3

ID #	SEX	CAPTURE DATE	EST AGE AT CAPTURE	EVENT/LOCATION/COMMENT
<u>NORTHERN FAKAHATCHEE STRAND, BEAR ISLAND & PRIVATE RANCHES (continued)</u>				
# 13	M	02-27-86	4-6 yr	Captured, immobilized and radio-collared in NE Bear Island.
		12-16-87	6-8 yr	Killed; Hit-by-car, SR 29, Sunniland. Possibly sired a litter with #19F within one month of his death (4 cubs in litter, radio-collared #30M only).
# 17	M	01-20-87	8-10 yr	Captured, immobilized and radio-instrumented near Gum Swamp on Collier Enterprize land SE of Immokalee, FL.
		01-21-87	8-10 yr	Treed; Searching for a female he was traveling with (captured #18F on 01-22-87)
		01-30-87	8-10 yr	Treed; "Saddie Cypress"
		02-26-87	8-10 yr	Treed; "Nine-Section"
		02-27-87	8-10 yr	Treed; "Saddie Cypress" with #18 F
		01-26-89	10-12 yr	Captured and immobilized to change radio-collar. Captured on Collier property leased by the Noble ranch north of SR 84, mm 38. Ejaculated to collect semen for cryopreservation but sperm concentration and quality was too poor to attempt to freeze. Male was in excellent physical condition the heaviest male to date at 154 lbs (but did have a full stomach).
		02-08-89	10-12 yr	Treed; hunting for uncollared female.
		02-09-89	10-12 yr	Treed; hunting for uncollared female.
		02- -89	10-12 yr	Treed; hunting for uncollared female.
# 18	F	01-22-87	8-10 yr	Immobilized; Radio-instrumented
		02-27-87		Treed; "Saddie Cypress" with #17 M
		01-23-89	10-12 yr	Captured and immobilized for change radio-collar. Captured on Collier property in Gum Swamp area north of SR 858 and east of SR 29 in Hendry Co. Female was apparently in estrus, she had been with #17 M the previous night and had fresh puncture wounds and lacerations in flank.
# 19	F	02-09-87	9 mo	Immobilized; Radio-instrumented (offspring of #11 F & #12 M)
		03-09-87		Treed; Searched for siblings
		11-09-87	18 mo	Immobilized; Changed radio-collar, entered from Prices' property, captured on north edge of Bear Island (offspring of #11 F & #12 M).
		05-03-89	36 mo	Treed; did not capture, tree to high.
		05-04-89	36 mo	Immobilized; Changed radio-collar, captured on Barfield lease of Collier Enterprise Inc. west of SR 29, west of Pistol Pond. Palpated vesicles in uterus, estimated fetuses to be 3 weeks old, was with #12M at that time (offspring of #11 F & #12 M).

Table 1. (continued)

Capture Summary FY 81/90 p.4

ID #	SEX	CAPTURE DATE	EST AGE AT CAPTURE	EVENT/LOCATION/COMMENT
<u>NORTHERN FAKAHATCHEE STRAND, BEAR ISLAND & PRIVATE RANCHES (continued)</u>				
# 19 (cont)	F	02-16-90	3.5 yr	Recaptured and recollared in FPNWR. This cat had been missing for several months due to collar failure. Believed to have kitten in nearby vicinity, so workup cut short.
		05-01-90	4.0 yr	Tracked in an attempt to locate kitten of this cat. Kitten (#43) was found and captured without treeing #19.
# 20	M	03-10-87	3-4 yr	Immobilized; Radio-instrumented
		06-17-87	3-4 yr	Immobilized; "Hit-by-car", removed from wild to Miami Metro Zoo for treatment. See captive section below.
		08-04-87	3-4 yr	Transported from Miami Metro Zoo to private ranch east of Immokalee for release in to the wild.
		08-24-88	4-5 yr	Carcass retrieved 8-24-88 (dead $\leq$ 24 hr), cause of death suspect heart failure related to an atrial septal defect in heart, also had lost considerable weight since released from zoo 12 months prior (138 lbs down to 105 lbs).
# 25	M	02-16-88	3-4 yr	Immobilized; Radio-instrumented, captured on Fred Barfield lease, Collier Property, west of SR 29 and south of Pistol pond (Carcass was retrieved 8/26/88, died 8/24-25/88 septicemia from puncture wounds)
		08-26-88	3-4 yr	Carcass was retrieved 8/26/88, died 8/24-25/88 of septicemia from puncture wounds in paralumbar fossa, abscess extended into peritoneal and pleural cavities.
# 26	M	03-01-88	4-5 yr	Immobilized; Radio-instrumented, captured north of Noble Ranch lease on Seminole Indian Reservation, Hendry Co.
		02- -89	5-7 yr	Treed on Nobles ranch; trying to capture uncollared female in area.
		02-10-90	6-8 yr	Recaptured and recollared on Noble's Lease. Electroejaculated and semen frozen by Drs. Howard and Barone, of the National Zoo. Cat appears in good health.
# 29	M	01-03-89	6 mo	Captured, immobilized and radio-collared in NE Bear Island, BCNP, with mother #11 F. Track data suggest that other siblings exist (sire suspected to be #20 M or possibly #25M).
		05-01-89	11 mo	Recaptured to change radio-collar, still with mother, no evidence of any other siblings.
		02-12-90	20 mo	Recaptured and recollared on Seminole Indian Reservation. Electroejaculated by Drs. Howard and Barone, of the National Zoo. Semen was not of sufficient quality to freeze. Cat appeared to have been in recent fights and had a wound over one carpus and scratches on forelimbs and shoulders.

Table 1. (continued)

Capture Summary FY 81/90 p.5

ID #	SEX	CAPTURE DATE	EST AGE AT CAPTURE	EVENT/LOCATION/COMMENT
<u>NORTHERN FAKAHATCHEE STRAND, BEAR ISLAND & PRIVATE RANCHES (continued)</u>				
# 30	M	01-06-89	9 mo	Captured, immobilized and radio-collared in NE Bear Island, BCNP, with mother #19 F. D. Maehr documented 4 kittens in litter at approx. 4 mos. of age (sire suspected to be #13 M).
		05-02-89	13 mo	Recaptured to change radio-collar, no longer with mother, no evidence of any other siblings in area. Captured to west of Catherine Island road surrounded by many large agricultural fields.
		01-10-90	21 mo	Tracked in Golden Gate area in an attempt to capture. Were not able to catch up to him. Capture attempt abandoned.
		01-29-90	21 mo	Found dead in Fakahatchee Strand State Preserve. Skull crushed by male panther #37 (captured the following day).
# 31	F	01-12-89	8-10 yr	Captured, immobilized and radio-collared on Vernon Roberts lease of Collier lands west of SR 29. Female approx. 55-75 days pregnant.
		03-5->15-89	8-10 yr	Denning behavior via radio-telemetry consistent with the birth of kittens.
		05-02-89	8-10 yr	Treed (unintentional); she was in close proximity to #30M
		01-05-90	9-11 yr	Tracked in an attempt to locate kitten(s) on FPNWR. No kittens found.
		01-08-90	9-11 yr	Treed in an attempt to capture kitten(s). Mother and kittens were all together when chase began. Capture of #34M was successful.
		01-11-90	9-11 yr	Tracked in an attempt to locate additional kitten(s) on FPNWR. No kittens found.
		01-15-90	9-11 yr	Treed with kitten FP #34 M in an attempt to capture a second kitten. Capture was successful, yielding FP #35 M. Believed to have yet another kitten, probably female.
# 32	F	02-03-89	2-2.5 yr	Captured, immobilized and radio-collared. Female approx. 60-80 days pregnant.
		03-05-89	2-2.5 yr	Denning behavior via radio-telemetry consistent with the birth of kittens.
		01-03->04-90	3-4 yr	Tracked both days in an attempt to capture kitten(s) in Florida Panther National Wildlife Refuge and adjacent private ranches. No kittens found.
		01-12-90	3-4 yr	Treed in an attempt to locate kitten(s) on Barfield's Lease, adjacent to FPNWR. No kittens found.
# 33	M	11-23-89	2.5-3 yr	Found dead in SW Hendry Co. on a private ranch. Died of rabies. Had recently moved to this area from the Stair Steeps Unit of BCNP (see below).

Table 1. (continued)

Capture Summary FY 81/90 p.6

ID #	SEX	CAPTURE DATE	EST AGE AT CAPTURE	EVENT/LOCATION/COMMENT
<u>NORTHERN FAKAHATCHEE STRAND, BEAR ISLAND & PRIVATE RANCHES (continued)</u>				
# 34	M	01-08-90	10 mo	Captured and collared in Catherine Island area. Other kitten(s) believed to be nearby. Cat was in good condition (son of #31F).
		05-02-90	14 mo	Treed for recollaring. Tree too high, so capture was cancelled.
		05-03-90	14 mo	Captured and collar changed. He is now separated from his mother, FP #31, but seems to be traveling with another kitten (young female tracks found along with his).
# 35	M	01-15-90	10 mo	Captured and collared in Catherine Island area. Was with mother, FP #31, and brother, FP #34, and possibly another kitten. He may have been bayed on the ground before treeing.
		01-22-90	10 mo	Recaptured and taken to Gainesville. This kitten had not gotten back with its mother, FP #31, or moved any substantial distance since the initial capture on 01-15-90.
		01-23-90	10 mo	Obviously sick panther, abdomen tucked, eyes dull, dehydrated. Immobilized to examine. Noted SQ infection on central abdomen. Started on IV antibiotic.
		01-24-90	10 mo	Condition deteriorating. Immobilized, taken to Vet school for work up. Died under anesthesia. Cause of death severe <u>E. coli</u> septicemia.
# 36	F	01-27-90	3-5 yr	Captured and collared on Noble's Lease. Cat was treed twice, and then bayed on the ground. Suffered minor lacerations on hind quarters. Appeared to be either very full from nearby kill, or pregnant. Palpation was inconclusive.
# 40	F	02-26-90	1.5-2 yr	Captured and collared on Noble's Lease. Cat is believed to have been with FP#17 M recently. She had scratches on hind quarters, but otherwise in good condition.
# 41	F	02-28-90	1.5-2 yr	Captured and collared on Noble's Lease. Cat was with FP#17 M when chase began. Some scratches evident on hind quarters. Cat otherwise in good health.
# 43	M	05-01-90	10 mo	Captured and collared in FPMWR. Kitten was still with his mother (#19), and appeared in good condition.

FAKAHATCHEE STRAND STATE PRESERVE AND "THE BLOCKS" TO THE WEST

# 01	M	02-10-81	10-12 yr	Captured, immobilized, and radio-collared. Radio malfunctioned approx. 3 months later, cat was lost to follow up.
		12-16-83	13-15 yr	Road-killed, SR 84 mm18.

Table 1. (continued)

Capture Summary FY 81/90 p.7

ID #	SEX	CAPTURE DATE	EST AGE AT CAPTURE	EVENT/LOCATION/COMMENT
<u>FAKAHATCHEE STRAND STATE PRESERVE</u> (continued)				
# 02	M	02-20-81	10-12 yr	Captured, immobilized, and radio-collared.
		01-26-82	11-13 yr	Immobilized to change collar.
		01-29-83	12-14 yr	Immobilized to change collar.
		01-27-84	13-15 yr	Treed; not immobilized, inaccessible so could not evaluate
		01-31-84	13-15 yr	Treed; was in very poor health, did not immobilize.
		10-27-83	14-16 yr	Found dead; had been killed and cannibalized by a panther, probably #07 M who had recently moved into the FSSP.
# 03	F	01-23-82	8-9+ yr	Captured, immobilized, and radio-collared.
		01-17-83	9-10+ yr	Died during immobilization, assume adverse drug reaction. Very lean body condition.
# 04	M	01-27-82	7-8 yr	Captured, immobilized, and radio-collared.
		01-29-83	8-9 yr	Immobilized to change collar.
		01-22-84	9-10 yr	Captured in N.Fakahatchee strand (see above)
# 07	M	01-26-85	9-10 yr	Captured and immobilized. Captured with #09F, in the same tree! Had been previously radio-collared in the eastern Raccoon Point Unit of the BCNP but the radio malfunctioned and the cat was lost to follow up on 05-30-85.
		10-28-85	10-11 yr	Road-killed, SR 29.
# 08	F	03-25-84	8-10 yr	Captured, immobilized, and radio-collared. Collar malfunctioned in Dec. 1984, lost cat until 02-21-85.
		02-21-85	9-11 yr	Immobilized and changed collar. Possibly had had kittens in winter of 84/85, nipples enlarged, abdomen slack and she was in poor condition.
		01-13-86	10-12 yr	Immobilized and changed collar. In poor physical condition.
		04-13-87	11-13 yr	Immobilized; Removed from wild because of poor physical condition and lack of documented reproduction since 1984 (see captive section below).
# 09	F	01-26-85	3-5 yr	Captured, immobilized, and radio-collared. Captured with #07M in the same tree.
		02-04-86	4-6 yr	Immobilized to change collar. Gave birth in May 1985 in "The Blocks" to a litter sired by either #07M or #04M. One surviving kitten captured on 01-15-86, #10M.
		01-08-87	4-6 yr	Immobilized to change collar; discovered fractured, infected rear foot due to gun shot injury. Removed to Miami Metro Zoo for treatment. Pregnant with 3 fetuses approx. 45 days developed. Aborted on 01-24-87 at the Zoo.
		02-10-87	4-6 yr	Foot repaired, transported and released to wild in the FSSP.
		03-30-87	4-6 yr	Treed; Examine physical condition after release from Zoo. With male (#12M) approx. 6 weeks after aborted, litter was born 6/87.

Table 1. (continued)

Capture Summary FY 81/90 p.8

ID #	SEX	CAPTURE DATE	EST AGE AT CAPTURE	EVENT/LOCATION/COMMENT
<u>FAKAHATCHEE STRAND STATE PRESERVE (continued)</u>				
# 09 (con't)	F	10-31-88	6-7 yr	Immobilized to change radio-collar. It was hoped that kittens born to this female in June of 1987 would still be with her at this time for capture, however we were unsuccessful in locating and capturing any surviving sub-adults.
		01-06-90	8-9 yr	Treed in an attempt to locate possible kittens from this cat. No kittens found.
		03-14-90	8-9 yr	Immobilized and collar changed. Cat was in good condition and had just killed a deer kill. Pregnant from FP#37M (D.Maehr)
# 10	M	01-15-86	5-7 mos	Captured, immobilized, and radio-collared in the northern Blocks. Offspring of #09F and #04M or #07M.
		02-04-86	5-7 mos	Treed; hunting for siblings, none found
		02-26-86	6-8 mos	Treed; hunting for siblings, none found
		05-05-86	9-11 mos	Immobilized to change radio-collar.
		01-27-87	17-19 mos	Found dead on Barfield's lease west of Pistol Pond. Had been killed by male panther, probably #12M. He had dispersed from #09 in approx. 12/86 and moved north of SR 84 5-7 miles.
# 37	M	01-30-90	3-4 yr	Captured and collared. This cat is believed to have killed FP #30 M and he was caught the day following #30's death and in approximately the same area. Had a very heavy tick load, but otherwise in good health.
<u>RACCOON POINT UNIT OF BIG CYPRESS NATIONAL PRESERVE</u>				
No #	F	03-10-84	10+ yr	Treed; but did not immobilize the "North Road Female" due to very poor physical condition.
# 06	M	02-27-82	6-7 yr	Captured, immobilized, and radio-collared. Cat did not move very much in 6 weeks following capture.
		04-16-82	6-7 yr	Found dead, cause of death "blunt trauma".
# 07	M	03-02-82	6-7 yr	Captured, immobilized, and radio-collared. Cat had a huge home range (400+ sq. miles, R.Belden) and utilized the water conservation areas 3A & 3B.
		03-27-83	7-8 yr	Immobilized to change collar. Radio malfunctioned in May 1983, cat was lost to follow up until 01-26-85 when he was captured in the FSSP, 60+ miles west. (see FSSP above).
# 38	F	02-08-90	3-5 yr	Captured and collared in BCNP, N.W. of Raccoon Point. Cat treed approximately 1:30 p.m., but not darted until approximately 5:30 p.m. Cat in good condition, and had moved by next morning. This cat's home range is over 900 sq.kilometers (!) and includes the Water Conservation Area 3A (D. Jansen).

Table 1. (continued)

Capture Summary FY 81/90 p.9

ID #	SEX	CAPTURE DATE	EST AGE AT CAPTURE	EVENT/LOCATION/COMMENT
<u>STAIR STEEPS UNIT OF BIG CYPRESS NATIONAL PRESERVE</u>				
# 33	M	03-05-89	2-2.5 yr	Captured, immobilized, and radio-collared. Cat utilized the SS and Loop units south of Hwy 41 until approx. Aug. 1989 when he moved north along the east side of Turner River Road to Bear Island and the private ranches to the north. He made this move in a matter of days.
		11-23-89	2.5-3 yr	Found dead; Rabid, died in SW Hendry Co.
<u>EVERGLADES NATIONAL PARK, EAST EVERGLADES AND PRIVATE LAND TO THE EAST</u>				
# 14	F	12-06-86	4-5 yr	Immobilized; Radio-instrumented (Mother of #16 M & #21 F)
		12- -86	4-5 yr	Treed; looking for kittens
		12- -86	4-5 yr	Walked across road with 2 kittens
		12- -86	4-5 yr	Treed; looking for kittens
		01-12-87	4-5 yr	Treed; captured kitten #16 M
		01-13-87	4-5 yr	Treed; looking for F kitten
		01-16-87	4-5 yr	Treed; looking for F kitten
		05- -87	4.5-5.5 yr	Treed; looking for adult male
		06- -87	4.5-5.5 yr	Treed; looking for adult male
		04-09-88	5.5-6.5 yr	Treed; Abort immobilization, tree too high
		04-11-88	5.5-6.5 yr	Immobilized; Changed Radio-collar.
		03-20->24-89	7-8 yr	Suspect denning behavior based on radio-telemetry data (O. Bass), she was with #16M 12-20->22-88.
		02-22-90	8-9 yr	Recaptured and collar changed. Cat was traveling with kitten, but dogs unable to tree both animals. Cat appeared in good condition.
		03-06-90	8-9 yr	Tracked; kitten (#42) treed and captured. #14 stayed nearby the entire time. A second documented kitten has disappeared between January and March, 1990 (O.Bass).
# 15	F	12-13-86	4-5 yr	Immobilized; Radio-instrumented (Mother of #22 & #23 F)
		12- -86	4-5 yr	Saw female with one small kitten
		01-14-86	4-5 yr	Treed; looking for kittens
		01-16-87	4-5 yr	Treed; hunting for kittens
		03-17-87	4-5 yr	Treed; hunting for kittens (400 h)
		04-07-87	4.5-5.5 yr	Immobilized; removed to captivity
		04-09-87	4.5-5.5 yr	Immobilized; returned to the wild
		05-27-87	4.5-5.5 yr	Treed; examine kitten collars
		06-15-87	4.5-5.5 yr	Treed; hunting for #22
		06-16-87	4.5-5.5 yr	Immobilized; Transported and released
		02-14-88	5-6 yr	S. Bass visualized her with #16 M
		05- -88	5.5-6.5 yr	S. Bass reports behavior change indicative of denning & cubbing
		06-10-88	5.5-6.5 yr	Found dead: Had been lactating; aggressive encounter with toxemia- bite wounds and hemorrhage on forearm and brisket.

Table 1. (continued)

Capture Summary FY 81/90 p.10

ID #	SEX	CAPTURE DATE	EST AGE AT CAPTURE	EVENT/LOCATION/COMMENT
<u>EVERGLADES NATIONAL PARK, EAST EVERGLADES AND PRIVATE LAND TO THE EAST (continued)</u>				
# 16	M	12- -86		Treed; in <u>Schynus</u> (offspring of #14 F, sib of #21 F)
		01-12-87	16-22 mo	Immobilized; Radio-instrumented (Note age diff. to sib #21)
		03-16-87	18-24 mo	Treed; Captured sibling #21 F
		05-25-87	20-26 mo	Treed; Examined fit of collar
		02-02-88	28-34 mo	Immobilized; Changed radio-collar, collect (2 1/2 yr) semen for freezing. Captured east of ENP boundary, north of Homestead Airport
		02-14-88	28-34 mo	S. Bass visualized this male with #15 F; impregnated her.
		03-30-88	29-34 mo	Treed; looking for un-collared female
		04-07-89	3-4 yr	Treed; hunting for uncollared panther.
		02-21-90	4-5 yr	Recaptured and recollared near Chekika State Park. Cat was in good condition. Electroejaculation performed by Dr. Mark Barone, no spermatozoon found.
# 21	F	12- -86		Treed; in <u>Schynus</u> (offspring of #14 F, sib of #16 M)
		03-16-87	14-16 mo	Immobilized; Radio-instrumented (Note age diff. to sib #16).
		06-14-87	17-20 mo	Treed; Examine fit of collar
		07-23-88	30-36 mo	"Hit-by-car" SE Homestead, fractured femur, (2.5-3 yr) evacuated to Gainesville, FL. Veterinary School for internal plate fixation- see captive section below.
# 22	F	03-18-87	6-7 mo	Immobilized; Radio-instrumented (offspring of #15 F, sib of #22 F)
		04-07-87	7-8 mo	Immobilized; Removed from wild
		04-09-87	7-8 mo	Immobilized; Returned to wild
		05-27-87	8-9 mo	Treed; Examine fit of collar
		06-15-87	9-10 mo	Immobilized; Removed from wild
		06-16-87	9-10 mo	Immobilized; Returned to wild
		03-24-88	18 mo	Immobilized; Changed radio-collar (offspring of #15 F, sib of #23 F)
		03-13-89	2.5-3.5 yr	Treed but not immobilized, looked to be in good physical.
		03-20-89	2.5-3.5 yr	Radio-collar signal malfunctioned and/or disappeared while cat was on the eastern boundary line of the ENP. Neither cat nor sign of her was found during the following 5 weeks despite intensive field searching. The possibility exists that cat was killed and the collar destroyed.
		Feb/Mar-90		Six weeks of hunting found no sign of this female. One sighting of a collared cat with no other radio signals in the area may indicate she is still alive.
# 23	F	03-18-87	6-7 mo	Immobilized; Radio-instrumented Resulted in orphaning (offspring of #15 F, sib of #22 F)

Table 1. (continued)

Capture Summary FY 81/90 p.11

ID #	SEX	CAPTURE DATE	EST AGE AT CAPTURE	EVENT/LOCATION/COMMENT
<u>EVERGLADES NATIONAL PARK, EAST EVERGLADES AND PRIVATE LAND TO THE EAST (continued)</u>				
# 23 (cont)	F	03-28-87	6-7 mo	Immobilized; Removed from wild, held and rehabilitated at ENP
		04-09-87	7-8 mo	Immobilized; Returned to wild, successfully reunited with family
		05-27-87	8-9 mo	Treed mother & sib; Examine fit of sib's collar, resulted in orphaning
		05-31-87	8-9 mo	Treed; Aborted capture
		06-01-87	8-9 mo	Immobilized; Removed from wild, rehabilitated at ENP
		06-16-87	9-10 mo	Immobilized; Returned to wild. Failed attempt to reunite family
		06-22-87	9-10 mo	Immobilized; Removed from wild due to orphaning from mother (see 1987/87). Held in captivity at White Oak Plantation for 11 months (see captive section below)
		05-14-88	20-21 mo	Released back into Everglades National Park
		06-22-88	21-22 mo	Immobilized; Removed from the wild, stranded on island in Shark River Slough for 13 days after water "came-up" and she was in very poor physical condition. Evacuated to Gainesville for treatment. See captivity section below.
		02-23-89	30-31 mo	Released into the wild near the Research Station in Hole-in-the-Donut. She was in excellent physical condition and in estrus at the time of her release.
		04-22-89	32-33 mo	Treed to examine condition after 8 weeks in the wild. She has apparently been living on raccoons in the mangrove edge and looks in very good condition.
		02-19-90	3.5 yr	Recaptured and recollared in Hole-in-the-donut area of ENP. Cat darted in low tree; jumped and ran, and found asleep on ground. Believed to be pregnant by #16M; nipples swollen, progesterone level high, no litter produced. Rebred with #16M in April, denning in mid-July (D. Jansen).
# 27	F	04-11-88	2-3 yr	Immobilized; Radio-instrumented, new animal captured just east of ENP east boundary, north of Pine Island, very small female.
		07-23-89	3-4 yr	Found dead in middle of Shark River Slough about 2.5 miles s. of Hwy 41. Had apparently been moving normally until her death. Good physical condition at death. Cause of death high probability of mercury toxicosis.
# 39	M	02-19-90	3-4 yr	Captured and collared. Cat appeared healthy. Electroejaculation and semen freezing performed by Dr. Mark Barone of the National Zoo.
		06-18-90	3-4 yr	Dead. Found in a nest of sawgrass, a few miles from initial capture site. Cat had not moved significantly for approximately 14 days, but had died during the night before he was to be captured and examined. Animal was dehydrated, emaciated, and pus was found in chest. Cause of death was pyothorax from a penetrating chest wound; found pieces of saw grass in thorax.

Table 1. (continued)

Capture Summary FY 81/90 p.12

ID #	SEX	CAPTURE DATE	EST AGE AT CAPTURE	EVENT/LOCATION/COMMENT
<u>EVERGLADES NATIONAL PARK, EAST EVERGLADES AND PRIVATE LAND TO THE EAST (continued)</u>				
# 42	M	03-06-90	10 mo	Captured and collared. Kitten was still with mother (#14). Appeared to be in good condition. No siblings found.
No #	F	04-02-87	18-26 mo	Treed; Did not radio-instrument
<u>CAPTIVITY: MIAMI METRO ZOO FOR TREATMENT AND REHABILITATION</u>				
# 09	F	01-08-87	4-6 yr	Immobilized to change collar in the Fakahatchee Strand State Preserve; discovered fractured, infected rear foot due to gun shot injury. Removed to Miami Metro Zoo for treatment.
		01-14-87	4-6 yr	Immobilized; Changed bandages, 3 fetuses identified with ultrasound
		01-20-87	4-6 yr	Immobilized; Changed bandages
		01-24-87	4-6 yr	Aborted fetuses
		01-25-87	4-6 yr	Immobilized; Changed bandages, Confirmed abortion with ultrasound
		01-31-87	4-6 yr	Immobilized; Changed bandages
		02-05-87	4-6 yr	Immobilized; Changed bandages
		02-10-87	4-6 yr	Transported and released to wild in the FSSP
# 20	M	06-17-87	3-4 yr	Immobilized; "Hit-by-car", removed from wild to Miami Metro Zoo for treatment. Forelimbs badly abraided, skin devitalized and eventually sloughed.
		06-23-87	3-4 yr	Immobilized; Debrided wounds, changed bandages, and treated severe dehydration
		06-28-87	3-4 yr	Immobilized; Treated wounds
		07-02-87	3-4 yr	Immobilized; Treated wounds
		07-06-87	3-4 yr	Immobilized; Treated wounds, performed dentistry, evaluated cardiac problem
		07-10-87	3-4 yr	Immobilized; Treated wounds and performed dentistry
		07-14-87	3-4 yr	Immobilized; Plastic surgery to close skin defect
		07-20-87	3-4 yr	Immobilized; Treated wounds
		07-27-87	3-4 yr	Immobilized; Treated wounds
		08-04-87	3-4 yr	Transported from Miami Metro Zoo to private ranch east of Immokalee for release in to the wild.
<u>CAPTIVITY: WHITE OAK PLANTATION & WILDLIFE RESEARCH LABORATORY AT GAINESVILLE</u>				
PCO 10	M	11-2-84	3-5 yr	Hit by car, SR 41 2 miles east of Ochopee, FL. Surgical repair and treatment of bilaterally fractured femurs plus 3 metatarsals at the College of Veterinary Medicine in Gainesville, FL.
		12-23-84	3-5 yr	Transferred to GFC research lab for rehabilitation.
		06-01-86	4.5-6.5 yr	Transferred to White Oak Plantation, Yulee, FL.

ID #	SEX	CAPTURE DATE	EST AGE AT CAPTURE	EVENT/LOCATION/COMMENT
<u>CAPTIVITY: WHITE OAK PLANTATION & WILDLIFE RESEARCH LABORATORY AT GAINESVILLE (continued)</u>				
PCO 10 (con't)		06-02-88	6.5-8.5 yr	Immobilized; semen collection and reproductive evaluation, semen used for <u>in vitro</u> fertilization project
		07-24-88	6.5-8.5 yr	Immobilized; Collected blood for transfusion for injured Florida panther #21 F
		01-15-90	8-10 yr	Immobilized; Semen evaluation, had bred recently with Texas #08F.
# 08	F	04-13-87	11-13 yr	Immobilized; Removed from Fakahatchee Strand State Preserve, underweight, anemic, non-reproductive in the wild since 1984.
		04-27-87	11-13 yr	Immobilized; health check
		05-18-87	11-13 yr	Immobilized; health check
		06-08-87	12-14 yr	Immobilized; post quarantine exam
		08-10-87	12-14 yr	Immobilized; vaginal exam
		09-02-87	12-14 yr	Immobilized; Laparotomy to evaluate reproductive system at Veterinary School
		11-01-87	12-14 yr	Transported to White Oak Plantation
		06-01-88	13-15 yr	Immobilized; Laparoscopy to evaluate ovarian response to hormone injections; no response
		08-20-88	13-15 yr	Died suddenly after 4 days of inappetence; cause of death kidney, liver and hyperthyroid disease.
# 21	F	07-23-88	30-36 mo	"Hit-by-car" SE Homestead, fractured femur. Captured, transported, and stabilized at Miami Metro Zoo overnight.
		07-24-88	30-36 mo	Evacuated to Gainesville, Fl. Veterinary School for treatment.
		07-25-88	30-36 mo	Immobilized; surgical repair of left femur with circlage wire and indwelling stainless steel plate
		07-29-88	30-36 mo	Moved from WMH to GFC research lab
		08-03-88	30-36 mo	Immobilized; treat decubital ulcer on L hip
		08-19-88	31-36 mo	Immobilized; treat decubital ulcer on hip
		10-21-88	33-39 mo	Immobilized; transported to WMH for radiographs to evaluate bone healing.
		12-29-88	3-3.5 yr	Immobilized; transported to WMH for radiographs to evaluate bone healing. There were still open fracture lines at this time.
		05-23-89	3.5-4 yr	Immobilized; draw blood for pre-surgical evaluation.
		06-07-89	3.5-4 yr	Immobilized; transported to WMH for radiographs to evaluate bone healing. Surgical removal of indwelling plate. Will be rechecked in 6 weeks at which time we will consider transferring her to White Oak Plantation.
		06-12-89	3.5-4 yr	Surgical incision dehissed. Immobilized to resuture and install drains.
		06-14-89	3.5-4 yr	Cat has worked distal portion of incision open again. Immobilized, used stainless steel sutures to close the wound to make it harder for the cat to remove.

Table 1. (continued)

Capture Summary FY 81/90 p.14

ID #	SEX	CAPTURE DATE	EST AGE AT CAPTURE	EVENT/LOCATION/COMMENT
<u>CAPTIVITY: WHITE OAK PLANTATION & WILDLIFE RESEARCH LABORATORY AT GAINESVILLE (continued)</u>				
# 21 (con't)	F	08-00-89	3.5-4 yr	Immobilized; transported to VMTH for radiographs of femur, not ready to be moved to WOP yet.
		12-00-89	4-4.5 yr	Immobilized; transport the VMTH for radiographs, bone has healed enough to move to WOP.
		01-00-90	4-4.5 yr	Transported to WOP. Came into estrus approximately 6 weeks after arrival at WOP.
# 23	F	06-22-87	9-10 mo	Immobilized; Removed from wild due to orphaning from mother, offspring of #15 F, sib of #22 F. Held at ENP for vaccinations and quarantine before transferring to WOP.
		08- -87	11-12 mo	Moved from ENP to White Oak Plantation.
		02-07-88	17-18 mo	Immobilized; lame, radiographs revealed healing fracture on radius
		05-12-88	20-21 mo	Immobilized; crated for return to the wild
		05-14-88	20-21 mo	Released back into Everglades National Park
		06-22-88	21-22 mo	Immobilized; Removed from the wild, stranded on island in Shark River Slough for 13 days after water "came-up" and in very poor physical condition. Evacuated to Gainesville for treatment.
		10-21-88	25-26 mo	Immobilized, transported to VMTH for radiographs of forelimbs (carpal deviation).
		11-05-88	26-27 mo	Immobilized; transported to White Oak Plantation. She was having her first documented estrus cycle at that time (vaginal smears agree with serum estrogen level and behavior).
		02-06-89	30-31 mo	Immobilized to draw blood for FIP screen.
		02-22-89	30-31 mo	Transported from White Oak Plantation to Everglades National Park.
		02-23-89	30-31 mo	Released into the wild near the Research Station in Hole-in-the-Donut. She was in excellent physical condition and in estrus at the time of her release. (Saga continues-see ENP wild section above)
# 28	M	11-30-88	18-24 mo	Hit by car near Ft. Myers International Airport, fractured scapula and head trauma. Transported to Gainesville Veterinary College for treatment.
		12-05-88	18-24 mo	Moved from VMTH to GFC Research Lab.
		12-30-88	19-25 mo	Immobilized, transported to VMTH for radiographs to evaluate bone healing.
		03-11-89	22-28 mo	Immobilized for semen collection and evaluation.
		03-13-89	22-28 mo	Immobilized and transported to VMTH for radiographs to evaluate healing of scapula prior to release to the wild.
		03-14-89	22-28 mo	Immobilization for transport.
		03-15-89	22-28 mo	Release to the wild on Corkscrew Swamp Sanctuary.

Table 2. Body weights, physical condition, reproductive status and select hematology values for panthers grouped by capture location handled in 1989/90.

LOCATION ^A	SEX/ ID#	AGE	DATE	WEIGHT	CONDITION ^B	PCV/HGB ^B	REPRO ^B
I-ACQ	#26	M-A	02-10-90	130 lbs	I	40.8/13.1	+/1/?
	#36	F-A	01-27-90	108 lbs	I	37.6/12.5	?/?
	#40	F-SA	02-26-90	65 lbs	I	38.2/11.7	0/N
	#41	F-SA	02-28-90	61 lbs	I	45.7/14.1	0/N
I-SIR	#29	M-A	02-12-90	101 lbs	II	39.0/12.4	+/1/?
I-N.FS	#11	F-A	01-02-90	88 lbs	II	35.7/11.7	1/Y
	#19	F-A	02-16-90	78 lbs	II	42.4/12.9	2/N
	#34	M-J	01-08-90	62 lbs	I	36.5/11.4	?/1/?
			05-03-90	68 lbs	II	35.7/11.8	?/1/?
	#35	M-J	01-15-90	52 lbs	II	34.4/10.9	?/1/?
			01-22-90	45 lbs	III	33.4/10.8	?/1/?
	#43	M-J	05-01-90	54 lbs	II	35.4/11.6	?/1/?
I-S.FS	#09	F-A	03-14-90	86 lbs	I	33.5/12.4	0/Y
	#37	M-A	01-30-90	102 lbs	II	35.3/10.7	+/2/?
I-RP/BCNP	#38	F-A	02-08-90	98 lbs	I	46.8/13.4	?/N
II-ENP	#14	F-A	02-22-90	83 lbs	II	29.1/9.9	1/N
	#16	M-A	02-21-90	104 lbs	II	29.9/9.7	-/2/Y
	#23	F-A	02-19-90	55 lbs	II	31.9/10.0	0/N
	#39	M-A	02-19-90	102 lbs	II	38.1/12.0	+/2/?
	#42	M-J	03-06-90	60 lbs	II	35.8/11.5	?/2/?

^AI- Big Cypress Swamp ecosystem; II- Everglades ecosystem. ACQ- BCNP acquisition land, currently privately owned (Nobels' lease); ENP - Everglades National Park; N.FS- northern Fakahatchee strand, includes Catherine Island; S.FS- southern Fakahatchee strand; RP/BCNP - Racoon Point; SIR - Seminole Indian Reservation.

^BSee footnotes of Tables 3 & 4.

Table 3. Body weights of male Florida panthers, 1978-90.

Location	ID#	Date	Age	Body WT ^A	Phys Cond ^B	HGB/PCV ^C	Repro ^D
Fisheating Creek Glades Co.	#24	30Jan88	3-4 yr	126	I	14.5/41.7	?/2/?
	G83-22	01Mar83 ^E	24-30 mo	117	II	ND	-/1+/?/
Ft. Myers & Corkscrew Swamp Lee Co.	#28	29Nov88	18-24 mo	93	I	11.1/33.8	?/1/?
	N89-64	25Jan89	3-4 yr	110	II	ND	+/1/?
Private Ranches East of Immokalee	#17	20Jan87	8-10 yr	142	I	14.8/45.1	?/2/?
		26Jan89	10-12 yr	154	I	11.8/36.5	-/2/?
	#20	10Mar87	3-4 yr	148	I ⁺	17.2/48.7	?/1/?
		17Jun87 ^E	3.5-4.5 y	134	I	14.8/43.9	+/1/?
		24Aug88 ^F	4.5-5.5 y	105 ^I	III ^I	ND	+/1/?
	PCO 185	18Jun90 ^F	10-12 mo	70 ^J	I	ND	?/1/?
Northern Fakahatchee Strand, Bear Island Unit of BCNP and Adjacent Private Ranches Collier County	#01	14Dec83 ^E	13-15 yr	124	II	ND	?/2/?
	#04	22Jan84	9-10 yr	132	I	16.0/42.0	?/1/?
		18Apr85 ^E	10-11 yr	130	I	ND	+/1/?
	#12	28Jan86	4-5 yr	122	I	14.3/41.0	+/1/Y
		31Jan88	6-7 yr	124	II	12.0/34.8	+/1/Y
		15Jan89	7-8 yr	120	II-	12.7/40.3	+/1/Y
	#13	27Feb86	4-6 yr	126	I	17.0/47.3	+/2/?
		16Dec87 ^E	6-8 yr		I	ND	?/2/Y
	G80-15	07Feb80	18-30 mo	111	I	ND	?
	#25	16Feb88	3-4 yr	121	I	13.6/39.7	?/2/?
		24Aug88 ^F	3.5-4.5 y		I	ND	+/2/?
	#26	01Mar88	4-5 yr	125	I	15.1/45.5	+/1/?
		10Feb90	6-7 yr	130	I	13.1/40.8	+/1/?
	#29	03Jan89	6 mo	44	II	13.5/43.7	?/1/I
		01May89	11.5 mo	76	II	12.7/38.8	?/1/I
		12Feb90	20 mo	101	I	12.4/39.0	+/1/?
	#30	06Jan89	9-10 mo	55	II	12.0/32.8	?/1/I
		02May89	13-14 mo	75	II	11.6/35.1	?/1/I
		01Jan90	21-22 mo		II	ND	+/1/?
	#33	11Nov89	2.5-3.5 yr		I	ND	+/2/?
	#34	08Jan90	10 mo	62	I	11.4/36.5	?/1/I
		03May90	14 mo	68	II	11.8/35.7	?/1/I
	#35	15Jan90	10 mo	52	II	10.9/34.4	?/1/I
		22Jan90	10 mo	45	III	10.8/33.4	?/1/I
	#43	01May90	10 mo	54	II	11.6/35.4	?/1/I
Fakahatchee Strand State Preserve and Adjacent Southern Golden Gate Estates, Collier Co.	#01	10Feb81	10-12 yr	120	II	ND	?/2/?
	#02	20Feb81	10-12 yr	108	II	ND	?/2/?
		26Jan82	11-13 yr	107	II	ND	?/2/?
		29Jan83	12-14 yr	117	II	14.5/44.0	?/2/?
		30Jan84	13-15 yr	80 ^J	IV	ND	?/2/?

Table 3. (continued)

Body Wt. - Males p.2

Location	ID#	Date	Age	Body WT ^A	Phys Cond ^B	HGB/PCV ^C	Repro ^D
FSSP and GGE cont'd	#04	27Jan82	7-8 yr	113	I	ND	?/1/?
		29Jan83	8-9 yr	106	II	9.7/30.4	?/1/?
	#07	26Jan85	9-10 yr	120	I	14.5/42.3	+/2/?
		28Oct85 ^E	10-11 yr	122	I	ND	-/2/?
	#10	13Jan86	5-7 mo	34	III	11.3/30.0	?/1/I
		02May86	9-11 mo	55	II	12.9/35.0	?/2/I
	#37	30Jan90	3-4 yr	102	II	10.7/35.3	+/2/Y
Big Cypress National Preserve South of SR 84 Collier & Monroe Co.	#06	27Feb82	6-7 yr	122	II	ND	?/2/?
	#07	02Mar82	6-7 yr	122	II	ND	?/2/?
		27Mar83	7-8 yr	114	II	ND	?/2/?
	G78-65	08Mar78 ^H	18-30 mo	97	ND	ND	?
	#33	05Mar89	24-30 mo	92	II	10.5/32.7	+/2/?
	PCO 10	02Nov84 ^E	3-5 yr	115 ^J	II	8.3/19.4	?/2/?
Everglades National Park Dade Co.	#16	12Jan87	16-22 mo	84	II*	13.1/38.0	+/2/?
		02Feb88	28-34 mo	86	III	12.0/33.9	+/2/?
		21Feb90	4.5-5 yr	104	II	9.7/29.9	-/2/Y
	#39	19Feb90	3-4 yr	102	II	12.0/38.1	+/2/?
		18Jun98 ^K	3-4 yr		IV	ND	+/2/?
	#42	06Mar90	10 mo	60	II	11.5/35.8	?/2/?

^APounds (lbs.);^BPhysical condition score: I-Excellent, II-Good, III-Poor, IV-Grave;^CHemoglobin (gms/100ml) PCV = packed cell volume;^DReproductive status; results of semen evaluation (+ = fertile, - = sterile, ? = unknown)/number of descended testicles/documentated reproduction (Y - known sire, S = suspected sire, ? = unknown, I = immature).^EHit by car;^FDied-congenital anomaly;^GDied-intraspecific aggression;^HIllegally killed;^I10+% dehydrated;^JEstimated wt.^KDied-pyothorax

Table 4. Body weights of female Florida panthers, 1980-90.

Location	ID#	Date	Age	Body WT ^A	Phys Cond ^B	HGB/PCV ^C	Repro ^D
Private Ranches							
East of Immokalee Hendry Co.	#18	22Jan87	8-10 yr	100	I	12.7/48.1	None Doc
		23JAN89	10-12 yr	85	I	13.8/41.2	None Doc
Northern Fakahatchee Strand, Bear Island (BCNP) & Adjacent Ranches Collier Co.	#05	23Feb82	7-8 yr	99 ^I	I	ND	PG80 ⁺ days
		G80-04 23Dec79 ^F	18-30 mo	68	ND	ND	Unknown
	#11	21Jan86	5-6 yr	92 ^J	I-	10.4/25.6	None Doc
		07Jan88	7-9 yr	91	II	12.0/34.8	2-3CBS/20m
		02Jan90	9-11 yr	88	II	11.7/35.7	1CB/20m; PG-60d Abort
	#19	09Feb87	9 mo	49	II	12.7/27.1	Immature
		09Nov87	18 mo	70	II	11.2/34.2	Immature
		04MAY89	36 mo	75-80	II	12.3/37.4	1+?CBS/13m; PG24days
		16Feb90	4 yr	78	II	12.9/42.4	1+?CBS/7m
		#31 12Jan89	8-10 yr	70	II	12.6/38.5	PG
	#32	03FEB89	24-30 mo	79	II	10.7/36.8	PG
	#36	27Jan90	3-5 yr	108	I	12.5/37.6	?PG
	#40	26Feb90	1.5-2 yr	65	I	11.7/38.2	None Doc
	#41	28Feb90	1.5-2 yr	61	I	14.1/45.7	None Doc
Fakahatchee Strand State Preserve and Adjacent Southern Golden Gate Estates Collier Co.	#03	22Jan82	8-9 yr	68	III	ND	None Doc
		17Jan83 ^F	9-10 yr	70	III	ND	SUSP PG ¹
	#08	25Mar84	8-10 yr	72	II	13.9/33.1	None Doc
		21Feb85	9-11 yr	70	III	11.2/27.9	SUSP PG ²
		13Jan86	10-12 yr	72	III	9.1/24.8	None Doc
	#09	13Apr87	11-13 yr	66	IV ⁺	12.0/33.5	None Doc
		26Jan85	3-4 yr	77	II	11.8/30.6	None Doc
		08Jan87	5-6 yr	76	II	13.9/32.5	PG45 days
		31Oct88	7-9 yr	80 ^K	II	12.5/37.0	SUSP PG ¹
		14Mar90	9-11 yr	86	I	12.4/33.5	PG
	G81-19	19Apr81 ^E	24-36 mo	85 ^I	I	ND	PG80 ⁺ days
		PC059 13Nov86 ^E	7-9 yr	70 ^I	II	ND	SUSP PG ²
Eastern Big Cypress National Preserve (BCNP) Collier Co.	NRoad #38	10Mar84	8-10 yr	60 ^I	IV	ND	None Doc
		08Feb90	3-4 yr	98	I	13.4/46.8	None Doc

Table 4. cont.

Body Wt. Females pg. 2

Location	ID#	Date	Age	Body WT ^A	Phys Cond ^B	HGB/PCV ^C	Repro ^D
Everglades National Park Dade Co.	#14	07Dec86	4-5 yr	71	II	13.7/35.4	2CBS/16m
		11Apr88	5-6 yr	85	II	12.7/36.6	None Doc
		22Feb90	7-8 yr	83	II	9.9/29.1	1+?CBS/9m
	#15	13Dec86	4-5 yr	72	II	12.9/36.2	2CBS/3-5
		07Apr87	4-5 yr	74 ^L	II	11.0/33.8	2CBS/7-9
		13Jun87	4-5 yr	76	II	10.3/30.1	2CBS/9-11
		10Jun88 ^G	5-6 yr	75	II	ND	SUSP PG ^{I2}
		16Mar87	14-18 mo	56	II	10.9/31.8	Immature
	#21	23Jul88 ^F	30-34 mo	62	II	7.8/26.0	None Doc
		18Mar87	6-8 mo	33	II	15.7/43.3	Immature
	#22	07Apr87	7-9 mo	36	II	11.8/34.4	Immature
		15Jun87	9-11 mo	43	II	9.8/30.0	Immature
		24Mar88	16-18 mo	60	II	9.8/30.1	None Doc
		18Mar87	6-8 mo	31	II	12.6/36.2	Immature
	#23	19Feb90	3.5 yr	55	II	10.0/31.9	?PG
		11Apr88	24-36 mo	50	II	10.9/32.0	None Doc
	#27	23Jul89 ^H	3-4 yr	50	II	ND	None Doc
Corbett WMA Palm Beach Co.	G84-20	20Oct84 ^H	2-3 yr	80	II	ND	None Doc

^APounds (lbs.); ^BPhysical condition score: I-Excellent, II-Good, III-Poor, IV-Grave; ^CHemoglobin (gms/100ml) PCV = packed cell volume; ^DReproduction: CBS-number of cubs/age in months, None Doc-no evidence of offspring documented in vicinity, PG-Pregnant no. days, SUSP PG - pregnant suspected based on ¹denning behavior or ²milk/serous fluid in mammary glands but no cubs ever documented; ^EHit by car; ^FCapture mortality; ^GDead-aggression; ^HIllegally killed; ^ILate pregnancy; ^JFull stomach, est 6-8 lbs. ^KRecently eaten, serum lipemic; ^LWeight estimated. ^MProbable cause of death mercury toxicosis.

Table 5. Body weights of sub-adult^A Florida panthers at varying ages.

Location	ID#	Date	Age	Body Weight lbs.
<u>FEMALES</u>				
Northern Fakahatchee Strand, Bear Isl. & Prices'	#19 F	02-09-87	9 mo	49
		11-09-87	18 mo	70
		05-03-89	36 mo	75-80
	G80-4 F	12-23-79	18-30 mo	68
	#32 F	02-03-89	24-30 mo	79
	#40 F	02-26-90	18-24 mo	65
	#41 F	02-28-90	18-24 mo	61
Everglades National Park	#21 F	03-16-87	14-18 mo	56
		07-23-88	30-34 mo	62
	#22 F	03-18-87	6-8 mo	33
		04-07-87	7-9 mo	36
		06-15-87	9-11 mo	43
		03-24-88	16-18 mo	60
	#23 F	03-18-87	6-8 mo	31
		06-22-88	18-20 mo	44
		11-05-88	24-36 mo	69
	#27 F	04-11-88	24-36 mo	50
<u>MALES</u>				
Northern Fakahatchee Strand, Bear Isl. & Prices'	#29 M	01-03-89	6 mo	44
		05-01-89	11.5 mo	76
	#30 M	01-06-89	9-10 mo	55
		05-02-89	13-14 mo	75
	#34 M	01-08-90	10 mo	62
		05-03-90	14 mo	68
	#35 M	01-15-90	10 mo	52
		01-22-90	10 mo	45
	#43 M	05-01-90	10 mo	54
Fakahatchee Strand State Preserve	#10 M	01-13-86	5-6 mo	34
		05-02-86	9-10 mo	55
Everglades National Park	#16 M	01-12-87	14-18 mo	84
		02-02-88	26-30 mo	86
	#42 M	03-06-90	10 mo	60
Other Areas	#28 M ^C	11-29-88	18-24 mo	74
	#33 M ^D	03-05-89	26 mo	92

^ASub-adult = $\leq$ 36 months; ^BIn captivity released to ENP in good condition; ^CFt. Myers/Corkscrew area; ^DStair Steps Unit of BCNP

Table 6. Comparison of hematology values from free ranging Florida panthers, Colorado mountain lions, and Oregon cougars

	FLORIDA			COLORADO		OREGON	
	"ALL" Mean	"SELECT" Mean $\pm$ S.E.	Range	Mean $\pm$ S.E.	Range	Mean $\pm$ S.E.	Range
A. FEMALES	(n = 38)	(n = 10)		(n = 2)		(n = 2)	
RBC	7.01	7.43 $\pm$ 0.22	(4.97-9.74)	8.23 $\pm$ 0.43	(7.82-8.64)	8.82 $\pm$ 0.60	(8.22-9.42)
WBC	11.5	12.6 $\pm$ 1.08	(6.5-18.0)	7.0 $\pm$ 1.13	(5.8-8.1)	0.20 $\pm$ 0.20	(10.3-10.7)
HGB	11.9	11.9 $\pm$ 0.19	(9.1-15.7)	14.4 $\pm$ 0.64	(13.7-15.0)	15.0 $\pm$ 1.30	(13.7-16.3)
PCV	34.4	35.4 $\pm$ 1.04	(24.8-48.4)	44.4 $\pm$ 3.33	(40.8-47.5)	40.4 $\pm$ 0.70	(39.7-41.1)
MCV	49.0	47.8 $\pm$ 0.57	(44.3-54.5)	51.5 $\pm$ 1.50	(50-53)	47.6 $\pm$ 0.75	(46.8-48.3)
MCH	17.1	16.0 $\pm$ 0.32	(13.2-19.7)	17.1 $\pm$ 0	(17.1-17.1)	16.9 $\pm$ 0.40	(16.5-17.3)
MCHC	36.2	33.5 $\pm$ 0.44	(26.4-46.0)	32.2 $\pm$ 0.92	(31.2-33.1)	35.6 $\pm$ 1.35	(34.2-36.9)
RDW	16.8	18.3 $\pm$ 2.55	(11.2-25.6)	ne	ne	29.2 $\pm$ 10.00	(19.2-39.2)
PLATELETS	370	372 $\pm$ 28.48	(229-867)	ne	ne	127 ⁿ⁼¹	ne
B. MALES	(n = 21)	(n = 12)		(n = 8)		(n = 2)	
RBC	8.51	8.59 $\pm$ 0.30	(6.25-10.37)	9.9 $\pm$ 0.67	(6.74-12.54)	7.83 $\pm$ 0.78	(7.03-8.63)
WBC	13.4	13.2 $\pm$ 0.58	(9.5-18.7)	12.0 $\pm$ 1.02	(7.9-17.0)	10.5 $\pm$ 5.04	(5.5-15.5)
HGB	14.1	14.0 $\pm$ 0.55	(9.7-17.2)	15.9 $\pm$ 0.81	(11.5-18.9)	13.5 $\pm$ 1.84	(11.6-15.3)
PCV	40.4	41.1 $\pm$ 1.45	(30.0-48.7)	46.0 $\pm$ 2.01	(34.0-54.0)	36.7 $\pm$ 4.54	(32.2-41.2)
MCV	47.6	48.0 $\pm$ 0.52	(44.0-50.8)	47.0 $\pm$ 1.84	(40.4-54.9)	46.7 $\pm$ 0.99	(45.7-47.7)
MCH	16.6	16.4 $\pm$ 0.29	(15.0-18.7)	16.3 $\pm$ 0.64	(14.4-18.2)	17.1 $\pm$ 0.64	(16.4-17.7)
MCHC	35.0	34.1 $\pm$ 0.38	(32.0-38.1)	34.5 $\pm$ 0.46	(32.2-36.1)	36.5 $\pm$ 0.58	(35.9-37.1)
RDW	16.7	17.5 $\pm$ 1.13	(9.4-30.6)	ne	ne	34.4 $\pm$ 0.43	(33.9-34.8)
PLATELETS	448	450 $\pm$ 43.35	(332-810)	183 $\pm$ 39.22	(60-340)	118 $\pm$ 101.75	(8-228)

ne = Not evaluated

Table 7. Comparison of serum biochemical values from wild Florida panthers, Colorado mountain lions, and Oregon cougars

	FLORIDA		COLORADO		OREGON	
	Mean $\pm$ SE	Range	Mean $\pm$ SE	Range	Mean $\pm$ SE	Range
A. FEMALES	(n = 27)		(n = 2)		(n = 2)	
Sodium (mEq/L)	152.3 $\pm$ 0.7	(145-167)	149.5 $\pm$ 2.48	(147-152)	159.5 $\pm$ 0.50	(159-160)
Potassium (mEq/L)	4.5 $\pm$ 0.06	(4.1-5.1)	4.5 $\pm$ 0.30	(4.2-4.8)	4.15 $\pm$ 0.15	(4.0-4.3)
Chloride (mEq/L)	116.7 $\pm$ 1.2	(111-125)	114 $\pm$ 2.00	(112-116)	112 $\pm$ 2.00	(110-114)
Total CO ₂ (mEq/L)	15.5 $\pm$ 0.8	(7-27)	15.5 $\pm$ 0.50	(15-16)	16.8 $\pm$ 0.20	(16.6-17.0)
Anion Gap (mEq/L)	14.3 $\pm$ 3.6	(8-35)	ne ^A	ne	ne	ne
Total Protein (gm/dl)	7.42 $\pm$ 0.13	(6.4-8.6)	7.65 $\pm$ 0.15	(7.5-7.8)	7.95 $\pm$ 0.65	(7.3-8.6)
Globulin (mg/dl)	3.8 $\pm$ 0.17	(2.7-5.0)	3.25 $\pm$ 0.05	(3.2-3.3)	3.65 $\pm$ 0.05	(3.6-3.7)
Albumin (gm/dl)	3.6 $\pm$ 0.15	(3.0-4.1)	4.4 $\pm$ 0.20	(4.2-4.6)	4.3 $\pm$ 0.63	(3.7-4.9)
Albumin/Globulin	1.0 $\pm$ 0.12	(0.6-1.6)	1.35 $\pm$ 0.05	(1.3-1.4)	1.15 $\pm$ 0.15	(1.0-1.3)
Calcium (mg/dl)	9.94 $\pm$ 0.28	(9.1-12.0)	10.1 $\pm$ 0.15	(9.9-10.2)	10.85 $\pm$ 1.05	(9.8-11.9)
Phosphorus (mg/dl)	5.17 $\pm$ 0.23	(3.2-7.2)	4.25 $\pm$ 0.58	(3.7-4.8)	6.15 $\pm$ 0.55	(5.6-6.7)
BUN (mg/dl)	38.7 $\pm$ 2.7	(14-70)	66 $\pm$ 3.00	(63-69)	68 $\pm$ 25.08	(43-93)
Creatinine (mg/dl)	1.96 $\pm$ 0.15	(1.0-3.5)	1.7 $\pm$ 0.10	(1.6-1.8)	1.5 $\pm$ 0.92	(0.7 ^E -2.3)
BUN/creatinine	22.4 $\pm$ 2.4	(7.2-42.0)	39 $\pm$ 4.00	(35-43.1)	75.8 $\pm$ 57.30	(18.7-132.9)
Glucose (mg/dl)	174.2 $\pm$ 17.0	(95-386)	164 $\pm$ 81.28	(83-245)	223 $\pm$ 5.01	(218-228)
CPK (u/L)	476 ^B $\pm$ 71.45	(196-7,430)	563 $\pm$ 6.52	(557-570)	10,720 $\pm$ 3,741	(6,990-14,450)
LDH (u/L)	220 ^B $\pm$ 33.5	(79-855)	224.5 $\pm$ 106.80	(118-331)	1,035 $\pm$ 255.25	(781-1,290)
AST/SGOT (u/L)	57 ^B $\pm$ 7.3	(32-215)	60.5 $\pm$ 18.55	(42-79)	374.5 $\pm$ 132.91	(245-510)
ALT/SGPT (u/L)	64.4 $\pm$ 6.1	(10-141)	5 $\pm$ 0	(5)	ne	ne
GGT (u/L)	2.5 $\pm$ 0.65	(0-10)	0.95 $\pm$ 0.05	(0.9-1)	1.5 $\pm$ 0.50	(1-2)
Total bilirubin (mg/d)	0.1 $\pm$ 0.01	(0.0-0.2)	0.0 $\pm$ 0	(0.0-0)	0.3 $\pm$ 0.10	(0.2-0.4)
ALK phos (u/L)	36.9 $\pm$ 12.9	(5-227)	7.95 $\pm$ 7.07	(0.9-15)	7 $\pm$ 1.99	(5-9)
Cholesterol (mg/dL)	140.6 $\pm$ 6.4	(84-238)	214 $\pm$ 32.62	(182-247)	208.5 $\pm$ 30.57	(178-239)
Triglycerides (mg/dL)	55.4 $\pm$ 20.8	(0-501 ^D)	73.5 $\pm$ 20.56	(53-94)	42 $\pm$ 6.02	(36-48)
Serum iron (mcg/dL)	70.7 $\pm$ 7.5	(27-146)	188.5 $\pm$ 62.70	(126-251)	ne	ne
Uric Acid (mg/dL)	0.80 ^C $\pm$ 0.198	(0.0-1.8)	0.9 $\pm$ 0.25	(0.9-1.4)	1.2 $\pm$ 0.20	(1.0-1.4)
Calcium/phosphorus	1.9 $\pm$ 0.09	(1.4-3.0)	2.4 $\pm$ 0.40	(2.0-2.8)	1.7 $\pm$ 0.30	(1.5-2.1)

Table 7. (continued)

Serum Chemistry P.2

	FLORIDA		COLORADO		OREGON	
	Mean $\pm$ SE	Range	Mean $\pm$ SE	Range	Mean $\pm$ SE	Range
B. MALES	(n = 21)		(n = 7)		(n = 2)	
Sodium (mEq/L)	153.4 $\pm$ 1.1	(142-157)	157.6 $\pm$ 2.98	(151-168)	160 $\pm$ 2.00	(158-162)
Potassium (mEq/L)	4.4 $\pm$ 0.05	(4.0-5.0)	4.0 $\pm$ 0.11	(3.4-4.3)	5.2 $\pm$ 0.85	(3.8-6.6)
Chloride (mEq/L)	116.5 $\pm$ 0.8	(110-122)	122.7 $\pm$ 1.62	(121-134)	123 $\pm$ 0.53	(122-124)
Total CO ₂ (mEq/L)	15.7 $\pm$ 0.9	(8-22)	17.7 $\pm$ 0.74	(14-21)	15.1 $\pm$ 2.10	(13-17.2)
Anion Gap (mEq/L)	21.4 ^F $\pm$ 2.2	(11-33)	14 ^F $\pm$ 0.84	(11-17)	ne	ne
Total Protein (gm/dl)	7.73 $\pm$ 0.19	(6.0-9.7)	8.0 $\pm$ 0.27	(7.2-9.4)	7.25 $\pm$ 0.35	(6.9-7.6)
Globulin (mg/dl)	4.2 $\pm$ 0.20	(2.7-6.0)	4.2 $\pm$ 0.50	(3.4-7.2)	4.7 $\pm$ 1.20	(3.5-5.9)
Albumin (gm/dl)	3.53 $\pm$ 0.19	(1.9-4.2)	3.9 $\pm$ 0.22	(2.8-4.6)	2.55 $\pm$ 1.55	(1.0 ^E -4.1)
Albumin/Globulin	0.87 $\pm$ 0.08	(0.3-1.1)	1.0 $\pm$ 0.10	(0.4-1.2)	0.7 $\pm$ 0.50	(0.2 ^E -1.2)
Calcium (mg/dl)	9.8 $\pm$ 0.09	(9.2-10.9)	10.4 $\pm$ 0.29	(8.8-10.6)	10.1 $\pm$ 0.05	(10.1-10.2)
Phosphorus (mg/dl)	5.49 $\pm$ 0.24	(3.4-7.3)	5.4 $\pm$ 0.31	(1.9 ^E -6.6)	5.8 $\pm$ 0.20	(5.6-6.0)
BUN (mg/dl)	41.6 $\pm$ 3.9	(13-69)	70.1 $\pm$ 1.13	(27-73)	36 ^{N=1}	(36)
Creatinine (mg/dl)	1.91 $\pm$ 0.11	(1.0-3.2)	1.6 $\pm$ 0.11	(1.4-2.2)	2.6 $\pm$ 0.10	(2.5-2.6)
BUN/creatinine	24.9 $\pm$ 3.3	(8.0-43.8)	44.9 $\pm$ 2.41	(27-68)	13.7 $\pm$ 0.70	(13-14.4)
Glucose (mg/dl)	184 $\pm$ 16.0	(95-411)	169 $\pm$ 34.84	(81-342)	145.5 $\pm$ 53.69	(92-199)
CPK (u/L)	640 $\pm$ 84.24 ^G	(254-1,290)	1,407 $\pm$ 586.68	(245-4,570)	1680 ^{N=1}	(1680)
LDH (u/L)	274.5 $\pm$ 27.5	(93-476)	226 $\pm$ 41.77	(114-398)	>680 ^H	(>600 ^G -760)
AST/SGOT (u/L)	77.8 $\pm$ 10.6	(30-234)	134 $\pm$ 36.04	(41-327)	>298 ^H	(95->500 ^G)
ALT/SGPT (u/L)	59.7 $\pm$ 6.8	(14-150)	65 $\pm$ 18.83	(17-169)	ne	ne
GGT (u/L)	1.92 $\pm$ 0.79 ^I	(0.0-5.0)	ne	ne	11 ^{N=1}	(11)
Total bilirubin (mg/d)	0.195 $\pm$ 0.167	(0.0-1.6)	0.14 $\pm$ 0.19	(0.1-0.3)	0.25 $\pm$ 0.05	(0.2-0.3)
ALK phos (u/L)	27.6 $\pm$ 8.8	(6-183)	12 $\pm$ 1.81	(5-16)	50 $\pm$ 8.01	(42-58)
Cholesterol (mg/dL)	155 $\pm$ 5.8	(120-196)	180 $\pm$ 15.32	(135-241)	148.5 $\pm$ 5.51	(143-154)
Triglycerides (mg/dL)	31.0 $\pm$ 6.3	(1-104)	27 $\pm$ 3.64	(17-46)	18.5 $\pm$ 15.55	(3-34)
Serum iron (mcg/dL)	74.2 $\pm$ 5.9	(39-108)	95.4 $\pm$ 12.72	(42-152)	ne	ne
Uric Acid (mg/dL)	0.73 $\pm$ 5.9	(0.4-2.0)	0.61 $\pm$ 0.08	(0.2-0.8)	2.1 ^{N=1}	(2.1)
Calcium/phosphorus	1.8 $\pm$ 0.09	(1.3-2.9)	2.0 ^{N=1}	(2.0)	1.7 ^{N=1}	(1.7)

^Ane = not examined; ^BDid not include values from #09F-muscle damage from fight wounds-CPK=7,430, LDH=855, SGOT=215; ^CDid not include #21F UA=511; ^DSerum Lipenic; ^EValue seems very low or high; ^FDid not include Anion gaps = 0; ^GN=16; ^HLab reported values only as > than ... ^IN=13.

Table 8. Documented panther longevity, injury and mortality: collared panthers, 10 February 1981 - 30 June 1990

ID#	Sex	Capture Date		Field ^A Captures	Months Collared		Age ^C	Dead or Injured Panthers	
		Initial	Latest		Total	Recent ^B		Date	Cause/Location ^D
#01	M	02-10-81	———— ^E	1	34	34	12-14 y	12-14-83	Road-killed SR 84 mm 18, Cco
#02	M	02-20-81	01-29-83	3	44	21	13* y	10-27-84	Intrasp aggression FSSP, Cco
#03	F	01-23-82	01-17-83	2	12	0	9-10* y	01-17-83	Capture related ^F FSSP, Cco
#04	M	01-27-82	01-22-84	3	39	15	10* y	04-18-85	Road-killed SR 84 mm 17, Cco
#05	F	02-23-82	————	1	21	21	8-9* y	11-18-83	Unknown- Brz & Hr ^G Buckshot found in hide 2/82 and at death, Fak Conc C, Cco
#06	M	02-27-82	————	1	2	2	6-7 y	04-16-82	Unknown- Brz & Hr RP/BCNP, Cco
#07	M	03-02-82	01-26-85	~~3~~	~~43~~	~~9~~	~~9-10 y~~	~~10-28-85~~	Road-killed SR 29 2mS SR84, Cco
#08	F	03-25-84	04-13-87	3	37 ^H	RFW ^{I1}	12-14* y	08-20-88	Kidney, liver, & thyroid disease, captivity - WOP
#09	F	01-26-85	01-08-87	2	24	RFW ^{I2}	5-7 y	01-08-87	Treated for gunshot wound & osteomyelitis of rear foot, Cco
		01-31-87	03-14-90	4	78	3	8-10 y	* Alive *	Returned to wild
#10	M	01-15-86	05-05-86	2	12	8	17-19 mo	01-27-87	Intrasp aggression Fak Conc C, Cco
#11	F	01-21-86	01-02-90	3	53	6	8-10 y	* Alive *	
#12	M	01-28-86	01-15-89	3	53	17	8-9 y	* Alive *	
#13	M	02-27-86	————	1	22	22	6-8 y	12-16-87	Road-killed SR 29 SunL, Cco
#14	F	12-06-86	02-22-90	3	42	4	8-9 y	* Alive *	
#15	F	12-13-86	06-16-87	3	18	12	5-7 y	06-10-88	Intrasp aggression & infection, Dco
#16	M	01-12-87	02-21-90	3	41	4	4.5-5 y	* Alive *	
#17	M	01-20-87	01-26-89	2	41	17	11-13 y	* Alive *	

Table 8. (continued)

Longevity p.2

ID#	Sex	Capture Date		Field ^A Captures	Months Collared		Age ^C	Dead or Injured Panthers	
		Initial	Latest		Total	Recent ^B		Date	Cause/Location ^D
#18	F	01-22-87	01-23-89	2	41	17	11-13 y	* Alive *	
#19	F	02-09-87	02-16-90	4	41	4	4 y	* Alive *	Radio-collar malfunctioned, "lost" cat between 9/89 and 2/90
#20	M	03-10-87	06-17-87	2	3	RFW ¹³	3-4 y	06-17-87	Hit-by-car SR 858 5mE SR 29
		08-02-87	————	2	16	13	4-5 y	08-24-88	Pos. heart related (atrial defect) BI/BCNP, Cco
#21	F	03-16-87	07-23-88	2	18	RFW ¹⁴	2.5-3 y	07-23-88	Hit-by-car, Palm Dr., SE Homestead, Dco. Alive in captivity at WOP.
#22	F	03-18-87	03-24-88	4	24	12	30-31 mo	03-20-89	Radio-signal missing- no sign of cat in ENP, Dco
#23	F	03-18-87	06-22-88	5	15 ^J	RFW ¹⁵	21-22 mo	06-22-88	Stranded on island, removed from wild
		02-22-89	02-19-90	6	31 ^I	4	4 y	* Alive *	Returned to wild, ENP
#24	M	01-30-88	————	1	8	8	3-4 y	08-12/16-88	Unknown- Brz & Hr; Lykes Bros, Gco
#25	M	02-16-88	————	1	7	7	3-4 y	08-25-88	Intrasp aggression and septicemia, Fak Conc C, Cco
#26	M	03-01-88	02-10-90	2	28	4	6-7 y	* Alive *	
#27	F	04-11-88	————	1	16	16	3-4 y	07-26-89	Suspect mercury toxicosis, East Everglades, Dco.
#28	M	11-29-88	11-29-88	1	0	RFW ¹⁶	18-24 mo	11-29-88	Hit-by-car, Ft. Myers airport, Lco
		03-15-89 ¹⁶	————	1	16	16	3-3.5 y	* Alive *	Returned to wild
#29	M	01-03-89	02-12-90	3	18	4	2 y	* Alive *	
#30	M	01-06-89	————	2	12	12	2.25 y	01-25-90	Intrasp aggression, FakStrStP, Cco

Table 8. (continued)

Longevity p.3

ID#	Sex	Capture Date		Field ^A Captures	Months Collared		Age ^C	Dead or Injured Panther	
		Initial	Latest		Total	Recent ^B		Date	Cause/Location ^D
#31	F	01-12-89	—	1	18	18	9-10 y	* Alive *	
#32	F	02-03-89	—	1	17	17	3-3.5 y	* Alive *	
#33	M	03-05-89	—	1	8	8	2.5-3 y	11-23-89	Rabies, Hco
#34	M	01-08-90	—	1	5	5	16 mo	* Alive *	
#35	M	01-15-90	01-22-90	2	0	RFW ¹⁷	10 mo	01-24-90	<u>E. coli</u> septicemia, possibly capture related, FPNWR, Cco
#36	F	01-27-90	—	1	5	5	3-5 y	* Alive *	
#37	M	01-30-90	—	1	5	5	3-4 y	* Alive *	
#38	F	02-08-90	—	1	5	5	3-5 y	* Alive *	
#39	M	02-19-90	—	1	3	3	3-4 y	05-18-90	Pyothorax, penetrating chest wound, ENP, Dco
#40	F	02-26-90	—	1	4	4	2-2.5 y	* Alive *	
#41	F	02-28-90	—	1	4	4	2-2.5 y	* Alive *	
#42	M	03-06-90	—	1	4	5	14 mo	* Alive *	
#43	M	05- -90	—	1	2	2	12 mo	* Alive *	
PCO 10	M	11-02-84	—	1	0	RFW ¹⁸	3-5 yr	11-02-84	Hit-by-car, SR 41 Ochopee, Fl., Cco. Permanently in captiv- ity at WOP

^AField captures = total number of times panther was captured and immobilized in the wild (field).

^BRecent = months lived since most recent capture.

^CAge at death or injury and removed from the wild or if still alive and free-ranging, estimate age on June 30, 1990.

^DLocation: County-Collier (Cco), Dade (Dco), Glades (Gco), Hendry (Hco), Lee (Lco); ENP-Everglades Nat. Park; Fak Conc C-Fakahatchee Conservation Club; FSSP-Fakahatchee Strand State Preserve; BI/BCNP & RP/BCNP - Bear Island and Raccoon Point in Big Cypress Nat. Preserve; SunL- Sunniland; WOP- White Oak Plantation.

^ERadio collar malfunctioned 6 months after collaring.

^FVery old female in poor physical condition, anesthetic possibly entered the blood stream.

^GBnz & Hr - skeleton was reduced to bones and hair.

^HLived for a total of 53 months post collaring, the last 16 months were in captivity.

^IRFW = Removed from wild:

¹poor physical condition and no reproduction for 3 years, FSSP, Cco.

²Illegally shot. Fractured metatarsal, osteomyelitis, removed from wild for one month. Treated at Miami Metro Zoo Hospital. Returned to wild.

³hit-by-car, removed for 6 weeks to treat injuries then returned to the wild.

⁴hit-by-car, removed to fix fractured femur, still in captivity.

⁵stranded on island surrounded by water in Shark River Slough, ENP.

⁶uncollared panther, hit-by-car, rehabilitated and released.

⁷did not rejoin mother and sibling after capture, nor move properly, elected to recapture for examination and treatment.

⁸uncollared panther, hit-by-car, rehabilitated, still in captivity.

^J#23 was in captivity from 6-22-87 until 5-14-88 (11 months) then returned to the wild and was removed 1 month later. She was then held in captivity for 8 more months before released on 02-22-89.

Table 9. Documented panther injury & mortality: uncollared panthers, 1978-1990

ID#	Sex	Date	Est. Age ^A	Cause of Death/Injury	Location/Comment/Source ^B
UF 9789	M	02-13-72	2-3 yr	Road injured/shot	S. of Moore Haven, Glades Co. ^{1,2,7}
"Sunniland"	F	10-07-72	Adult	Road-killed	S. of Sunniland, Collier Co. No specimen - may not be valid report ²
G78-65	M	03-08-78	2-3 yr	Illegally-killed	Levee 28, Dade Co. ^{3,4,7}
G80-4	F	12-23-79	1.5-2.5 yr	Road-killed	SR 29, 200 yds. N. of SR 84, Collier Co. ^{3,4,7}
G80-15	M	02-07-80	1.5-2.5 yr	Road-killed	Sunniland, 1 mile N. on SR 29, Collier Co. ^{3,4,7}
G81-19	F	04-19-81	2-3 yr	Road-killed	SR29, 9.5 m. So of SR 84, 1.6 m. S. o f Road Prison, Collier Co., Pregnant 2-3 mos. - 4 fetuses ^{3,4,7}
G83-22	M	03-18-83	2-3 yr	Road-killed	SR 27 near Palmdale, Glades Co. ^{3,4,7}
"Canal Pt."	F	05-22-83	Adult	Illegally-killed	L-8 canal near Canal Point, Fl., Martin Co. ^{3,7}
G83-75	M	12-01-83	3-6 yr	Illegally-killed	Seminole Indian Reservation, shot by Chief James Billy, Hendry Co. ^{3,7}
G84-20	F	10-30-84	2-3 yr	Illegally-killed	Corbett Wildlife Management Area, Palm Beach Co. ^{5,7}
PCO 10	M	11-02-84	3-5 yr	Road-injured	SR 41, 2 m. E. of Ochoppee, Fl., fractured both femurs, * Alive * in captivity, "Big Guy" ⁵ (A.K.A. PCO 10)
G84-26	F	11-18-84	8-10 yr	Road-killed	SR 84, mm 16, Collier Co. ^{5,7}
G85-BNZ	F	01-10-85	18-24 mo	Road-killed	SR 84, mm 16, Collier Co. ^{5,7}
G85-CS	F	03-23-85	2-3 yr	Illegally-killed	Collier Seminole State Park, N. of SR 41, ~20 m. E. of Naples, Fl., shot through neck and skinned, long bones removed (butchered) ^{5,7}
"Naples"	F	05-12-85	unknown	Road-injured	SR 951, 2 m. N of SR 41, struck by car, not killed - did not find body, saw tracks ⁵
PCO 59	F	11-14-86	7-9 yr	Road-killed	SR 84, mm 16, Collier Co. ^{7,8}

Table 9. (continued)

Uncollared Panther Mortality p.2

ID#	Sex	Date	Est. Age ^A	Cause of Death/Injury	Location/Comment/Source ^B
UF 24042	M	12-19-87	8-10 ⁺ yr	Unknown	Skeleton found by hunter in Crane Swamp, Franton Wildlife Management Area, 6 m. S. of Edgewater, Fl., Volusia Co. ^{3,7}
G88-16	M	03-01-88	10 mos.	Road-killed	CAPTIVE born/Released by Ted Turner in Jan. 1988 along with sibling. Killed near Capps, Fl. S. of Tallahassee ^{7,8}
FP #28	M	11-29-88	18-24 mo	Road-injured	Near Ft. Myers Int. Airport, was rehabilitated and is now radio-collared and free ranging ⁸
N89-64	M	01-26-89	3-4 yr	Road-killed	SR 850, NW of Immakolee, Fl. ⁸ (A.K.A. N89-64)
PCO 185	M	06-18-90	10-12 mo	Road-killed	E of Immakolee, Fl. ⁸

^AEstimated age is based on growth plate closure, tooth wear, and "subjective" field impressions.^BSource of information:

- 1) Belden, Robert C., and Lovett E. Williams, Jr. Survival Status of the Florida Panther. In: Proceedings of the Florida Panther Conference, March 17-18, 1976, Orlando, Florida. Pub. by the Florida Audubon Society of Florida Game and Fresh Water Fish Commission.
- 2) Nowack, Ronald M., and Roy McBride. Staus Survey of the Florida Panther. Reprinted from World Wildlife Fund Yearbook, 1973-74. In: Proceedings of the Florida Panther Conference, March 17-18, 1976, Orlando, Florida. Published by the Florida Audubon Society of Florida Game and Fresh Water Fish Commission, p. 118.
- 3) Belden, Robert C. Field capture records, radio-telemetry data, and personal communication- for 1981-83. Florida Game and Fresh Water Fish Commission. Gainesville, Fl.
- 4) Forrester, Donald J. Necropsy examination records for 1978-83. Department Infectious Disease, College of Veterinary Medicine, University of Florida, Gainesville, Fl.
- 5) Roelke, Melody E., Elliott R. Jacobson, and George V. Kollias. Veterinary medical records for field seasons 1983/84, 1984/85, and 1985/86. Department of Special Clinical Sciences, College of Veterinary Medicine, University of Florida, Gainesville, Fl.
- 6) Roboski, John and Walt McCown. Field capture records, radio-telemetry data, and personal communication- 1984 & 1985. Florida Game and Fresh Water Fish Commission. Naples, Fl.
- 7) Wilkins, Laurie. Specimens held at Museum collection. Mammal Range Florida State Museum, University of Florida, Gainesville, Fl.
- 8) Roelke, Melody E. Veterinary medical records for field seasons 1986-1990. Florida Game and Fresh Water Fish Commission. Gainesville, Fl.

Table 10. Causes of documented panther mortality/injury: radio-collared verses uncollared panthers, 1972-1990

Category of Death/Injury	Collared		Uncollared		Total	
	No.	(Percent)	No.	(Percent)	No.	(Percent)
Road killed/Injured	6 ^A	(26.0)	14 ^B	(70.0)	20	(46.5)
Illegally killed	2	(8.7)	5	(25.0)	5	(16.3)
Intraspecific Aggression ^C	5	(21.7)	0	0	5	(11.6)
Unknown cause ^D	3	(13.0)	1	(5.0)	4	(9.3)
Other:						
Congenital Heart Defect	1	(4.4)	0	0	1	(2.3)
Kidney Disease ^E	1	(4.4)	0	0	1	(2.3)
Capture mortality	1	(4.4)	0	0	1	(2.3)
Septicemia	1	(4.4)	0	0	1	(2.3)
Pyothorax	1	(4.4)	0	0	1	(2.3)
Rabies	1	(4.4)	0	0	1	(2.3)
Probable mercury toxicosis	1	(4.4)	0	0	1	(2.3)
TOTAL	23		20		43	

^ATwo panthers were injured by vehicles and would have died without treatment: #21 F is still in captivity healing from a fractured femur; #20 M recovered from injuries and was released, later died, probably related to congenital atrial septal defect.

^BThree panthers were hit by cars and survived, two of which would have died without medical intervention: G84-25 M ("Big Guy") in captivity, recovered from two fractured femurs; a female ("Naples") survived at least the first day, found tracks, never found body. F1. panther #28 was rehabilitated, radio-collared, and released.

^CThis also includes those panthers that died of septicemia &/or toxemia as a result of bite and puncture wounds.

^DSkeletal and hair remains only were recovered on these animals, no obvious cause of death.

^EKidney and liver disease were the primary causes of death for panther #08 F, however, her thyroid and reproductive systems were failing as well.

Table 11. Causes of Florida panther mortality or injury by year, 1972-1990

Fiscal Year ^A	Road Hit ^B	Gunshot	Aggression ^C	Unknown	Other ^D	Total
1972/73	2 (0/2) ^E	0	0	0	0	2 (0/2)
1973/-/77	0	0	0	0	0	0
1977/78	0	1 (0/1)	0	0	0	1 (0/1)
1978/79	0	0	0	0	0	0
1979/80	2 (0/2)	0	0	0	0	2 (0/2)
1980/81 ^E	1 (0/1)	0	0	0	0	1 (0/1)
1981/82	0	1 (1 ^F /0)	0	1 (1/0)	0	2 (2 ^F /0)
1982/83	1 (0/1)	1 (0/1)	0	0	1 (1/0)	3 (1/2)
1983/84	1 (1/0)	1 (0/1)	0	1 (1 ^F /0)	0	3 (2 ^F /1)
1984/85	5 (1/4 ^{B2})	2 (0/2)	1 (1/0)	0	0	8 (2/6)
1985/86	1 (1/0)	0	0	0	0	1 (1/0)
1986/87	2 (1 ^{BG} /1)	1 (1 ^H /0)	1 (1/0)	0	0	4 (3/1)
1987/88 ^I	1 (1/0)	0	1 (1/0)	1 (0/1)	0	3 (2/1)
1988/89	3 (1 ^B /2 ^{B1})	0	1 (1/0)	1 (1/0)	2 (2 ^G /0)	7 (5/2)
1989/90	1 (0/1)	0	1 (1/0)	0	4 (4/0)	6 (5/1)
TOTAL	20 (6/14)	7 (2/5)	5 (5/0)	4 (3/1)	7 (7/0)	43 (23/20)
DEAD	15 (4/11)	5 (0/5)	5 (5/0)	4 (3/1)	7 (7/0)	36 (19/17)
INJURED	5 (2/3)	2 (2/0)	0	0	0	7 (4/3)

^AFiscal year: July 1- June 30, centered around the winter.

^BThis category includes 5 panthers that were injured by vehicles and not killed. (BG #20,21,28 & NAP)

^CAggression- intraspecific, includes deaths due to septicemia &/or toxemia subsequent to fight wounds as well as deaths from combat and cannibalism.

^DOther: Capture mortality (1), kidney disease (1), heart anomaly^F (1), rabies (1), pyothorax from penetrating chest wound (1), probable mercury toxicosis (1), and *E. coli* septicemia.

^ERadio-collared/Uncollared panthers in parenthesis, collaring project started Jan. 1981.

^G#20 M was road injured, rehabilitated and released to the wild, he later died of a heart defect (presumptive diagnosis) in FY 88/89, therefore he was scored twice.

^ICaptive born cat released to wild and road-killed was not included in this table.

^FBuckshot removed from skin at initial capture and found with carcass (cause of death unknown)(#05F)

^HInjured foot from gunshot (#09F) treated osteomyelitis and returned to the wild.

Table 12. Bacterial and protozoan diseases of Florida panthers and bobcats in Florida.

Disease and Etiologic agent	Host ^A	Basis of Diagnosis	Year	No. Animals		County ^B
				Exam	Pos.	
BACTERIA						
Brucellosis <u>Brucella</u> spp. (<u>Brucella abortus</u>)	FP	Serology	1978-90	41	1 ^C	Cco, Dco, Gco, Hco, HLco, Lco, Mco
	BC	Serology	1984-89	37	0	Cco, HLco
Campylobacterosis <u>Campylobacter</u> sp.	FP	Culture of Feces	1988	1	1	Dco
Edwardsiellosis <u>Edwardsiella</u> <u>tarda</u>	FP	Culture of Feces	1985	8 ^D	3	Cco
	FP	Culture of Feces	1988	1	1	Dco
	BC	Culture of Feces	1985	4 ^D	0	Cco
Plesiomoniasis <u>Plesiomonas</u> <u>shigelloides</u>	FP	Culture of Feces	1985	8 ^D	2	Cco
	BC	Culture of Feces	1985	4 ^D	1	Cco
Salmonellosis <u>Salmonella</u> spp.	FP	Culture of Feces	1985	8 ^D	1 ^E	Cco
	BC	Culture of Feces	1985	4 ^D	0	Cco
Septicemia <u>Escherichia coli</u> <u>Streptococcus</u> <u>equisimilis</u>	FP	Culture organs	1990	1 ^{FG}	1 ^{FG}	Cco
	FP	Culture of chest exudate	1990	1 ^G	1 ^G	Mco
PROTOZOA						
Coccidiosis <u>Eimeria</u> sp.	FP	Fecal floatation	1986-87	15	1 ^H	Cco, Dco, Hco, Mco
<u>Isospora</u> sp.	FP	Fecal floatation	1986-87	15	1 ^H	Cco, Dco, Hco, Mco

Table 12. (continued)

Bacteria and protozoa p. 2

Disease and Etiologic agent	Host ^A	Basis of Diagnosis	Year	No. Animals		County ^B
				Exam	Pos.	
Cytosporosis <u>Cytospora</u> <u>felis</u>	FP	Blood smear	1989-90	19	10	Cco, Hco, Mco, Dco
	BC	Blood smear	1984-85	36	1 ^I	Cco, Bco, Aco
Sarcocystosis <u>Sarcocystis</u> sp.	FP	Histopathology	1983-87	9	7	Cco, PBco
	BC	Histopathology	1985-88	60	30	Aco, Cco, Dco, DVco, Gco, Hco, HLco, LKco, Lco
Toxoplasmosis <u>Toxoplasma gondii</u>	FP	Serology	1978-90	50	4	Cco, Gco, Hco, HLco, Lco, Mco
	BC	Serology	1986-90	28	2	Cco, Hco, HLco

^AFP = Florida panther; BC = bobcat^BCounty Codes: Alachua (Aco), Baker (Bco), Collier (cco), Dade (Dco), Duval (DVco), Glades, (Gco), Hendry (Hco), Highlands (HLco), Lake (LKco), Lee (Lco), Monroe (Mco), Palm Beach (PBco)^CThe positive panther came from Monroe County^DSix of eight panthers and all four bobcats were cultured also for Shigella, Campylobacter, Vibrio, and Yersinia; results were all negative.^ESalmonella arizonae^FPanther #35 died of a fulminating E. coli septicemia. (serotype O antigen:2,H antigen 1(week), fimbriae:k88 (wk), toxin type - negative for labile and stabile toxins)^GPanther #39 died of a pyothorax secondary to a penetrating wound to the chest.^HThe positive panthers were both from Dade County, Everglades National Park.^IThe one positive bobcat was from Alachua County

Table 13. Thyroid hormone levels in Florida panthers
(Triiodothyronine = T_3 , Thyroxine = T_4).

ID #	Sex	Date Sample Drawn	T_4	T_3
#02	M	01-29-83	1.78	70.39
#04	M	01-29-83	1.95	28.46
#07	M	01-26-85	3.16	137.53
#08	F	03-25-84	3.36	140.61
		02-21-85	2.61	116.81
		01-13-86	2.66	165.22
		04-13-87	5.67	201.36
		05-18-87	6.45	197.13
		06-09-87	6.94	246.46
		08-18-87	6.57	264.09
		09-02-87	5.31	141.86
		06-01-88	7.42	311.98
#10	M	01-15-86	1.84	100.39
#11	F	01-17-88	1.99	185.5
#12	M	01-31-88	2.71	115.80
		01-15-89	1.17	65.37
#13	M	02-27-86	2.29	131.64
#14	F	12-07-86	1.82	122.78
#15	F	12-13-86	2.45	169.55
#16	M	02-02-88	3.76	101.79
#17	M	01-20-87	2.36	90.97
#18	F	01-22-87	2.06	105.29
		01-13-89	1.52	99.24
#19	F	11-09-87	3.11	174.63
#20	M	03-10-87	1.82	255.62
#24	M	01-30-88	2.66	189.05
#25	M	02-16-88	2.92	104.12

Table 13. (continued).

thyroid p.2

ID#	Sex	Date Sample Drawn	T ₄	T ³
#27	F	04-11-88	2.34	87.63
#29	M	01-03-89	5.05	163.59
#30	M	01-06-89	3.90	128.13
#31	F	01-12-89	3.23	110.23
#32	F	02-03-89	1.66	76.71
#33	M	03-05-89	2.34	81.46

Table 14. Serologic tests, antigens, and references used to determine antibody titers for selected pathogenic agents in wild Florida panthers, 1978-90.

Agent (antigen)	No. of samples	Test	Positive threshold	Reference
BACTERIA				
<u>Brucella</u> spp. (<u>Brucella abortus</u>)	44	Plate agglutination	$\geq 1:25$	USDA, no date
PROTOZOA				
<u>Toxoplasma gondii</u>	94	KELA ^A	$\geq 1:48$	Jacobson et al. (1982)
VIRUSES				
Feline calicivirus (FP 255)	94	Plaque reduction	$> 1:4$	Scott (1977)
Feline enteric corona- virus/feline periton- itis virus	56	KELA ^B	$\geq 1:9$	Barlough et al. (1983)
	45	IFA ^C	$\leq 1:25$	Evermann et al. (1986)
Feline immunodeficiency virus	82	IFA, ELISA ^D , & western blot	Qual. ^E	Barr et al. (1989)
Feline leukemia virus	94	ELISA ^F	Qual.	Mia et al. (1981)
Feline parvovirus	94	Serum neutralization	$\geq 1:50$	Scott et al. (1970a)
Feline viral rhino- tracheitis virus (FVR-Goldstein)	94	Plaque reduction	$\geq 1:2$	Scott (1977)
Pseudorabies virus	50	Latex agglutination ^G	$> 1:4$	Pirtle et al. (1986)
Rabies virus	42	Serum neutralization	≥ 6 IU	Reagan et al. (1983)
Syncicial forming virus	13	IFA ^C	Qual.	Gaskin and Gillespie (1973)
	13	AGID ^H	Qual.	

^AKELA: kinetics enzyme-linked immunosorbant assay. ^BThis KELA results are considered to be "IFA-equivalent" titers. ^CIFA: indirect immunofluorescence assay. ^DElisa-Petchek FTLV Antibody test, 100 Fore St., Portland, Maine 04101, USA. ^EQualitative tests, no titers determined. ^FELISA: enzyme-linked immunosorbant assay Feline Leukemia Virus test kits from VIRACHEK™-FeLV by Symbiotics Corporation and LEUKASSAYR II by Pitman-Moore; ^GPseudorabies Virus antibody test kit-Latex agglutination from Viral Antigens, INC.; ^HAgar gel immunodiffusion.

Table 15. Prevalences and reciprocal titers for antibodies to selected pathogens in individual wild Florida panthers, 1978-90.

Agent	Number of panthers			Reciprocal titer	
	Examined	Positive	Percent	Minimum	Maximum
BACTERIA					
<u>Brucella</u> spp.	41	1	2.4	<25	25
PROTOZOA					
<u>Toxoplasma gondii</u>	50 ^A	4	8.0	<48	308
VIRUSES					
Feline calicivirus	50	19 ^B	36.0	<2-<20 ^C	>256
Feline enteric coronavirus/ Feline infectious peritonitis (coronavirus)	32 ^D 30 ^E	0 7 ^F	0 37.0	<9 <5	625
Feline immunodeficiency virus	39	10	25.6	Qual. ^G	
Feline leukemia virus	51	0	0	Qual.	
Feline parvovirus (panleukopenia virus)	50	32	64.0	<5	>10,000
Feline rhinotracheitis virus (herpesvirus)	50	0	0	<2-<8 ^C	
Pseudorabies virus	42	0	0	0	
Rabies virus	38	11	26.0	≤0.2 IU	2.0 IU
Feline syncytia forming virus	12	4	33.3	Qual.	

^AData on five of these serum samples were presented in two earlier papers (four in Forrester et al., 1985 and one in Burridge et al., 1979). ^BTwo animals sero-converted after a 12 and 22 mo resampling interval, and each was included once in the tally as a positive animal. ^CHemolyzed sera from necrosied animals resulted in higher negative thresholds which could interfere with detection of low positive titers. ^DKELA results, Cornell University, Ithaca, New York. ^EIFA results, Washington State University, Pullman, Washington. ^FThree of the four were indeterminant and gave weak positive results when retested (1:25 to 1:5). ^GQualitative assays, no titers determined.

Table 16. Seroprevalence of selected disease agents in free-living Florida panthers, 1978-90.

ID#	SEX	LOCATION ^B	DATE	TESTS ^A									
				AGE CLASS ^C	FPL	FCV	TOX	FVR	FELV	FIP	FIV	BRUC	PRV
# 01	M	I-S.FS	12-16-83 ^D	6	>5,000	12	-	<4	-	-	nd ^H	nd	-
# 02	M	I-S.FS	01-29-83	6	>4,000	<2	-	<4	-	-	-	-	nd
		I-S.FS	10-27-84 ^{DE}	6	100	<4	-	<5	-	-	-	nd	nd
# 03	F	I-S.FS	01-17-83 ^D	6	2,250	<4	- ^{F1}	<4	-	-	nd	nd	nd
# 04	M	I-FS	01-29-83	6	<5	<2	-	<4	-	-	-	-	nd
		I-N.FS	01-22-84	6	>5,000	2	-	<4	-	-	-	-	nd
		I-N.FS	04-18-85 ^{OG}	6	50	<20	-	<10	-	-	nd	nd	nd
# 07	M	I-RP	03-27-83	5	1,000	<2	49	<4	-	-	+	-	nd
		I-S.FS	01-26-85	6	1,000	>256	188	<5	-	-	+	nd	-
		I-S.FS	10-28-85 ^{OH}	6	500 ^V	80 ^V	-	<10 ^V	-	-	nd	nd	-
# 08	F	I-S.FS	03-25-84	5	>5,000	48	-	<4	-	-	-	-	nd
		I-S.FS	02-21-85	6	10,000	16	-	<5	-	-/-	-	nd	-
		I-S.FS	01-13-86	6	>10,000 ^V	64 ^V	39	<2 ^V	-	-	+	nd	nd
		I-S.FS	04-13-87	6	5,000 ^V	96 ^V	9	12 ^V	-	-	+	nd	nd
		CAP/GFC	06-09-87	6	1,000 ^V	>256 ^V	-	96 ^V	-	-	nd	nd	nd
		CAP/GFC	08-18-87	6	nd	nd	nd	nd	nd	nd	+	nd	nd
		CAP/WOP	06-01-88	6	>10,000 ^V	24 ^V	50	16 ^V	-	-/-	+	nd	nd
		CAP/WOP	08-20-88 ^D	6	10,000 ^V	16 ^V	nd	48 ^V	*1	-	+	nd	nd
# 09	F	I-S.FS	01-26-85	4	10,000	10	308	<5	-	-	nd	-	-
		I-S.FS	01-08-87	5	1,000 ^V	24 ^V	79	6 ^V	-	-	-	nd	nd
		CAP/MMZ	02-05-87	5	10,000 ^V	192 ^V	150	96 ^V	-	-/-	-	nd	nd
		I-S.FS	10-31-88	5	>10,000 ^V	48 ^V	47	6 ^V	-	-/-	-	nd	nd
		I-S.FS	03-14-90	6	10,000 ^V	8 ^V	<48	4 ^V	-	/-	nd	-	-
# 10	M	I-S.FS	01-15-86	1	100	4	-	<2	-	-/+	nd	-	-
		I-S.FS	05-02-86	2	100 ^V	3 ^V	-	<2 ^V	-	-	nd	nd	nd
# 11	F	I-BI	01-21-86	5	500	2	-	<2	-	-/-	-	nd	nd
		I-PR	01-07-88	5	500 ^V	24 ^V	15	6 ^V	-	-/+	-	-	-
		I-N.FS	01-02-90	6	5,000 ^V	12 ^V	<48	8 ^V	-	/+	-	-	-
# 12	M	I-BI/FS	01-28-86	5	500	<2	-	<2	-	-/-	-	nd	nd
		I-BI/FS	01-31-88	5	100 ^V	6 ^V	26	<2 ^V	-	-	-	-	-
		I-N.FS	01-15-89	6	500 ^V	6 ^V	21	3 ^V	-	-/-	-	nd	nd
# 13	M	I-BI/PR	02-27-86	5	>10,000	8	-	<2	-	-	-	-	-
		I-BR/PR	12-16-87 ^D	5	>10,000 ^V	≤6 ^V	13	≤6 ^V	-	-/-	-	NS ^X	-

Table 16. (continued)

Seroprevalence p.2

ID# / SEX	LOCATION ^B	DATE	AGE CLASS ^C	TESTS ^A									
				FPL	FCV	TOX	FVR	FELV	FIP	FIV	BRUC	PRV	
# 14	F	II-ENP	12-07-86	5	50	>256	9/27	<2	-	-/+	+	-	-
		II-ENP	04-11-88	5	500 ^V	80 ^V	7	3 ^V	-	-/-	+	nd	nd
		II-ENP	02-22-90	6	5,000	8	<48	<2	-	/-	+	-	-
# 15	F	II-ENP	12-13-86	5	100	<2	6	<2	-	-/-	nd	-	-
		II-ENP	04-07-87	5	100 ^V	>256 ^V	-	2 ^V	-	-	-	nd	nd
		II-ENP	06-16-87	5	nd	nd	nd	nd	nd	/-	-	nd	nd
		II-ENP	06-11-88 ^D	5	≤50	nd	≤10	nd	* ^I	-	-	nd	nd
# 16	M	II-ENP	01-12-87	2	<10	48	6	<2	-	-/+	+	-	-
		II-ENP	02-02-88	4	<10	240	12	<2	-	-/-	+	-	-
		II-ENP	02-21-90	4	<10	8	<48	<2	-	/+	+	-	-
# 17	M	I-PR	01-20-87	6	500	32	24	2	-	-/-	-	-	-
		I-PR	01-26-89	6	1000 ^V	8 ^V	50	<2 ^V	-	-/-	-	nd	nd
# 18	F	I-PR	01-22-87	6	500	16	9	<2	-	-/-	+	-	-
		I-PR	01-23-89	6	10,000 ^V	4 ^V	40	<2 ^V	-	-/-	+	nd	nd
# 19	F	I-BI	02-09-87	2	10,000	8	17	<2	-	-/-	-	-	-
		I-BI/PR	11-09-87	3	5,000 ^V	≤2 ^V	73	≤2 ^V	-	-/-	-	nd	nd
		I-N.FS	05-04-89	4	5,000 ^V	4 ^V	66	12 ^V	-	-/-	-	nd	nd
		I-N.FS	02-16-90	4	>10,000 ^V	4 ^V	<48	8 ^V	-	/-	-	-	-
# 20	M	I-PR	03-10-87	4	100	6	15	<2	-	-	-	-	-
		CAP/MMZ	07-06-87	4	nd	nd	37	nd	nd	nd	nd	nd	nd
		CAP/MMZ	07-27-87	4	nd	nd	nd	nd	nd	/-	-	nd	nd
		I-BI	08-24-88 ^D	4	>10,000 ^V	10 ^V	nd	≤24 ^V	* ^I	-	-	nd	nd
# 21	F	II-ENP	03-16-87	2	<10	2	15	<2	-	-/-	+	-	-
		II-HST	07-23-88	4	<10	<2	<10	<2	-	-	-	-	-
		CAP/GFC	10-19-88	4	nd	nd	nd	nd	nd	nd	-	nd	nd
		CAP/GFC	12-29-88	4	nd	nd	nd	nd	nd	/-	nd	nd	nd
		CAP/GFC	01-28-89	4	nd	nd	nd	nd	nd	nd	-	nd	nd
		CAP/GFC	02-24-89	4	nd	nd	nd	nd	nd	nd	-	nd	nd
		CAP/GFC	05-23-89	4	>10,000 ^V	24 ^V	<10	16 ^V	-	-	-	nd	nd
# 22	F	II-ENP	03-18-87	2	<10	<2	4	<2	-	-/-	-	nd	nd
		II-ENP	04-09-87	2	nd	nd	nd	nd	nd	/-	nd	-	-
		II-ENP	03-24-88	3	<10	32	5	<2	-	-	-	nd	nd
# 23	F	II-ENP	03-18-87	2	<10	<2	3	<2	-	-	nd	nd	nd
		II-ENP	04-09-87	2	nd	nd	nd	nd	nd	nd	-	-	-
		II-ENP	06-01-87	2	<10	2	3	<2	-	-	-	nd	nd
		II-ENP	06-22-87	2	nd	nd	nd	nd	nd	nd	-	nd	nd

Table 16. (continued)

Seroprevalence p.3

ID# / SEX	LOCATION ^B	DATE	AGE CLASS ^C	TESTS ^A									
				FPL	FCV	TOX	FVR	FELV	FIP	FIV	BRUC	PRV	
# 23 F (con't.)	II-ENP	05-12-88	3	nd	nd	nd	nd	nd	/-	nd	nd	nd	
	CAP/GFC	10-21-88	4	nd	nd	nd	nd	nd	/-	-	nd	nd	
	CAP/GFC	11-05-88	4	nd	nd	nd	nd	nd	nd	-	nd	nd	
	II-ENP	02-19-90	4	10,000 ^v	48 ^v	<48	3 ^v	-	/-	-	-	-	
# 24 M	III-FEC	01-30-88	4	<10	48	23	<2	-	-/-	-	-	-	
# 25 M	I-N.FS	02-16-88	4	500	3	8	<2	-	-/-	+	-	nd	
	I-N.FS	08-26-88 ^p	4	nd	nd	nd	nd	nd	nd	+	nd	nd	
# 26 M	I-SIR	03-01-88	5	500	16	8	<2	-	-/-	+	-	-	
	I-ACQ	02-10-90	5	>10,000 ^v	4 ^v	<48	<2	-	/+	+	-	-	
# 27 F	II-ENP	04-11-88	4	100	16	10	<2	-	-/-	-	-	-	
	II-ENP	07-23-89 ^p	4	≤500	<12	<48	<12	nd	nd	nd	NS	nd	
# 28 M	I-CORK	11-29-88	2	<10	<2	nd	<2	nd	nd	nd	nd	nd	
	CAP/GFC	12-30-88	2	nd	nd	nd	nd	nd	/-	-	-	nd	
	CAP/GFC	02-24-89	3	nd	nd	nd	nd	nd	/-	nd	nd	nd	
	CAP/GFC	03-02-89	3	10,000 ^v	<2 ^v	<10	<2 ^v	-	-	nd	nd	nd	
# 29 M	I-BI/PR	01-03-89	1	<10	<2	47	<2	-	-/-	-	nd	nd	
	I-BI/PR	05-01-89	2	50 ^v	2 ^v	58	<2 ^v	-	-/-	-	-	nd	
	I-SIR	02-12-90	3	10,000 ^v	6 ^v	<48	<2 ^v	-	/-	-	-	-	
# 30 M	I-BI/PR	01-06-89	2	<10	<2	28	<2	-	-/+	-	nd	nd	
	I-N.FS	05-02-89	2	<10 ^v	8 ^v	21	<2 ^v	-	-/+	-	-	nd	
	I-S.FS	01-29-90 ^p	4	10,000 ^v	<12	<48	<12	-	nd	nd	nd	-	
# 31 F	I-N.FS	01-12-89	6	5,000	<2	<10	<2	-	-/-	-	-	nd	
# 32 F	I-N.FS	02-03-89	4	<10	<2	<10	<2	-	-/-	-	-	nd	
# 33 M	I-SS	03-05-89	4	<10	<2	<10	<2	-	-/-	-	+ / 25	nd	
# 34 M	I-CAI	01-08-90	2	<10	<2	<48	<2	-	/-	-	-	-	
# 35 M	I-CAI	01-15-90	2	<10	<2	<48	<2	-	/+	-	-	-	
	I-CAI	01-22-90	2	50 ^v	<2 ^v	nd	<2 ^v	nd	nd	nd	nd	nd	
	CAP/GFC	01-24-90 ^p	2	≤500 ^v	<12 ^v	nd	<12 ^v	nd	nd	nd	nd	nd	
# 36 F	I-ACQ	01-27-90	4	1,000	6	<48	<2	-	/-	+	-	-	
# 37 M	I-S.FS	01-30-90	4	5,000	<2	<48	<2	-	/-	+/-	-	-	

Table 16. (continued)

Seroprevalence p.4

ID#	SEX	LOCATION ^B	DATE	AGE CLASS ^C	TESTS ^A								
					FPL	FCV	TOX	FVR	FELV	FIP	FIV	BRUC	PRV
= 38	F	I-RP	02-08-90	4	10,000	<2	<48	<2	-	/-	+	-	-
= 39	M	II-ENP	02-19-90	4	<10	<2	<48	<2	-	/-	-	-	-
= 40	F	I-ACQ	02-26-90	3	>10,000	<2	<48	<2	-	/-	+	-	-
= 41	F	I-ACQ	02-28-90	3	>10,000	<2	<48	<2	-	/+	-	-	-
= 42	M	II-ENP	03-06-90	2	>10	<2	<48	<2	-	/-	-	-	-
= 43	M	I-N.FS	05-01-90	2	nd	nd	nd	nd	-	nd	nd	nd	nd
PCO 10	M	I-MO	11-02-84	4	<20	40	-	5	-	-	-	-	-
		CAP/WOP	11-20-84	4	nd	nd	nd	nd	nd	/-	nd	nd	nd
		CAP/WOP	06-13-87	5	nd	nd	nd	nd	nd	nd	-	nd	nd
		CAP/WOP	06-02-88	5	5,000 ^V	12 ^V	<10	8 ^V	-	-/-	-	nd	nd
G78-65	M	I-RP	03-17-78 ^D	3	5,000	<8	- ^{F2}	<4	-	-	nd	-	-
G80-15	M	I-N.FS/BI	02-11-80 ^D	4	500	48	- ^{F2}	<8	-	-	nd	nd	nd
G81-19	F	I-S.FS	04-19-81 ^D	4	<5	<8	- ^{F2}	<8	-	-	nd	nd	nd
G83-22	M	III-FEC	03-17-83 ^D	4	2,250	64	-	<8	-	-	nd	nd	-
G84-20	F	IV-CORBET	11-01-84 ^D	4	1,000	<4	-	<5	-	-	nd	nd	nd
G84-26	F	I-FS	11-12-84 ^D	6	1,000	<4	-	<5	-	-	nd	nd	nd
G88-TED	M	N.FLORIDA	03-10-88 ^D	2	≤50	<3	-	<3	-	-	nd	-	nd
N89-64	M	I-CORK	01-25-89	4	<10	<2	<10	<2	-	-/+	-	nd	nd
PCO 59	F	I-S.FS	11-14-86 ^D	6	100	≤24	<10	≤12	* ^I	-	-	nd	nd

Table 16. (continued).

LEGEND: SEROPREVALENCE TABLE

Seroprevalence p.5

^ASEROLOGICAL TESTS:

BRUC - brucellosis, +/- = plate agglutination test screens serum for antibodies against bacteria *Brucella* spp., titer = tube agglutination; FCV - feline calicivirus, SN antibody > 1:4 considered positive; FELV - feline leukemia virus, ELISA test detects presence of virus; FIP - feline infectious peritonitis - KELA test determines antibody to coronaviruses (+ or -) at Cornell, /IFA titer determined at WADDL, $\geq 1:25$ positive, for IFA titer details see Table 26; FIV - feline immunodeficiency virus, ELISA test detects presence of antibodies; FPL - feline panleukopenia virus, serum neutralizing antibody titer, test detects and cross reacts with all parvoviruses. Titers $\geq 1:50$ are considered positive; FVR - feline viral rhinotracheitis, SN antibody titer $\geq 1:2$ considered positive; TOX - toxoplasmosis, caused by protozoan *Toxoplasma gondii*. KELA titer > 1:48 considered positive; PRV - pseudorabies virus, latex agglutination > 1:4 considered positive.

^BLOCATION OF PANTHER- (see Figure 5)

MAJOR POPULATIONS: I- Southwestern Florida, Big Cypress Swamp & Fakahatchee Strand and surrounding ecosystem including privately owned land; II- Southeastern Florida, Everglades National Park; III Central Florida; IV- not part of a discrete documented population of panthers.

LOCALITY OF RANGE: ACQ - Acquisition lands (BCNP) east of BI and north of SR 84; BI - Bear Island Unit of Big Cypress National Preserve; CAI - Catherine Island, SW of Immokalee, north and south of Hwy 856 and west of Hwy 29; CORBETT - Corbett Management Area; CORK - Corkscrew Swamp Sanctuary and Ft. Myers area; ENP - Everglades National Park; FEC - Fish Eating Creek; FS- Fakahatchee Strand both north and south of SR 84; HST - Homestead, Florida; MO - Southwestern Monument Unit, Big Cypress National Preserve; N. Florida- 10 months old captive cougar released near Capps, Fl. south of Tallahassee 2 months before death on highway by car; N.FS - Northern Fakahatchee Strand; PR - Private ranches east of Immokalee; RP - Raccoon Point, Eastern Big Cypress National Preserve; S.FS - Southern Fakahatchee Strand (Fakahatchee Strand State Preserve); SIR - Seminole Indian Reservation; SS -Stair Steps Unit of Big Cypress National Preserve.

OTHER: Cap - captivity; GFC - Florida Game and Fresh Water Fish Commission, Wildlife Research Laboratory, Gainesville, Fl.; MMZ - Miami Metro Zoo, Miami, Fl.; WOP - White Oak Plantation, Yulee, Fl.

^CAGE CLASS: 1 - kitten (0-6 months); 2 - juvenile (7-18 months); 3 - subadult (19-24 months); 4 - young adult (2-4 years); 5 - mature adult (5-8 years); 6 - older adult (> 8 years).

^DBlood collected postmortem

^EVery autolysed carcass (3-4 days P.M.).

^FReported by Forrester, 1985, sera tested at CDC <1:256 considered negative: ¹1:256, ² $\leq 1:32$, also G80-4 $\leq 1:32$

^GMinimal blood collected from eviscerated carcass

^HCarcass was 12+ hours postmortem when collected

^IEquivocal positive reaction on ELIZA

^Jnd- not determined

^KNS- non specific reaction due to hemolysed sample

^VCertain test results on this date may be influenced by vaccinations received on the previous immobilization date. Panthers were vaccinated with killed virus vaccine (Fort Dodge: FEL-O-VAX[®]) for FPL, FCV, and FVR.

Table 17. Relationship of prevalence of feline panleukopenia virus^A and feline calicivirus^B antibodies to location, age, and sex of Florida panther

Disease Agent	Factor	N	χ^2	P value	Significant ^c
Feline Panleukopenia Virus	Location ^D	29	$\chi^2_1 = 7.472$	.006	Yes
	Age ^E	32	$\chi^2_3 = 9.719$	.027	Yes
	Sex	32	$\chi^2_1 = 2.169$	.141	No
Feline Calicivirus	Location ^D	29	$\chi^2_1 = 1.766$	.184	No
	Age ^E	32	$\chi^2_3 = 0.44$	.93	No
	Sex	32	$\chi^2_1 = 3.388$	.066	No

NOTE: All data for analysis was taken from the "master" individual F1. panther seroprevalence table - statistics include all sera 1978 - December, 1988.

^aPrevalence data for panleukopenia titers scored as < 1:50 = negative
> 1:50 = positive

^BPrevalence data for calicivirus titers scored as < 1:4 = negative
 ≥ 1:4 = positive

^cP value of .05 or less is accepted as significant

^DLocation of panther- prevalence compared between MAJOR POPULATIONS: I- Southwestern Florida, Big Cypress Swamp & Fakahatchee Strand and surrounding ecosystem including privately owned land; II- Southeastern Florida, Everglades National Park

^EAge class: 1 - kitten (0-6 months); 2 - juvenile (7-18 months); 3 - subadult (19-24 months); 4 - young adult (2-4 years); 5 - mature adult (5-8 years); 6 - older adult (> 8 years).

Table 18. Results of serologic tests for selected pathogens in 113 wild Florida bobcats from three regions of Florida, 1984-1990.

Agent ^A	Percent Prevalence (No. Tested)		
	Southern	Central	Northern
BACTERIA			
<u>Brucella</u> spp. (<u>Brucella abortus</u>)	0 (32)	0 (5)	ND
PROTOZOA			
<u>Toxoplasma gondii</u>	4.3 (23)	20.0 (5)	ND
VIRUSES			
Feline calicivirus	30.9 (81)	50.0 (10)	0 (7)
Feline enteric corona- virus/feline peritonitis virus ^B	0 (21)	0 (10)	
Feline immunodeficiency virus	18.0 (11)	ND	ND
Feline leukemia virus	0 (21)	0 (5)	ND
Feline parvovirus	44.4 (81)	40.0 (10)	45.5 (22)
Feline viral rhino- tracheitis virus	5.3 (38)	40.0 (5)	ND
Pseudorabies virus	0 (33)	ND	ND
Syncicial forming virus	0 (15)	ND	ND

^ARefer to Table 14 for assay methods and references.

^BKELA

Table 19. Seroprevalence of selected disease agents in bobcats of southern Florida, 1986-90.

Location	ID #	TESTS ^A					
		FPL	FCV	FRV	FELV	FIP	TOXO
Highland County Private Ranches	N88-06 BC	<10	96	<2	-	-	-
	N88-07 BC	50	64	6	-	-	-
	N88-08 BC	50	12	128	-	-	-
	N88-09 BC	50	<2	<2	-	-	69
	N88-11 BC	<10	128	<2	-	-	-
Collier & Hendry County Private Ranches	N87-02 BC	1,000	<2	<2	-	-	-
	N87-07 BC	5,000	8	<2	-	-	-
	N87-08 BC	50	<2	<2	-	-	-
	N88-02 BC	5,000	16	<2	-	-	-
	N88-03 BC	<10	4	<2	-	-	-
	N88-04 BC	5,000	12	3	-	-	63
Bear Island/Northern Fakahatchee Strand	LC87-04 BC	5,000	6	<2	-	-	-
	LC87-06 BC	10	4	<2	-	-	-
	LC87-08 BC	<10	8	<2	-	-	-
	N87-09 BC	10	<2	<2	-	-	-
	N88-10 BC	<10	<3	4	-	-	-
	N88-12 BC	5,000	6	<2	-	-	-
	LC90-01 BC	<10	<2	<2	ND	ND	-
	LC90-02 BC	<10	<2	<2	ND	ND	-
Corkscrew Sanctuary	LC87-07 BC	>10,000	192	<2	-	-	-
Turner River Road	N88-01 BC	<10	4	6	-	-	-
Fakahatchee Strand State Preserve	LC87-05 BC	<10	3	<2	-	-	-
	N87-01 BC	<10	<2	<2	-	-	-
	N87-10 BC	<10	<2	<2	-	-	-
Everglades National Park	LC87-01 BC	<10	24	<2	-	-	-
	LC87-02 BC	<10	8	<2	-	-	-
	LC87-03 BC	<10	64	<2	-	-	-
	N86-17 BC	<10	<2	<2	-	-	-

^ARefer to footnotes for Table 16.

Table 20. Distribution of bobcats positive for parvovirus and calicivirus antibody in Collier County, 1984-1985.

Virus	Western Collier County		Fakahatchee and Deep Lake Strands		Eastern Big Cypress National Preserve	
	No. Tested	% Positive	No. Tested	%Positive	No. Tested	%Positive
Parvovirus	8	12.5	30	73.3	12	25.0
Calicivirus	8	25.0	30	26.7	12	16.7

Table 21. Prevalence of serologic reactors (serum neutralization) to feline panleukopenia virus in bobcats from Florida, 1973-1990.

County	Year	Number of Bobcats		Percent
		Tested	Positive	
Alachua	1976	1	0	0
	1978	1	0	0
Baker	1979	3	2	67.0
Collier	1973	1	0	0
	1983-84	15	4	27.0
	1984-85	55	27	49.0
	1986-87	8	2	25.0
	1987-88	3	2	67.0
	1989-90	2	0	0
Columbia	1978	2	0	0
	1979	1	0	0
Dade	1984-85	3	1	33.0
	1986-87	4	0	0
Hendry	1987-88	3	2	67.0
Highlands	1987-88	5	3	60.0
Levy	1979	3	0	0
Palm Beach	1974	1	0	0
Total		111	43	38.7

Table 22. Parvovirus antibodies^A in wild Florida carnivores, 1967-1990.

Species	Number of Animals		Percent
	Positive	Tested	
Florida Panther	32	50	64.0
Feral cat ^B	3	5	60.0
Bobcat	50	113	44.2
Raccoon	37	86	43.0
Otter	5	38	13.2
Grey fox	1	12	8.3
Everglades Mink	0	2	0
Black bear	0	9	0
Opposum ^D	0	3	0
Total	132	318	41.5

^AThe parvovirus antibodies present in at least the felids (panther, feral cat, and bobcat) are most probably against feline panleucopenia virus.

^BThese were domestic cats killed by vehicles, it was not possible to determine if they were truly feral.

^CA member of the order Marsupialia, not Carnivora.

Table 23. Results of serologic tests for parvovirus^A antibodies in bobcats, raccoons, & grey fox from three different regions of Florida, 1967-1990.

Species	Region of Florida	Number of Animals		
		Positive	Tested	Percent
Bobcats	Southern	36	81	44.4
	Central	4	10	40.0
	Northern	10	22	45.5
Raccoon	Southern	10	50	20.0
	Central ^B	27	36	75.0
Grey Fox	Southern	0	7	0
	Northern ^C	1	5	20.0

^AThe parvovirus of the bobcats is probably Feline panleukopenia virus

^BRaccoons are from Merrit Island National Wildlife Refuge, 1985

^CThese grey foxes are all from Tyndal Airforce Base, 1971

Table 24. Results of serologic survey for pseudorabies antibodies in wild Florida carnivores, 1967-1990

Species	Region of Florida	Number of Animals		
		Tested	Positive	Percent
Black Bear	Central	20	2	10.0
Raccoon	Central	36	3	8.4
	Southern	21	0	0
Bobcat	Southern	33	0	0
	Northern	9	0	0
Florida Panther	Southern	42	0	0
Otter	Southern	4	0	0
Grey Fox	Southern	1	0	0

Table 25. Sero-conversion, persistence, and familial association of feline immunodeficiency virus (FIV) antibodies in free-ranging Florida panthers.

ID#-Location ^A	Date	Age	ELISA	IFA	Immunoblot
INDIVIDUALS					
#07 M - I	27MAR83	6-8 YR	+	+	+/- (1 Band)
	23MAR85 ^B	8-10 YR	+	+	ID ^C
#08 F - I	21FEB85	9-10 YR	-	-	-
	13JAN86	10-11 YR	+	ND ^D	+
	13APR87 ^E	11-13 YR	+	ND	+
	18AUG87	11-13 YR	+	+	+
	01JUN88	12-14 YR	+	+	+
	20AUG88 ^F	12-14 YR	+	+	+
#18 F - I	22JAN87	8-10 YR	+	+	+
	23JAN89 ^G	10-12 YR	+	ND	+
#25 M - I	16FEB88	3-4 YR	+	+	+/- (1 Band)
	26AUG88 ^H	3.5-4.5 YR	+	ND	+/- (1 Band)
#26 M - I	01MAR88 ^G	4-6 YR	+/-	ND	+/- (1 Band)
FAMILY MEMBERS					
#14 F - II (MOTHER)	04DEC86 ^I	4-6 YR	+	+	+/- (1 Band)
	11APR88 ^G	6-8 YR	+	ND	+
#16 M - II (#14's F1)	12JAN87 ^I	1-1.5 YR	+	+ ^{WK}	+
	02FEB88 ^G	2-2.5 YR	+	ND	+
#21 F - II (#14's F1)	16MAR87 ^I	1-1.5 YR	+/-	+	+/- (1 Band)
	23JUL88 ^L	2-2.5 YR	-	ND	+/- (1 Band)
	19OCT88	2.5-3 YR	-	-	+/- (1 Band)
	28JAN89	3-3.5 YR	-	ND	-
	24FEB89	3-3.5 YR	-	+ ^{WK}	+/- (1 Band)
	23MAY89	3-3.5 YR	-	ND	+
	12JUN89 ^M	3-3.5 YR	-	ND	+/- (1 Band)

^AI-Big Cypress Swamp, II-Everglades national Park. ^BDied October 1985, hit by car, otherwise apparently healthy. ^CID - Indeterminant. ^DND - Not determined. ^ERemoved from wild due to declining health; anemia, weight loss, and lack of reproductive success. All subsequent dates were in captivity. ^FPost mortem sample; died of renal and hepatic failure and adenomatous hyperthyroidism. ^GAlive and apparently healthy. ^HPost mortem sample; died of septicemia following intra-specific aggression. ^ITrio of panthers which functioned as a family unit, traveling and eating together. Subadults dispersed from their dam approximately April 1, 1987. ^LPanther hit by car and removed from wild. ^MIn captivity has had persistent problems with low grade anemia, slow bone healing and persistent concurrent infection with Cytauxzoon felis.

Table 26. Feline enteric coronavirus/feline infectious peritonitis IFA titer results^A for Florida panthers and other wild and captive cougars.

Population	ID#/Name	Sex	Date Sample Drawn	Date Sample Tested	Result ^B
FLORIDA PANTHERS					
	#08	F	02-21-85	03-02-89	<25
			09-02-87	02-10-89	<25
			06-01-88	02-10-89	<25
	#09	F	02-05-87	04-19-89	<5
			10-31-88	06-08-89	<5
			03-14-90	04-01-90	<25
	#10	M	01-15-86	03-02-89	<25
	#11	F	01-21-86	03-02-89	<25
			01-07-88	02-10-89	25
			01-07-88	06-08-89	5
			01-02-90	04-01-90	25
	#12	M	01-28-86	03-02-89	<25
			01-15-89	06-08-89	<5
	#13	M	12-16-87	04-19-89	<5
	#14	F	12-07-86	02-10-89	<25
			12-07-86	02-10-89	25
			12-07-86	06-08-89	25
			04-11-88	04-19-89	<5
			02-22-90	04-01-90	<25
	#15	F	12-13-86	02-10-89	<25
			12-13-86	02-10-89	25
			12-13-86	06-08-89	<5
			06-16-87	04-19-89	<5
	#16	M	01-12-87	02-10-89	125
			01-12-87	06-08-89	25
			02-02-88	04-19-89	<5
			02-21-90	04-01-90	625
	#17	M	01-20-87	04-19-89	<5
			01-26-89	06-08-89	<5
	#18	F	01-22-87	02-10-89	<25
			01-23-89	06-08-89	<5

Table 26. (continued)

FIP p. 2

Population	ID#/Name	Sex	Date Sample Drawn	Date Sample Tested	Result ^B
FLORIDA (cont.)					
	#19	F	02-09-87	04-19-89	<5
			11-09-87	02-10-89	<25
			11-09-87	06-08-89	5
			05-04-89	06-08-89	<5
			02-16-90	04-01-90	<25
	#20	M	07-27-87	04-19-89	<5
	#21	F	03-16-87	03-02-89	<25
			12-29-88	02-10-89	<25
			02-24-89	03-02-89	<25
	#22	F	03-18-87	03-02-89	<25
			04-07-87	02-10-89	<25
	#23	F	05-12-88	02-02-89	<25
			10-21-88	02-10-89	<25
			10-21-88	03-02-89	<25
			02-19-90	04-01-90	<25
	#24	M	01-30-88	04-19-89	<5
	#25	M	02-16-88	04-19-89	<5
	#26	M	03-01-88	04-19-89	<5
			02-10-90	04-01-90	25
	#27	F	04-11-88	04-19-89	<5
	#28	M	12-30-88	02-02-89	<25
			02-24-89	03-02-89	<25
	#29	M	01-03-89	06-08-89	<5
			05-01-89	06-08-89	<5
			02-12-90	04-01-90	<25
	#30	M	01-06-89	06-08-89	25
			05-02-89	06-08-89	25
	#31	F	01-12-89	06-08-89	<5
	#32	F	02-03-89	06-08-89	5
	#33	M	03-05-89	06-08-89	5
	#34	M	01-08-90	04-01-90	<25

Table 26. (continued)

FIP p. 3

Population	ID#/Name	Sex	Date Sample Drawn	Date Sample Tested	Result ^B
Florida (cont.)	#35	M	01-15-90	04-01-90	125
	#36	F	01-27-90	04-01-90	<25
	#37	M	01-30-90	04-01-90	<25
	#38	F	02-08-90	04-01-90	<25
	#39	M	02-19-90	04-01-90	<25
	#40	F	02-26-90	04-01-90	<25
	#41	F	02-28-90	04-01-90	suspect at 25
	#42	M	03-06-90	04-01-90	<25
	PCO 10	M	11-20-84	03-02-89	<25
			06-02-88	02-10-89	<25
	N89-64	M	01-26-89	06-08-89	25
TEXAS COUGARS					
	#01	F	06-14-86	02-10-89	<25
			06-14-86	02-10-89	<25
	#02	F	06-14-86	02-10-89	25
			05-31-88	02-10-89	<25
	#03	M	06-21-86	02-10-89	<25
	#04	M	06-22-86	02-10-89	<25
	#05	M	06-22-86	02-10-89	<25
	#06	M	06-22-86	02-10-89	125
	#07	F	06-23-86	02-10-89	<25
	#08	F	06-23-86	02-10-89	25
			06-01-88	02-10-89	<25
	#09	F	06-23-86	02-10-89	125
	#10	F	06-23-86	02-10-89	<25
	#13	F	06-01-88	02-02-89	<25

Table 26. (continued)

FIP p. 4

Population	ID#/Name	Sex	Date Sample Drawn	Date Sample Tested	Result ^B
Texas (cont.)	#14	F	06-01-88	02-02-89	<25
			06-01-88	02-02-89	<25
	#15	F	06-01-88	02-02-89	<25
	#16	M	06-02-88	02-02-89	<25
	#17	M	01-25-88	02-02-89	25
			10-26-88	02-10-89	<25
			02-24-89	03-02-89	25
	#18	M	06-02-88	02-02-89	25
	#19	F	01-24-89	02-02-89	25
			02-24-89	03-02-89	<25
	#20	M	01-26-89	02-02-89	125
	#21	M	01-28-89	02-02-89	25
			02-24-89	03-02-89	<25
	#22	F	03-20-89	03-25-89	3,125
	#23	M	03-20-89	03-25-89	3,125
ARIZONA MT. LIONS	#28	M	11-00-89	11-00-89	<25
			01-00-90	01-00-90	
	#29	M	12-00-89	12-00-89	<25
			01-00-90	01-00-90	
ARIZONA MT. LIONS	#03		01-20-87	06-08-89	<5
	#07		10-10-86	06-08-89	<5
	#08		12-12-86	06-08-89	<5
	#14		12-30-86	06-08-89	<5
CALIFORNIA COUGARS	#02		07-21-86	02-10-89	25
	#04		06-13-86	02-10-89	<25
	#05		06-25-86	02-10-89	25

Table 26. (continued)

FIP p. 5

Population	ID#/Name	Sex	Date Sample Drawn	Date Sample Tested	Result ^B
COLORADO MT. LIONS					
	#05	M	04-20-88	02-10-89	<25
	#07	F	04-25-87	02-10-89	<25
	#20	M	04-25-88	02-10-89	<25
	#21	F	05-21-87	02-10-89	<25
	#22	M	04-23-88	02-10-89	<25
	#40	M	04-22-88	02-10-89	<25
	#46	M	04-27-88	02-10-89	<25
	#52	M	04-19-88	02-10-89	<25
	#55	M	04-26-88	02-10-89	<25
OREGON COUGARS					
	#03		03-13-86	02-10-89	<25
	#04		04-16-86	06-08-89	5
	#06		05-16-86	06-08-89	25
	#07		- -86	06-08-89	<5
	#08		01-19-87	02-10-89	25
	#30		03-11-87	02-10-89	<25
UTAH COUGARS					
	#29		03-15-87	02-10-89	25
	#34		03-01-87	02-10-89	<25
CAPTIVE COUGARS					
	"Tom"	M	05-31-88	02-10-89	<25
			11-05-88	02-02-89	25
	"Ocho"	M	01-18-89	04-19-89	<25

^ATested at Washington Animal Disease Diagnostic Laboratory;^B≥IFA titer 1:25 = positive for corona virus, test cross reacts with all corona viruses.

Table 27. Prevalence of syncicial forming virus antibodies in free ranging Florida panthers, Florida bobcats, and Colorado mountain lions, samples collected in 1987 - 88.

Assay	Florida Panther		Colorado Mountain Lion		Florida Bobcat	
	Examined	No. % Positive	Examined	No. %Positive	Examined	No. %Positive
IFA ^A	13	33.3	8	100.0	15	0
AGID ^B	13	30.8	8	100.0	15	0

^AIndirect immunofluorescence assay

^BAgar gel immunodiffusion

Table 28. Incidence of syncicial forming virus (SFV) in free-ranging Florida panthers and Colorado mountain lions and the presence of tissue culture lysis, 1987-88.

ID#	SEX	LOCATION	DATE	AGE CLASS ^C	TESTS ^A		FIBROBLAST TISSUE CULTURE LYSIS
					IFA-SFV	AGID-SVF	
<u>FLORIDA</u>							
# 08	F	I-S.FS	01-13-86	6	-	-	Normal growth
		I-S.FS	04-13-87	6	-	-	Normal growth
# 09	F	I-S.FS	01-08-87	5	+	+	Lysis
# 14	F	II-ENP	12-07-86	5	-	-	Lysis; Ok in '88
# 15	F	II-ENP	12-13-86	5	-	-	Normal growth
# 16	M	II-ENP	01-12-87	2	-	-	Normal growth
# 17	M	I-PR	01-20-87	6	+	+	Lysis
# 18	F	I-PR	01-22-87	6	+	+	Lysis
# 19	F	I-BI	02-09-87	2	-	-	Normal growth
# 20	M	I-PR	03-10-87	4	+	+	Lysis
# 21	F	II-ENP	03-16-87	2	-	-	Normal growth
# 22	F	II-ENP	03-18-87	2	-	-	Normal growth
# 23	F	II-ENP	03-18-87	2	-	-	Normal growth
<u>COLORADO</u>							
#05	M	COL-SW	04-20-88	6	+	+	Not Attempted ^D
#20	M	COL-SW	04-25-88	4	+	+	Not Attempted ^D
#22	M	COL-SW	04-23-88	4	+	+	Not Attempted ^D
#40	M	COL-SW	04-22-88	5	+	+	Not Attempted ^D
#46	M	COL-SW	04-27-88	3	+	+	Not Attempted ^D
#50	M	COL-SW	04-00-88	4	+	+	Not Attempted ^D
#52	M	COL-SW	04-19-88	4	+	+	Not Attempted ^D
#55	M	COL-SW	04-26-88	4	+	+	Not Attempted ^D

^ASerological tests: IFA - Indirect immunofluorescence assay; AGID - Agar gel immunodiffusion.

^BLocation of panther- See Footnote Table 16.

^CAge class: See Footnote Table 16.

^DFibroblast cells viably frozen LN², culture has not been attempted because all 3 Colorado samples collected in 1987 (Colorado #05, #07, and #21) lysed.

Table 29. Presence of rabies-specific virus neutralizing antibodies (VNA) in Florida panthers, pre and post vaccination.

ID#	SEX	LOCATION ^B	DATE	AGE CLASS ^C	STATUS ^A ADV?	SAMPLE	RABIES TITER ^D	
							+/-	VNA (IU)
#07	M	I-S.FS	01-26-85	6	A	Serum/P?	-	0.07
#08	F	I-S.FS	02-21-85	6	A	Serum	+	0.7
		I-S.FS	01-13-86	6	A ^{VB}	Serum/P?	+	0.6
		I-S.FS	04-13-87	6	A ^{VB}	Serum	+	78.0
		CAP/GFC	05-18-87	6	A ^{VB}	Serum	+	486.0
		CAP/GFC	06-09-87	6	A ^{VB}	Serum	+	1458.0
		CAP/GFC	08-18-87	6	A ^{VB}	Serum	+	486.0
		CAP/WOP	06-01-88	6	A ^{VB}	Serum	+	1458.0
#09	F	I-S.FS	01-26-85	4	A	Serum/P?	-	0.07
		I-S.FS	01-08-87	5	A ^{VB}	Serum	-/+	0.22
		CAP/MMZ	01-31-87	5	A ^{VB}	Serum	+	486.0
		I-S.FS	10-31-88	5	A ^{VB}	Serum	+	0.7
		I-S.FS	03-14-90	6	A ^{VI}	Serum	+	2.0
#10	M	I-S.FS	01-15-86	1	A	Serum	-	0.07
		I-S.FS	05-02-86	2	A ^{VB}	Plasma	+	2.0
#11	F	I-BI	01-21-86	5	A	Plasma	-	0.07
		I-PR	01-07-88	5	A ^{VB}	Serum	+	2.0
		I-N.FS	01-02-90	6	A ^{VI}	Serum	+	6.0
#12	M	I-BI/FS	01-28-86	5	A	Serum	-	0.07
		I-BI/FS	01-31-88	5	A ^{VB}	Serum	+	2.0
		I-BI/FS	01-15-89	6	A ^{VI}	Serum	+	54.0
#13	M	I-BI/PR	02-27-86	5	A	Serum	+	0.7
#14	F	II-ENP	12-07-86	5	A	Serum	-	0.07
		II-ENP	04-11-88	5	A ^{VB}	Serum	-	0.07
		II-ENP	02-22-90	6	A	Serum	-	0.07
#15	F	II-ENP	12-13-86	5	A	Plasma	+	0.6
		II-ENP	04-07-87	5	A ^{VB}	Plasma	+	2.0
#16	F	II-ENP	01-12-87	2	A	Serum	+	0.6
		II-ENP	02-02-88	4	A	Serum	+	2.0
		II-ENP	02-21-90	4	A	Serum	-	0.07
#17	M	I-PR	01-20-87	6	A	Serum	-	0.2
		I-PR	01-26-89	6	A ^{VB}	Serum	-	0.07
#18	F	I-PR	01-22-87	6	A	Serum	-	0.07
		I-PR	01-23-89	6	A ^{VB}	Serum	-	0.2

Table 29. (cont.)

Rabies p. 2

ID#	SEX	LOCATION ^B	DATE	AGE CLASS ^C	STATUS ^A ADV?	SAMPLE	RABIES TITER	
							+/-	VNA (IU)
#19	F	I-BI	02-09-87	2	A	Serum	+	0.6
		I-BI	11-09-87	3	A ^{VB}	Serum	+	6.0
		I-PR	05-04-89	4	A ^{VI}	Serum	-	0.2
		I-N.FS	02-16-90	4	A ^{VI}	Serum	+	2.0
#20	M	I-PR	03-10-87	4	A	Serum	-	0.02
		CAP/MMZ	06-17-87	4	A ^{VB}	Serum	+	0.7
		CAP/MMZ	07-20-87	4	A ^{VI}	Serum	+	1458.0
#21	F	II-ENP	03-16-87	2	A	Serum	+	0.6
		II-ENP	07-23-88	4	A	Serum	+	0.7
		CAP/GFC	02-24-89	4	A	Serum	-	0.07
		CAP/GFC	05-23-89	4	A ^{VI}	Serum	+	54.0
		CAP/GFC	08-09-89	4	A ^{VI}	Serum	+	486.0
#22	F	II-ENP	03-18-87	2	A	Serum	-/+	0.22
		II-ENP	03-24-88	3	A	Plasma	+	2.0
#23	F	II-ENP	06-22-87	2	A	Serum	+	0.6
		CAP/ENP	08-03-87	2	A ^{VI1}	Serum	+	162.0
		CAP/WOP	05-12-88	3	A ^{VI2}	Serum	+	2.0
		II-ENP	02-19-90	4	A ^{VI}	Serum	-	0.2
#24	M	III-FEC	01-30-88	4	A	Serum	-	0.2
#25	M	I-N.FS	02-16-88	4	A	Serum	-	0.2
#26	M	I-PR	03-01-88	5	A	Serum	-	0.2
		I-PR/NOB	02-10-90	5	A ^{VI}	Serum	-	0.2
#27	F	II-ENP	04-11-88	4	A	Serum	-	0.2
#28	M	CAP/GFC	12-30-88	2	A	Serum	-	0.07
		CAP/GFC	02-24-89	3	A	Plasma	-	0.2
		CAP/GFC	03-11-89	3	A ^{VI3}	Serum	+	18.0
#29	M	I-BI/PR	01-03-89	1	A	Plasma	+	0.6
		I-BI/PR	05-01-89	2	A ^{VI}	Serum	-	0.07
		I-SIR	02-12-90	3	A ^{VI}	Serum	+	0.7
#30	M	I-BI/PR	01-06-89	2	A	Serum	+	2.0
		I-N.FS	05-02-89	2	A ^{VI}	Serum	+	2.0
#31	F	I-N.FS	01-12-89	6	A	Serum	-	0.07

Table 29. (cont.)

Rabies p. 3

ID#	SEX	LOCATION ^B	DATE	AGE CLASS ^C	STATUS ^A ADV?	SAMPLE	RABIES TITER	
							+/-	VNA (IU)
#32	F	I-N.FS	02-03-89	4	A	Serum	+	0.6
#33	M	I-SS	03-05-89	4	A	Serum	-	0.07
#34	M	I-N.FS	01-08-90	2	A	Serum	-	≤0.2
#35	M	I-N.FS	01-15-90	2	A	Serum	-	≤0.2
		I-N.FS	01-22-90	2	A ^{V1}	Serum	-	≤0.2
#36	F	BCNP/NOB	01-27-90	4	A	Serum	-	≤0.2
#37	M	BCNP/FSSP	01-30-90	4	A	Serum	-	≤0.2
#38	F	BCNP/RP	02-08-90	4	A	Serum	-	≤0.2
#39	M	ENP/E.BC	02-19-90	4	A	Serum	-	≤0.2
#40	F	BCNP/NOB	02-26-90	3	A	Serum	-	≤0.2
#41	F	BCNP/NOB	02-28-90	3	A	Serum	-	≤0.2
#42	M	ENP	03-06-90	2	A	Serum	-	≤0.2
PCO 10M	I-MO		11-09-84	4	A	Serum/P?	-	0.07
N89-64M	I-CORK		01-25-89	4	D	Serum	-	0.2

^AStatus: Alive (A), dead (D) and/or previously vaccinated (V) on date indicated.

^BLocation of panther: See footnote Table 16.

^CAge class: See footnote Table 16.

^DRabies titer: Virus neutralizing antibodies (IU), ≤0.2 IU is negative and ≥0.6 IU is positive.

^VCertain test results on this date may be influenced by vaccinations received on the previous immobilization date. Panthers were vaccinated with killed rabies virus vaccine; ^B = Bio-rab or ^I = Immrab.

^{V1}-Prior to this date, cat was vaccinated with Fel-o-vax on 06-24-87 and 07-14-87, and Imrab on 07-14-87.

^{V2}-Panther was vaccinated with a "booster" of Imrab on 08-03-87.

^{V3}-Prior to this date panther was vaccinated with fel-o-vax on 12-30-88 and Fel-o-vax and Imrab on 02-24-89.

Table 30. Mercury levels in blood and hair from free-living Florida panthers, 1978-90.

ID#	SEX	LOCATION ^B	DATE	AGE CLASS ^C	TISSUES ^A (PPM WET WT)				PM SERUM	HAIR
					WHOLE BLOOD	CALC [*] W.BLD	RBC	CLOT		
# 01	M	I-S.FS	12-16-83 ^D	6					0.04 ^M	
# 07	M	I-S.FS	01-26-85	6	1.7					
# 08	F	I-S.FS	01-13-86	6						20.0
		I-S.FS	04-13-87	6		1.12C [*]		3.3		
		CAP/WOP	08-20-88 ^D	6						14.0
# 09	F	I-S.FS	10-31-88	5		0.31R [*]	0.82			
		I-S.FS	03-14-90	6	0.14					5.8
# 11	F	I-N.FS	01-02-90	6	0.058					0.6
# 12	M	I-BI/FS	01-15-89	6	0.24					
# 13	M	I-BI/PR	02-27-86	5		0.02C [*]		0.046		0.28
# 14	F	II-ENP	12-07-86	5						8.5
		II-ENP	04-11-88	5	0.23					
		II-ENP	02-22-90 ^R	6	1.1					18.0
			II-R		1.41A ^N					19.14 ^N
			II-R		1.25B ^N			2.26B ^N		
			II-R					3.7A		
			II-R					4.9A		
# 15	F	II-ENP	12-13-86	5	0.21					
		II-ENP	06-11-88 ^D	5						6.4
# 16	M	II-ENP	02-02-88	4		1.83R [*]	4.9			82.0
		II-ENP	02-21-90 ^R	4	2.8					80.0
			II-R		3.4			1.8		100.0
			II-R		2.51 ^N			4.99 ^N		62.59 ^N
# 19	F	I-N.FS	02-16-90	4	0.11					21.0
# 20	M	I-PR	03-10-87	4	0.044					
# 21	F	II-HST	07-23-88	4						14.0
		CAP/GFC	08-19-88	4	0.54 ^{RPW}					
# 22	F	II-ENP	03-24-88	3	0.22					7.1
# 23	F	II-ENP	02-19-90 ^R	4	0.51					0.69
			II-R		1.0			1.5		39.00

Table 30. (continued)

Mercury in blood and hair p.2

ID#	SEX	LOCATION ^B	DATE	AGE CLASS ^C	TISSUES ^A (PPM WET WT)			CLOT	PM SERUM	HAIR
					WHOLE BLOOD	CALC [*] W.BLD	RBC			
# 25	M	I-N.FS	02-16-88	4						0.20
# 26	M	I-SIR	03-01-88	5	0.069					
		I-ACQ	02-10-90	5	0.053					0.82
# 27	F	II-ENP	04-11-88	4	1.7		4.3	4.6		
		II-ENP	07-23-89 ^D	4					4.1	130.0
# 29	M	I-SIR	02-12-90	3	0.076					38.0
# 31	F	I-N.FS	01-12-89	6	0.35					
# 33	M	I-SS	03-05-89	4	0.26					
# 34	M	I-CAI	01-08-90	2	0.073					1.2
# 35	M	I-CAI	01-15-90	2	0.060					0.67
# 36	F	I-ACQ	01-27-90	4	0.035					0.77
# 37	M	I-S.FS	01-30-90	4	0.046					0.60
# 38	F	I-RP	02-08-90 ^R "R	4	0.49					69.0
					0.78 ^N			1.41 ^N		25.98 ^N
# 39	M	II-ENP	02-19-90 ^R	4	10.0					16.0
			"R		2.2			3.5		18.0
			"R		1.3 ^N			2.66 ^N		14.4 ^N
# 40	F	I-ACQ	02-26-90	3	0.039					0.90
# 41	F	I-ACQ	02-28-90	3	0.096					
# 42	M	II-ENP	03-06-90	2	0.32					59.0
G78-65	M	I-RP	03-17-78 ^D	3					0.08 ^M	
G80-15	M	I-N.FS/BI	02-11-80 ^D	4					0.07 ^M	
G83-22	M	III-FEC	03-17-83 ^D	4					0.03 ^M	
G84-26	F	I-FS	11-12-84 ^D	6					0.76	
N89-64	M	I-CORK	01-25-89	4	0.25					7.0

Table 30. (continued).

Mercury in blood and hair p.3

LEGEND: MERCURY TABLE

^ATISSUES: WHOLE BLOOD - Whole blood collected in vacutiner tubes with either EDTA or Na or Li Heparin as anticoagulant; CALC W.BLD - calculated whole blood values based on mercury found in the RBC or Clot, formula used is below (*); RBC - washed red blood cells, prepared by washing whole blood in PBS and sedimenting RBCs by centrifugation (tissues prepared for genetic study); Clot - red cells and fibrin clot remaining in serum separator tube after serum is removed; PM SERUM - hemolysed "serum" collected during necropsy and post mortem exam- generally grossly hemolysed; HAIR - small samples of hair collected from all over the body by plucking.

ANALYSIS - All values are reported in PPM calculated on a wet weight basis. All samples analysed at the U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center, Analytical Control Facility in Laurel, Maryland unless footnoted other wise.

^BLOCATION OF PANTHER-

MAJOR POPULATIONS: I- Southwestern Florida, Big Cypress Swamp & Fakahatchee Strand and surrounding ecosystem including privately owned land; II- Southeastern Florida, Everglades National Park; III Central Florida; IV- not part of a discrete documented population of panthers.

LOCALITY OF RANGE: ACQ - Acquisition lands (BCNP) east of BI and north of SR 84; BI - Bear Island Unit of Big Cypress National Preserve; CAI - Catherine Island, SW of Immokalee, north and south of Hwy 856 and west of Hwy 29; CORBETT - Corbett Management Area; CORK - Corkscrew Swamp Sanctuary and Ft. Myers area; ENP - Everglades National Park; FEC - Fish Eating Creek; FS- Fakahatchee Strand both north and south of SR 84; HST - Homestead, Florida; MO - Southwestern Monument Unit, Big Cypress National Preserve; N. Florida- 10 months old captive cougar released near Capps, Fl. south of Tallahassee 2 months before death on highway by car; N.FS - Northern Fakahatchee Strand; PR - Private ranches east of Immokalee; RP - Raccoon Point, Eastern Big Cypress National Preserve; S.FS - Southern Fakahatchee Strand (Fakahatchee Strand State Preserve); SIR -Seminole Indian Reservation; SS -Stair Steps Unit of Big Cypress National Preserve.

OTHER: Cap - captivity; GFC - Florida Game and Fresh Water Fish Commission, Wildlife Research Laboratory, Gainesville, Fl.; MMZ - Miami Metro Zoo, Miami, Fl.; WOP - White Oak Plantation, Yulee, Fl.

^CAGE CLASS: 1 - kitten (0-6 months); 2 - juvenile (7-18 months); 3 - subadult (19-24 months); 4 - young adult (2-4 years); 5 - mature adult (5-8 years); 6 - older adult (> 8 years).

^DPostmortem sample

^MAnalysis conducted in 1985 at a midwestern human toxicology laboratory.

^NNicolas Bloom Analitical Lab in Seattle, Wash.

^RRepeat analyses performed on the same sample by the same or different labs.

^{RFH}Removed from the wild for treatment:

Hit-by-car on 7-23-88; 27 days prior, aprox. 1 t_{1/2} for whole blood Hg in domestic cats

^{*}CALC W.BLD - Calculated whole blood Hg levels, based on absolute value found in either washed red blood cells(R) or in RBC/fibrin clot (C).

$$\frac{\text{Packed cell volume (PCV)} \times \text{RBC or Clot Hg value}}{0.97} = \text{Calculated Whole Blood Value}$$

Table 31. Mercury levels in tissue samples from deceased free-living Florida panthers, 1978-90.

ID#	SEX	LOCATION ^B	DATE	AGE CLASS ^C	TISSUES ^A (PPM WET WT)				WHOLE BLOOD	RBC/ CLOT	PM SERUM	HAIR
					LIVER	KIDNEY	MUSCLE	BRAIN				
# 01	M	I-S.FS	12-16-83 ^D	6	3.6 ^M	0.7 ^M					0.04 ^M	
# 04	M	I-N.FS	04-18-85 ^{OG} "R	6	7.8 11.2 ^E	0.82 ^E	0.17 ^E					
# 07	M	I-S.FS	10-28-85 ^D "R "R	6	20.0 16.3 ^E 18.75 ^N	8.5 ^E 5.74 ^N	0.76 ^E	0.73				
# 08	F	I-S.FS	01-13-86	6								20.0
		I-S.FS	04-13-87	6					1.12C*	3.3C		
		CAP/WOP	08-20-88 ^D	6	19.0			0.1				14.0
			"R "R		21.0 ^E 15.18 ^N	1.80 ^E 0.86 ^N	0.19 ^E	0.11 ^N				
# 13	M	I-BI/PR	02-27-86	5					0.02C*	0.046C		0.28
		I-BI/PR	12-16-87 ^D "R	5	0.05 1.3 ^E	0.16 ^E	0.06 ^E					
# 15	F	II-ENP	12-13-86	5					0.21			
		II-ENP	06-11-88 ^D	5	13.0 11.9 ^E 8.20 ^N		0.29 ^E	0.16				6.4
			"R									
# 20	M	I-PR	03-10-87	4					0.044			
		I-BI	08-24-88 ^D "R	4	0.05 0.91 ^E	0.19 ^E						
# 22	F	II-ENP	03-24-88	3					0.22			7.1
# 25	M	I-N.FS	02-16-88	4								0.20
		I-N.FS	08-26-88 ^D "R	4	2.5 2.5 ^E	0.57 ^E						
# 27	F	II-ENP	04-11-88	4					1.7	4.6C		
		II-ENP	07-23-89 ^D	4	110.0 86.4 ^E 98.0 ^{PR} 109.0 ^N	8.7 ^E 31.90 ^N	4.2 ^E	6.3			4.1	130.0
			"R									
			"R					6.07 ^N				
# 33	M	I-SS	03-05-89	4					0.26			
# 35	M	I-CAI	01-15-90	2					0.060			0.67

Table 31. (continued)

Mercury in tissues p.2

ID#	SEX	LOCATION ^B	DATE	AGE CLASS ^C	TISSUES ^A (PPM WET WT)				WHOLE BLOOD	RBC/ CLOT	PM SERUM	HAIR
					LIVER	KIDNEY	MUSCLE	BRAIN				
# 39	M	II-ENP	02-19-90 ^R nr	4					10.0			16.0
			nr						2.2	3.5C		18.0
									1.3 ^N	2.66C ^N		14.4 ^N
		II-ENP	05-18-90	4	15.0		4.7					
G78-65	M	I-RP	03-17-78 ^D	3	15.0 ^M						0.08 ^M	
G80-15	M	I-N.FS/BI	02-11-80 ^D	4							0.07 ^M	
G81-19	F	I-S.FS	04-19-81 ^D	4		9.1 ^M						
G83-22	M	III-FEC	03-17-83 ^D	4							0.03 ^M	
G84-20	F	IV-CORBET	11-01-84 ^D nr	4	12.0 12.1 ^E		0.24 ^E	0.24				
G84-26	F	I-FS	11-12-84 ^D	6			1.75 ^E				0.76	
N89-64	M	I-CORK	01-25-89 nr	4	1.4 1.5 ^E	0.61 ^E		0.11	0.25			7.0
PCO 59	F	I-S.FS	11-14-86 ^D nr	6	20.0 25.07 ^E	0.56 ^E	0.52 ^E					

^ATissues: See foot note Table 30.

ANALYSIS - All values are reported in PPM calculated on a wet weight basis. All samples analysed at the U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center, Analytical Control Facility in Laurel, Maryland unless footnoted other wise.

^BLocation of panther- See foot note Table 30.^CAge class: See foot note Table 30.^DBlood collected postmortem^EEustis Fisheries Lab, GFC^MAnalysis conducted in 1985 at a midwestern human toxicology laboratory.^NNicolas Bloom Analytical Lab in Seattle, Wash.^{PR}Patuxent referral lab^RRepeat analyses performed on the same sample by the same or different labs.^{*}Calc W.Bld - See foot note Table 30.

Table 32. Methyl mercury levels in tissues from free-living Florida panthers, 1990.

ID#	SEX	LOCATION ^B	DATE	AGE CLASS ^C	TISSUES ^A (PPM WET WT)								
					LIVER			KIDNEY			BRAIN		
					T-Hg	HgCH ₃	%HgCH ₃	T-Hg	HgCH ₃	%HgCH ₃	T-Hg	HgCH ₃	%HgCH ₃
# 07	M	I-S.FS	10-28-85 ^D	6	18.75	2.68	14.3	5.74	1.31	22.8			
# 08	F	CAP/WOP	08-20-88 ^{DE}	6	15.18	0.26	1.3	0.86	0.09	10.9	0.11	0.07	61.5
# 15	F	II-ENP	06-11-88 ^D	5	8.20	0.32	3.9						
# 27	F	II-ENP	07-23-89 ^D	4	109.00	12.64	11.6	31.90	7.61	23.9			
PCO 59	F	I-S.FS	11-14-86 ^D	6	26.92	1.87	7.0						

^ATissues analysed at Nicolas Bloom Lab, Seattle, Wash.

^BLocation of panther see footnotes Table 30.

^CAge class, see footnotes Table 30.

^DTissues collected at necropsy

^EThis panther was removed from the wild 16 months prior to her death. If the Hg $t_{1/2}$ = 76 as for domestic cats, then her liver level would have been considerably higher when she was in the wild (5 $t_{1/2}$ = 485?!).

Table 34. Seminal traits of Florida panthers, 1986-87.

	PCO 10 ^A		#04 ^B	#07 ^C	#12 ^D	#13	#16 ^E	X	S.D. ^A
	04-18-85	04-18-86	04-18-85	01-26-85	01-28-86	02-26-86	01-12-87		
Normal Sperm (%) ^F	3.7	4.7	6.0	8.8	5.7	10.3	4.0	6.5	2.5
Abnormal Sperm (%) ^F	96.3	95.4	94.0	91.7	94.3	89.6	92.0	92.9	2.2
Primary Abnormalities	70.3	87.0	69.0	70.0	71.7	74.3	84.0	74.6	5.8
Coiled Flagellum	9.0	7.7	18.0	17.3	23.67	16.7	8.0	15.4	6.1
Microcephalic Defect	7.0	3.4	0	0	4.7	4.0	12.0	4.3	4.4
Macrocephalic Defect	0.6	0.6	0	0	0	0	4.0	0.8	1.6
Spherical Cephalic Defect	4.3	2.4	2.0	0	1.3	3.0	0	1.6	1.5
Abnormal Acrosome	48.3	70.0	48.0	44.0	39.7	46.0	36	45.5	8.0
Knobbed Acrosome	0	0	0	0	0	0	16	2.7	6.5
Midpiece Defect	0.6	1.3	0	3.3	2.0	2.3	0	1.3	1.4
Absence of Midpiece	0.3	0.3	1.0	5.3	0.3	2.3	6.0	2.5	2.5
Bicephalic	0	0.3	0	0	0	0	2.0	0.4	0.8
Secondary Abnormalities	26.0	8.4	25.0	21.7	22.7	15.3	8.0	18.3	6.2
Bent Midpiece	7.0	1.7	5.0	11.3	11.7	8.0	6.0	7.7	3.2
Bent Flagellum	0.3	0.7	1.0	1.0	1.0	2.0	0	0.9	0.7
Bent Flagellum Tip	0	0	0	0	0	0	0	0	0
Protoplasmic Droplet	18.6	5.7	19.0	9.3	10.0	5.3	2.0	9.6	5.9
Bent Neck	0	0.3	0	0	0	0	0	.02	0.1
Other									
Spermatid	0	0	0	0	0	0	4	0.7	1.6

^AThe average of two ejaculates from this captive male was used to calculate the mean and S.D.

^BRoad-killed panther live spermatozoa were recovered 13 hours postmortem from vas deferens of refrigerated testicle.

^CUrine collected (~300cc), centrifuged at < 1,000RPM, and sediment preserved in 2% Formalin and saline.

^DProven breeder - known to have sired 2 litters of 3 kittens each.

^ESubadult male - estimated to be 16-22 months old.

^FMorphological evaluation.

Table 35. Seminal traits of Florida panthers compared to wild Texas and captive cougars, cheetahs and domestic cats.

Number of Males Examined	FLORIDA PANTHERS 6	WILD TEXAS ^A COUGARS 5	CAPTIVE ^B COUGARS 7	CHEETAH ^F 18	DOMESTIC CAT ^C 16
Mean $\pm$ S.D.	X $\pm$ S.D.	X	X	X $\pm$ S.D.	X $\pm$ S.D.
Normal Sperm (%)	6.5 $\pm$ 2.5	30-40	24.8	29.0 $\pm$ 0.9	70.9 $\pm$ 3.7
Abnormal Sperm (%)	92.9 $\pm$ 2.2	60-70	75.2	71.0 $\pm$ 0.9	29.1 $\pm$ 3.7
Primary Abnormalities	74.6 $\pm$ 5.8	20	25.7	27.4 $\pm$ 2.8	5.8 $\pm$ 1.3
Coiled Flagellum	15.4 $\pm$ 6.1	15	17.2	25.8 $\pm$ 2.3	5.5 $\pm$ 0.8
Microcephalic Defect	4.3 $\pm$ 4.4		0	1.2 $\pm$ 0.3	0.2 $\pm$ 0.1
Macrocephalic Defect	0.8 $\pm$ 1.6		0	0.4 $\pm$ 0.2	0.1 $\pm$ 0.04
Spherical Cephalic Defect	1.6 $\pm$ 1.5		0	0	0
Abnormal Acrosome	45.5 $\pm$ 8.0	2-3	3.4	0	0
Knobbed Acrosome	2.7 $\pm$ 6.5		0	0	0
Midpiece Defect	1.3 $\pm$ 1.4		0	0	0
Absence of Midpiece	2.5 $\pm$ 2.5		0	0	0
Bicephalic	0.4 $\pm$ 0.8		0	0	0
Secondary Abnormalities	18.3 $\pm$ 6.2	50	49.5	43.6 $\pm$ 3.3	11.52 $\pm$ 1.6
Bent Midpiece	7.7 $\pm$ 3.2	30	25.0	23.3 $\pm$ 1.1	6.4 $\pm$ 0.8
Bent Flagellum	0.9 $\pm$ 0.7		7.9	1.2 $\pm$ 1.3	5.1 $\pm$ 0.7
Bent Flagellum Tip	0		12.0	2.8 $\pm$ 0.6	0.02 $\pm$ 0.1
Protoplasmic Droplet	9.6 $\pm$ 5.9		0	1.3 $\pm$ 0.3	0
Bent Neck	.02 $\pm$ 0.1		0	0	0
Other					
Spermatid	0.7 1.6		0	0	0

^AThese are preliminary results, precise values may change when analysis is completed.

^BHoward et al. 1984. ^CWildt et al. 1983.

Table 36. Allelic isozyme phenotypes of polymorphic loci in different populations of puma (*F. concolor*).

Locus ^A Population ^B	PP	PGD	APRT	CAT	DIA-W	ES1	ADA	GPI	ACP2	GOT2	ESa	NUMBER LOCI VARIABLE
Florida												
BCNP (13-24) ^{CD}	AB	AB	AB	AA	AA	AA	AA	AA	AA	AA	AA	3
ENP (6-7) ^D	AB	AB	AB	AA	AA	AA	AA	AA	AA	AA	AA	3
California (4)	AB	AB	AA	AA	AA	AB	AA	AA	AA	AA	AA	3
Oregon												
Western (5)	AB	AA	AA	AA	AA	AB	BB	AA	AA	AA	AB	3
Eastern (1)	AA	AA	AA	AA	AA	BB	AA	AA	BB	AB	AA	1
Texas (12)	AB	AA	AA	AA	AA	AB	AB	AA	AA	AB	AA	4
Arizona (6)	AB	AB	AA	AA	AA	AB	AB	AB	AB	AB	AA	7
Colorado (3)	AA	AA	AA	AA	AA	AB	AA	AA	AA	AB	AA	2
Utah (2)	AA	AB	AA	AA	AA	AB	AA	AA	AB	BB	AA	3
"Piper" (10)	AB	AB	AB	AB	AB	AA	AA	AA	AA	AA	AA	5
Captive (15)	AB	ABC	AA	AA	AA	AB	AB	AB	AB	AB	AA	9

^AGene names are homologous to human loci of the same name and abbreviation

^BSUBSPECIFIC DESIGNATION: Florida (*F. c. coryi*), BCNP-Big Cypress Swamp physiographic region, ENP-Everglades National Park; western Oregon (border between *F. c. oregonensis* and *F. c. californica*), eastern Oregon (*F. c. missoulensis*); California (*F. c. californica*); Texas (*F. c. stanleyana*); Arizona (*F. c. azteca* & *browni*); Colorado (*F. c. hipolestes*); Utah (*F. c. kaibabensis*); "Piper" stock, bred by Everglades Wonder Gardens of Bonita Springs Fl., original breeding stock obtained from wild Florida panther (*F. c. coryi*) in approx. 1940 from Big Cypress swamp; Captive (wild origin could not be determined)

^CNumber of individuals examined for each population in parentheses

^DAPRT was examined in 24 and 7 individuals, all other genes were examined in 13 and 6 animals.

Table 37. Gene frequencies for eleven polymorphic loci in nine different populations^A of puma (*F. concolor*).

Locus ^B		Florida		Oregon		California	Texas
		BCNP (13-24) ^{CD}	ENP (6-7) ^D	Western (5)	Eastern (1)	(4)	(12)
ADA	a =	1.0	1.0	0	1.0	1.0	0.44
	b =			1.0			0.56
CAT	a =	1.0	1.0	1.0	1.0	1.0	1.0
	b =						
ESa	a =	1.0	1.0	0.9	1.0	1.0	1.0
	b =			0.1			
ES1	a =	1.0	1.0	0.5		0.5	0.22
	b =			0.5	1.0	0.5	0.78
GOT2	a =	1.0	1.0	1.0	0.5	1.0	0.35
	b =				0.5		0.65
GPI	a =	1.0	1.0	1.0	1.0	1.0	1.0
	b =						
PGD	a =	0.65	0.08	1.0	1.0	0.5	1.0
	b =	0.35	0.92			0.5	
	c =						
PP	a =	0.86	0.94	0.38	1.0	0.75	0.75
	b =	0.14	0.06	0.62		0.25	0.25
APRT	a =	0.96	0.42	1.0	1.0	1.0	1.0
	b =	0.04	0.58				
ACP ₂	a =	1.0	1.0	1.0		1.0	1.0
	b =				1.0		
DIA-W	a =	1.0	1.0	1.0	1.0		1.0
	b =						

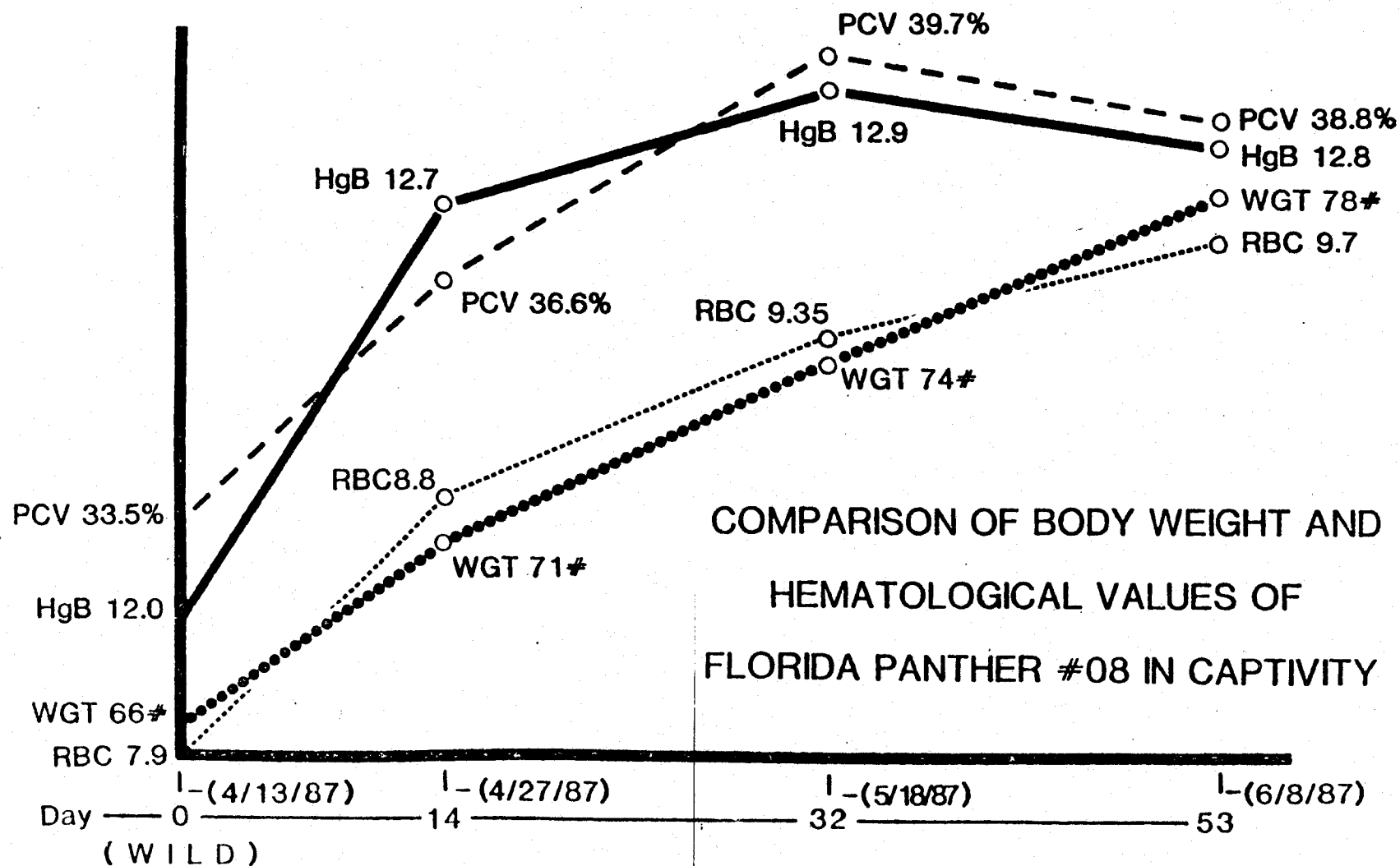
Table 37. (continued)

Gene Frequency Table p.2

Locus ^B		Arizona (6) ^C	Colorado (3)	Utah (2)	"Piper" (10)	Captive (15)
ADA	a =	0.6	1.0	1.0	1.0	0.9
	b =	0.4				0.1
CAT	a =	1.0	1.0	1.0	0.75	1.0
	b =				0.25	
ESa	a =	1.0	1.0	1.0	1.0	1.0
	b =					
ES1	a =	0.58	0.33	0.5	1.0	0.68
	b =	0.42	0.66	0.5		0.32
GOT2	a =	0.75	0.75		1.0	0.77
	b =	0.25	0.25	1.0		0.23
GPI	a =	0.42	1.0	1.0	1.0	0.9
	b =					0.1
PGD	a =	0.75	1.0	0.75	0.3	0.65
	b =	0.25		0.25	0.7	0.31
	c =					0.04
PP	a =	0.75	1.0	1.0	0.06	0.875
	b =	0.25			0.94	0.125
APRT	a =	1.0	1.0	1.0	0.4	0.94
	b =				0.6	0.06
ACP ₂	a =	0.92	1.0	0.5	1.0	0.89
	b =	0.08		0.5		0.11
DIA-W	a =	1.0	1.0	1.0	0.72	1.0
	b =				0.28	

^ASUBSPECIFIC DESIGNATION: Florida (*F. c. coryi*), BCNP-Big Cypress National Preserve and surrounding ecosystem, ENP-Everglades National Park; Oregon-western (border between *F. c. oregonensis* and *F. c. californica*), eastern (*F. c. missoulensis*); California (*F. c. californica*); Texas (*F. c. stanleyana*); Arizona (*F. c. azteca* & *browni*); Colorado (*F. c. hippolestes*); Utah (*F. c. kaibabensis*); "Piper" stock, bred by Everglades Wonder Gardens of Bonita Springs Fl., original breeding stock obtained from wild Florida panther in approx. 1940 from Big Cypress swamp; Captive (wild origin could not be determined). ^BGene names are homologous to human loci of the same name and abbreviation. ^CNumber of individuals examined for each population in parentheses. ^DAPRT was tested for 24 and 7 individuals, others only 13 and 6.

Figure 1. Comparison of body weight and hematological values of Florida panther #08F in captivity.



NUMBER OF DAYS IN CAPTIVITY
APRIL 13 - JUNE 8 1987

Figure 2. Documented mortality and injury for all Florida panthers, 1972-1990.

ALL PANTHERS 1972 - 1990

(Human Related = 65.1 %)

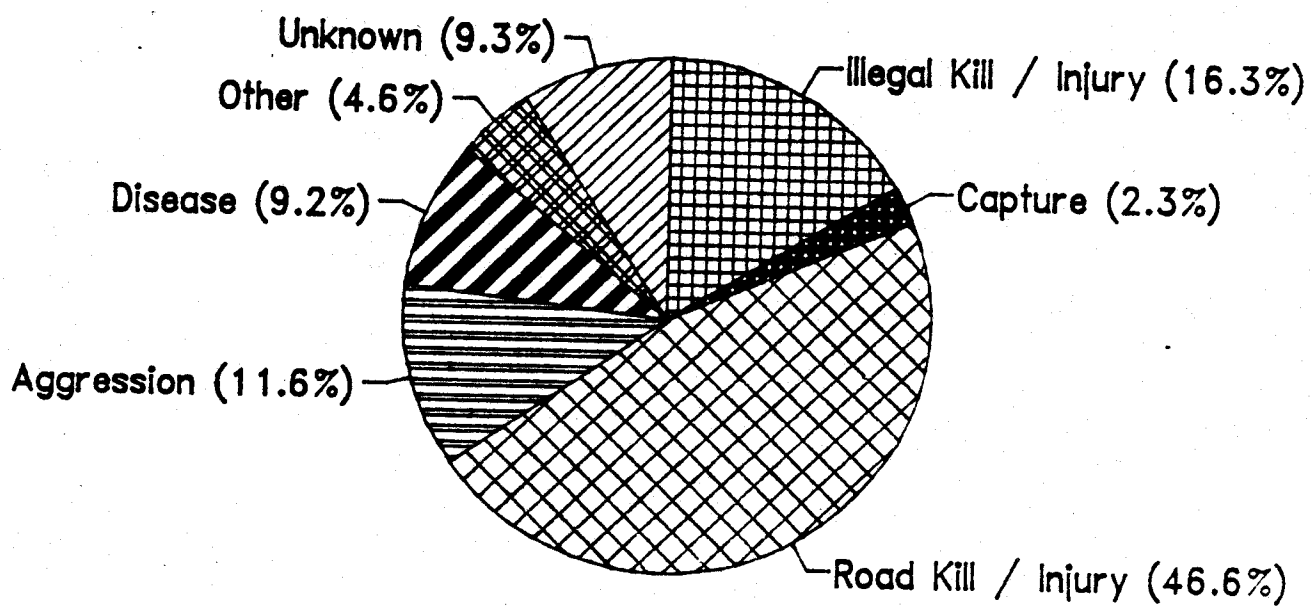


Figure 3. Documented mortality and injury for uncollared panthers, 1972-1990.

UNCOLLARED 1972 - 1990

(N = 20 : Dead 17, Injured 3)

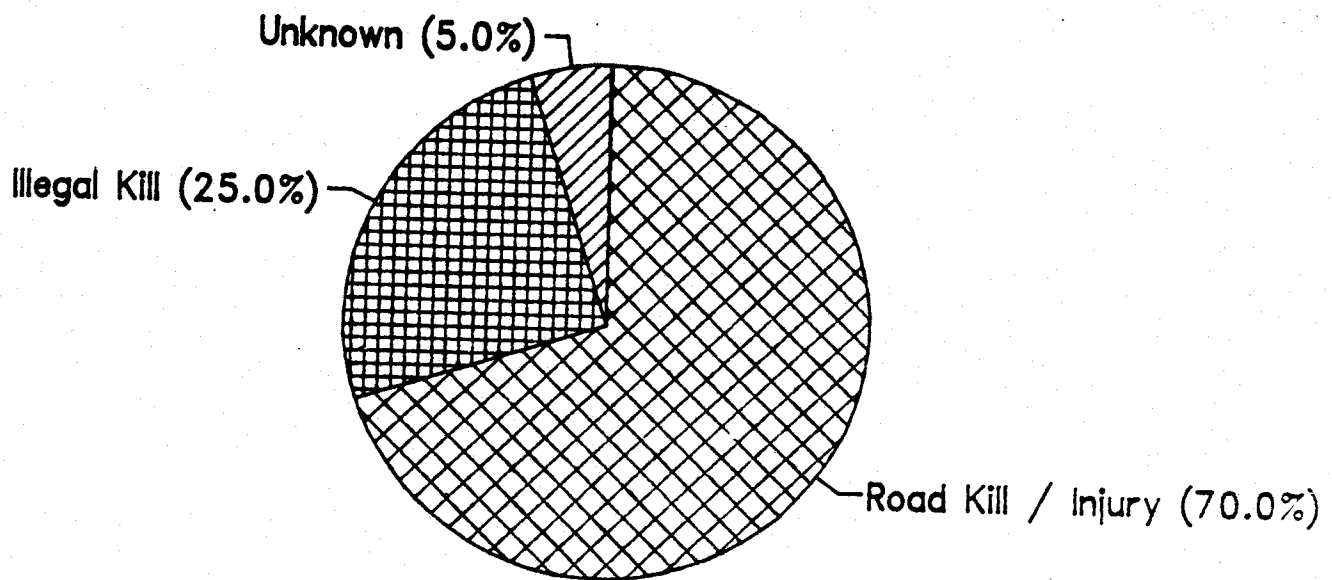


Figure 4. Documented mortality and injury for radio-collared panthers, 1981-1990.

RADIO-COLLARED 1981 - 1990

(N = 23 : Dead 19, Injured 4)

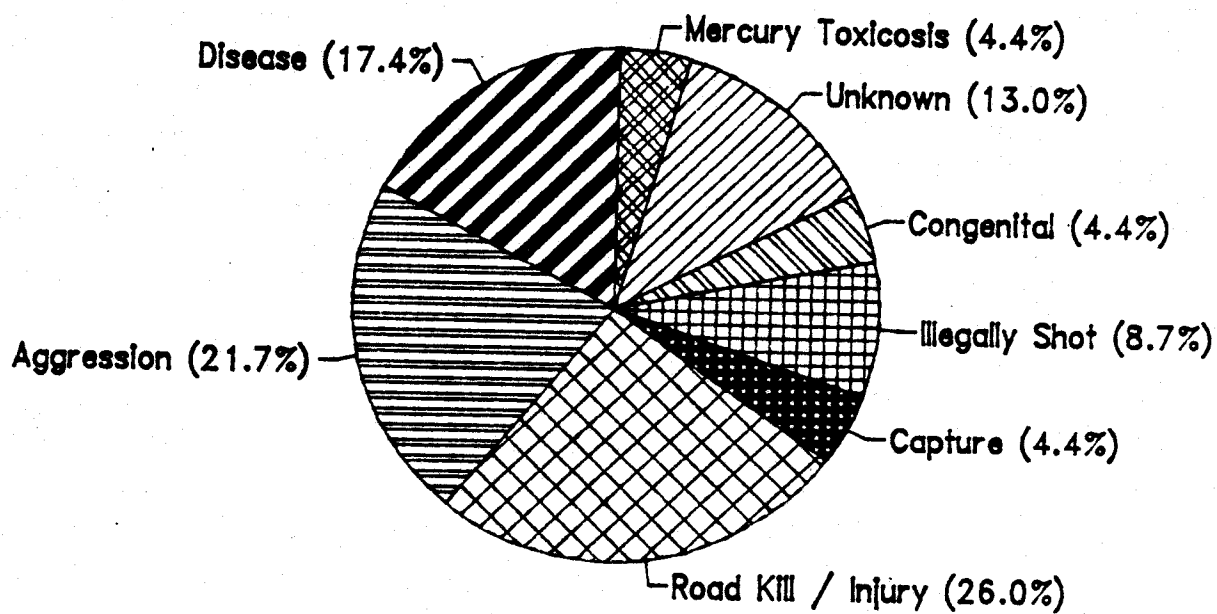


Figure 5. Geographic locations of sampled Florida panthers. I. - Big Cypress Swamp, Fakahatchee Strand, and adjacent private ranches. II. - Everglades ecosystem.

Florida Panther Geographic Regions

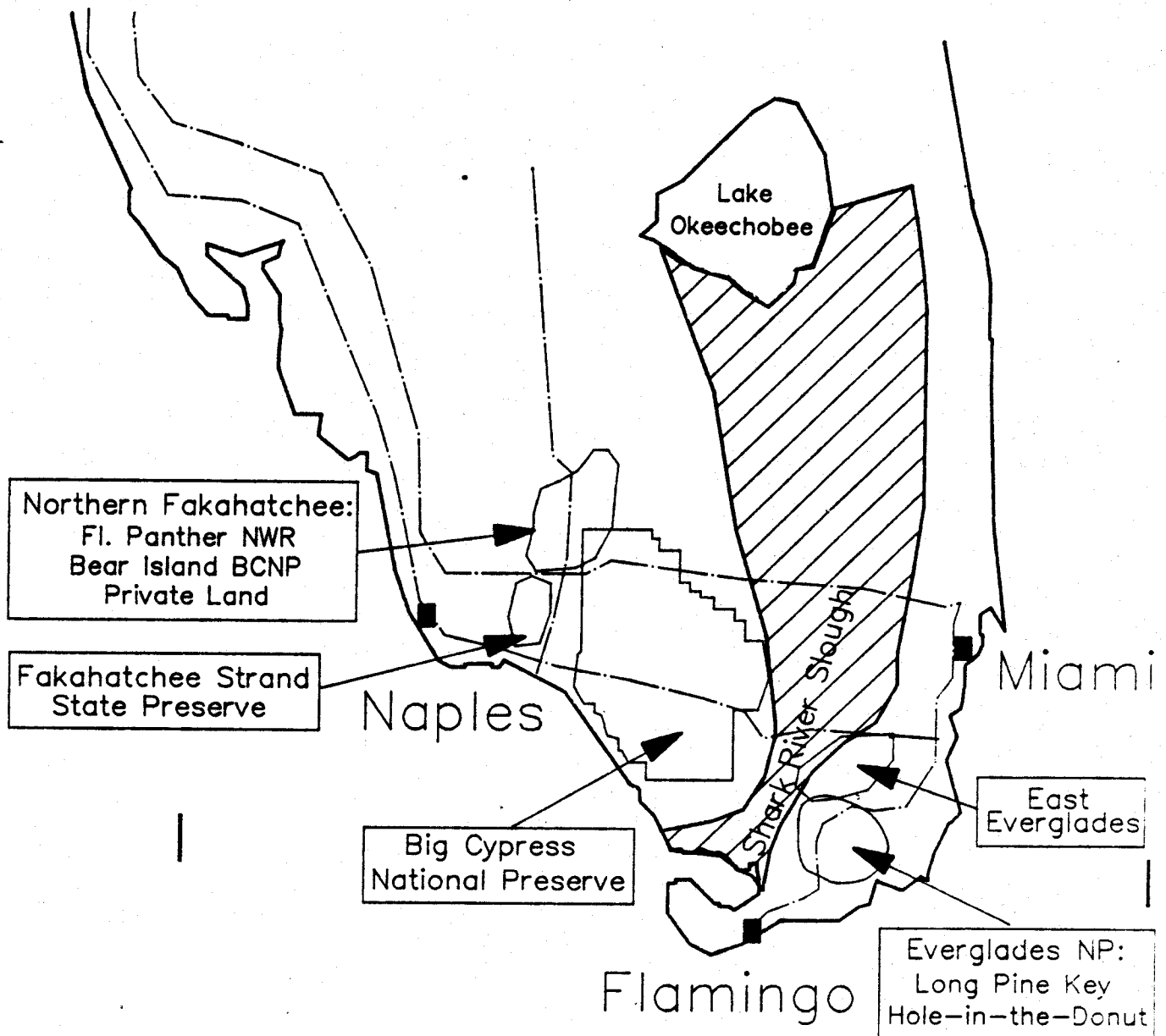


Figure 6. Total mercury values in liver samples from dead panthers showing geographic distribution of contaminants.

Florida Panther Liver Mercury (ppm wet weight)

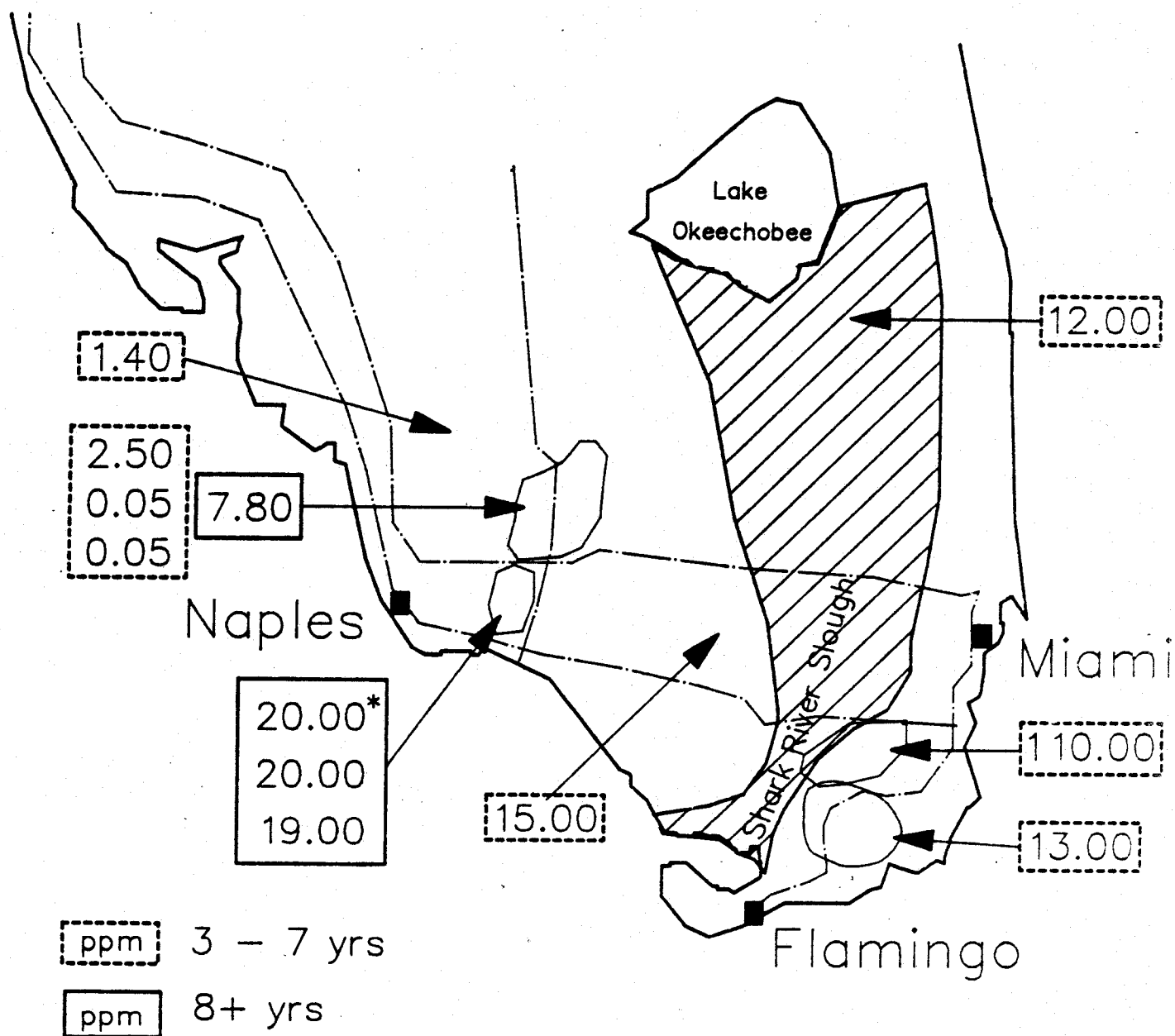


Figure 7. Linear regression was used to develop a prediction model for liver mercury level given hair mercury concentration. Mercury concentrations were log transformed prior to plotting.

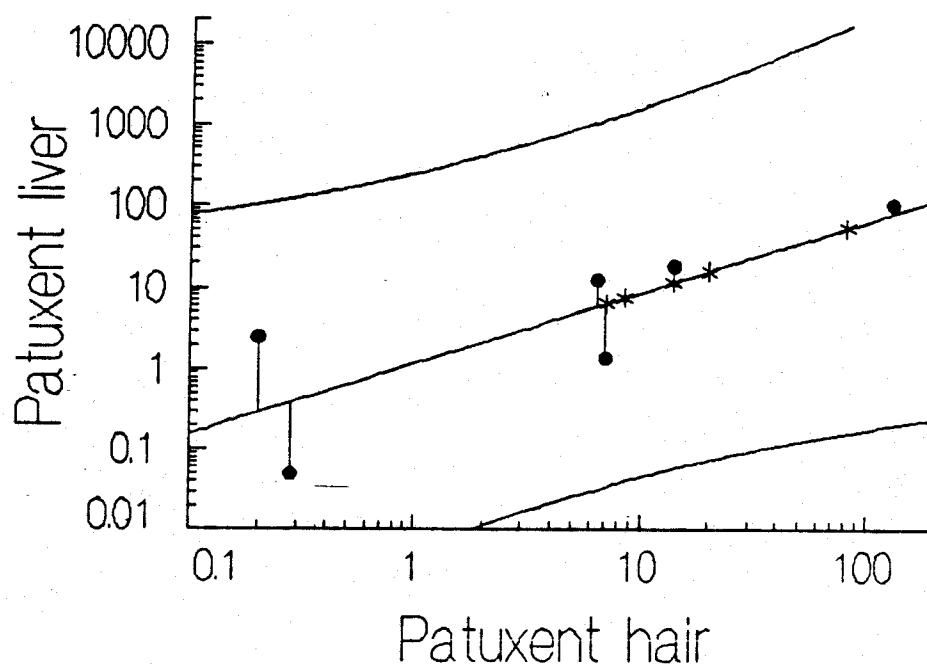
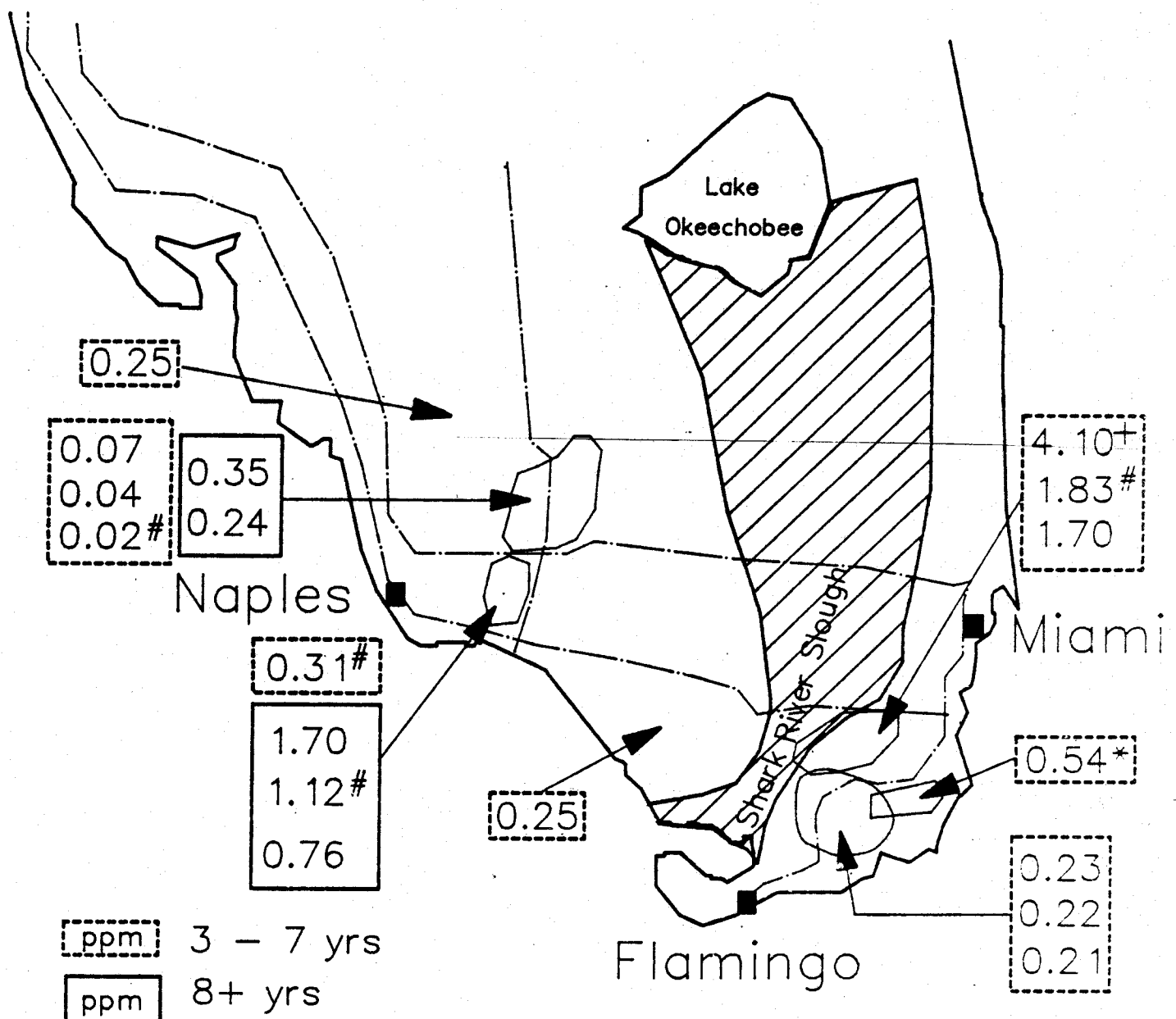


Figure 8. Total mercury values in whole blood samples from dead and living panthers showing geographic distribution of contaminant.

Florida Panther

Whole Blood Mercury (ppm wet weight)



* 1 month in captivity

calculated from clot or washed red cells

+ post mortem hemolysed blood

Figure 9. Florida panther reproductive success by area expressed as the number of documented kittens ≥ 6 months of age per female year (total accumulative time that all females in respective areas were monitored, in years). Primary areas were the N.FS/BI/PR - northern Fakahatchee Strand, Bear Island Unit of the Big Cypress National Preserve and adjacent private ranches; FSSP - Fakahatchee Strand State Preserve; and ENP - Everglades National Park.

Florida Panther Reproductive Success

Kittens surviving to ≥ 6 months of age
January 1981 – January 1990

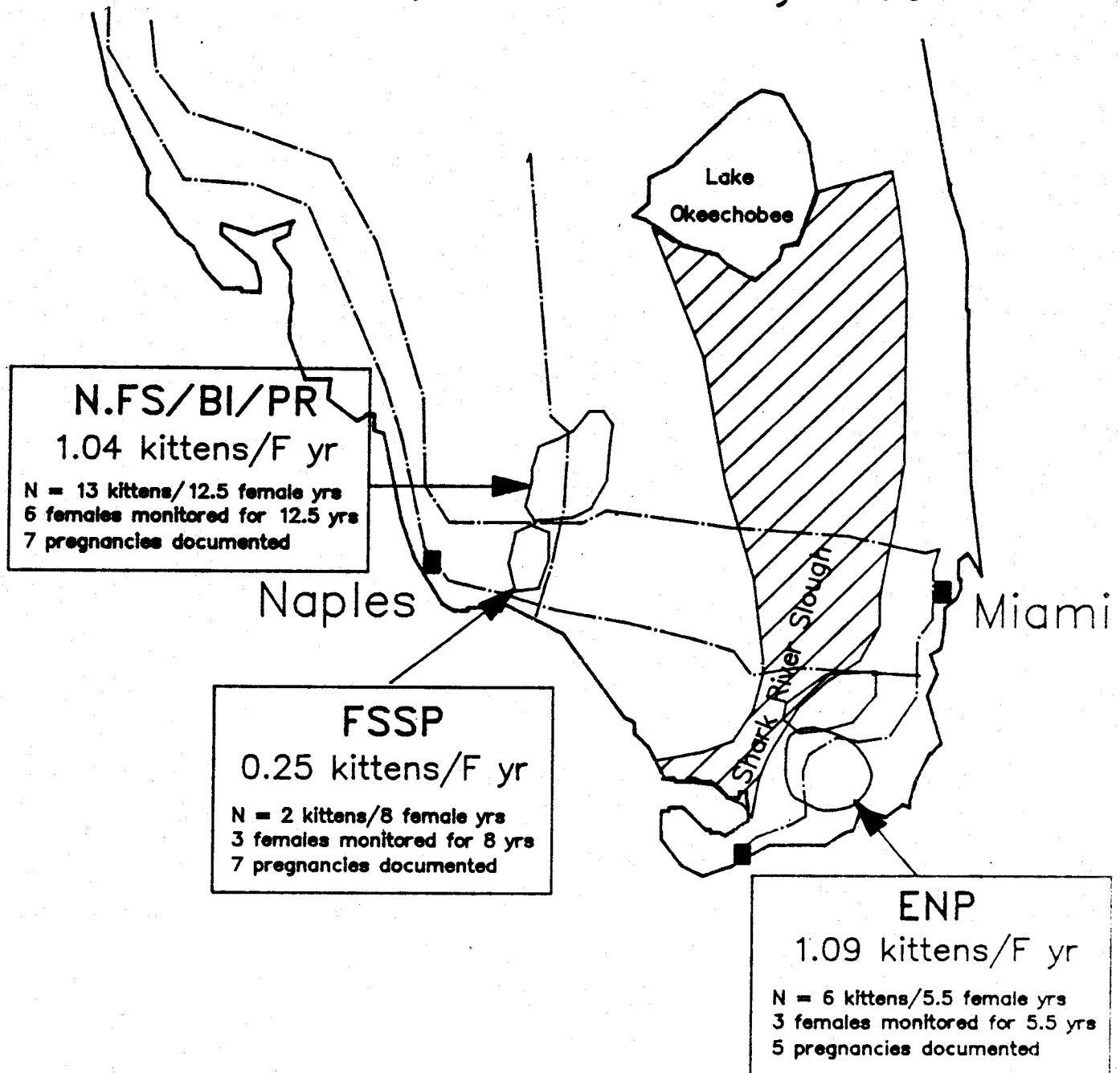


Figure 10. Comparison of abnormal spermatozoa between Florida panthers, cougars, cheetahs, and domestic cats.

COMPARISON OF ABNORMAL SPERMATOZOA BETWEEN FLORIDA PANTHERS, COUGARS, CHEETAHS, AND DOMESTIC CATS

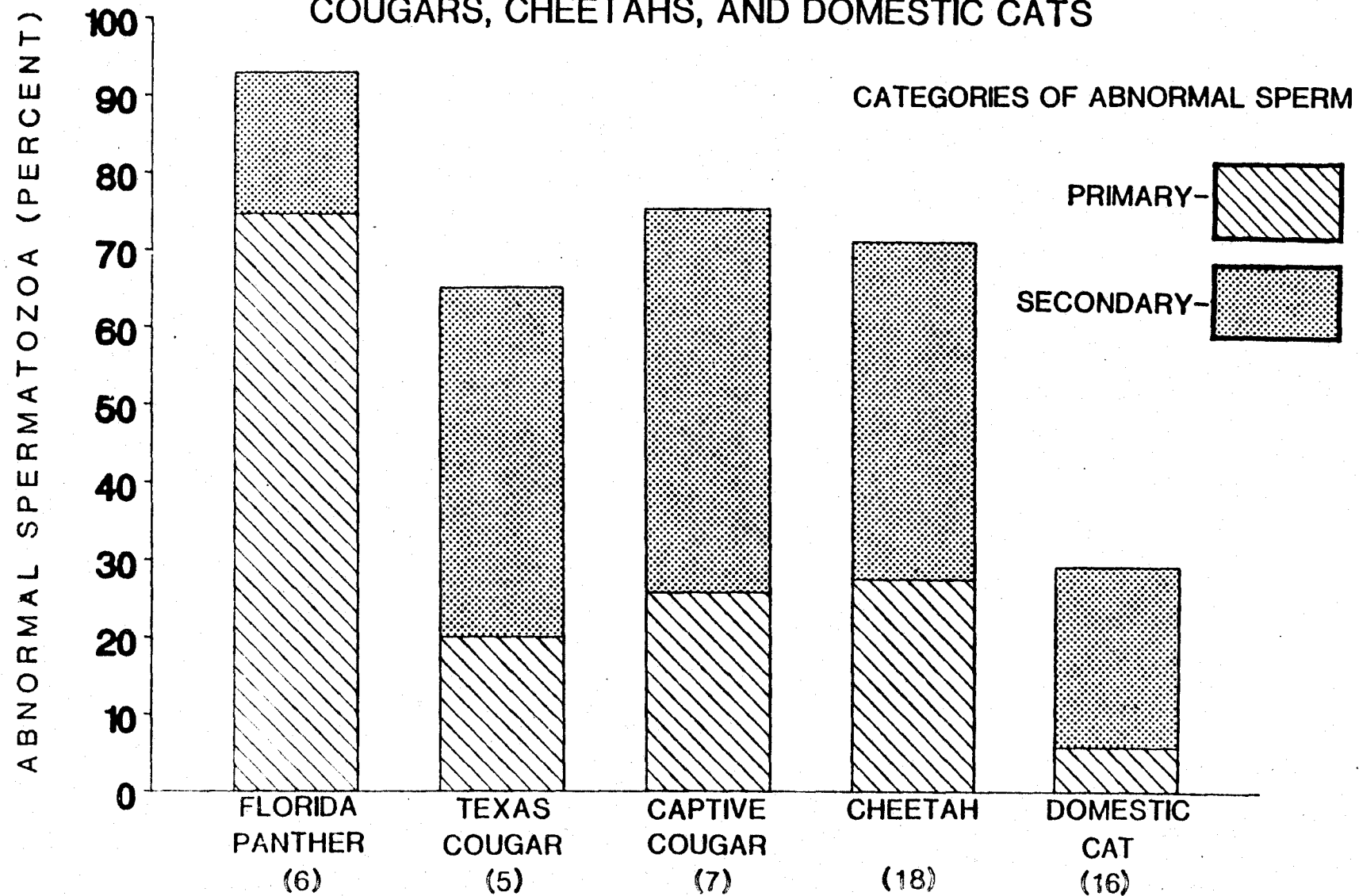
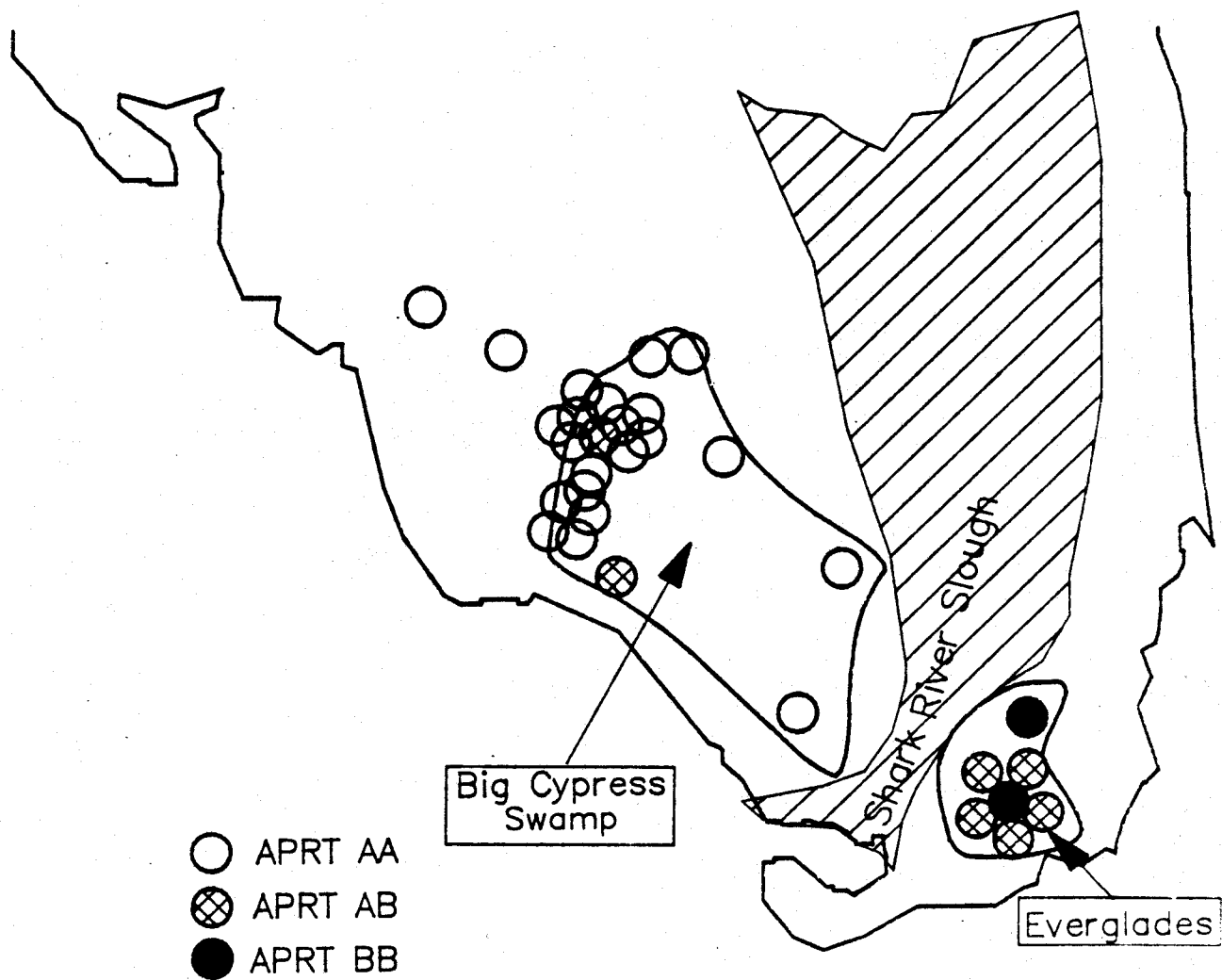
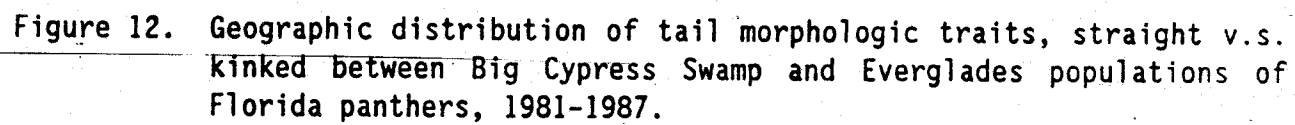


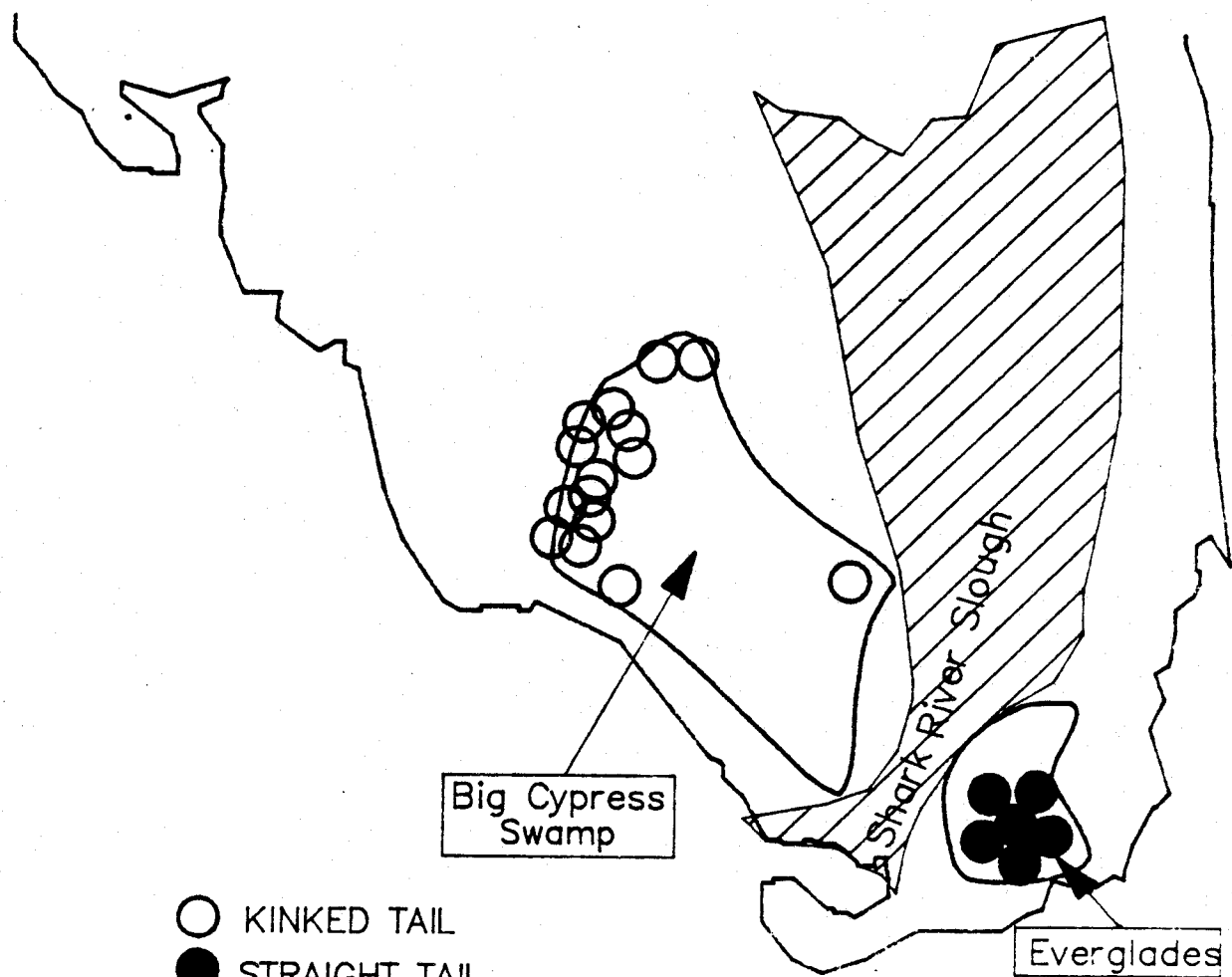
Figure 11. Geographic distribution of APRT (Adenosine phosphoribosyl transferase) between Big Cypress Swamp and Everglades populations of Florida panthers, 1981-1989.



1981 — 1989

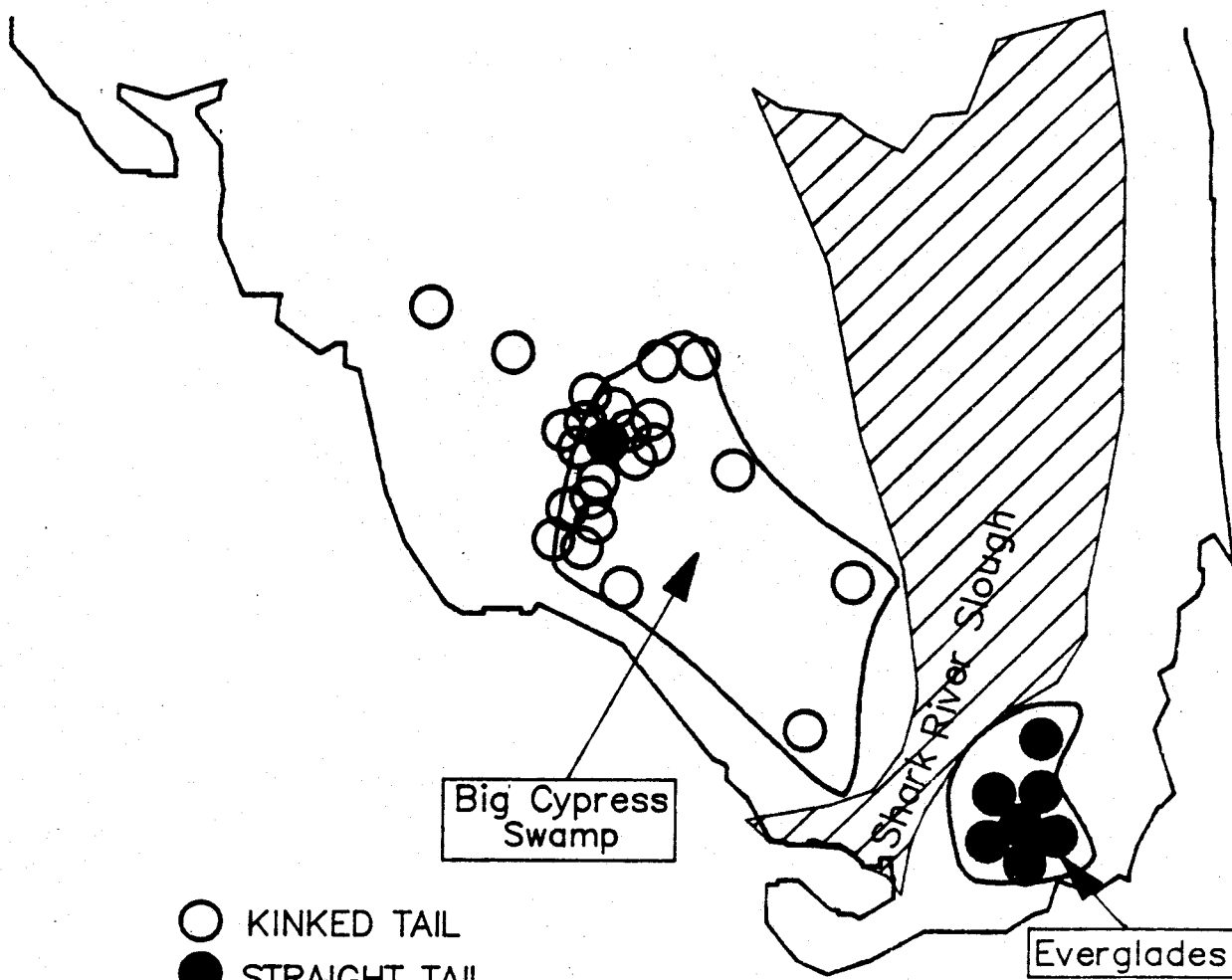
Figure 12. Geographic distribution of tail morphologic traits, straight v.s. kinked between Big Cypress Swamp and Everglades populations of Florida panthers, 1981-1987.

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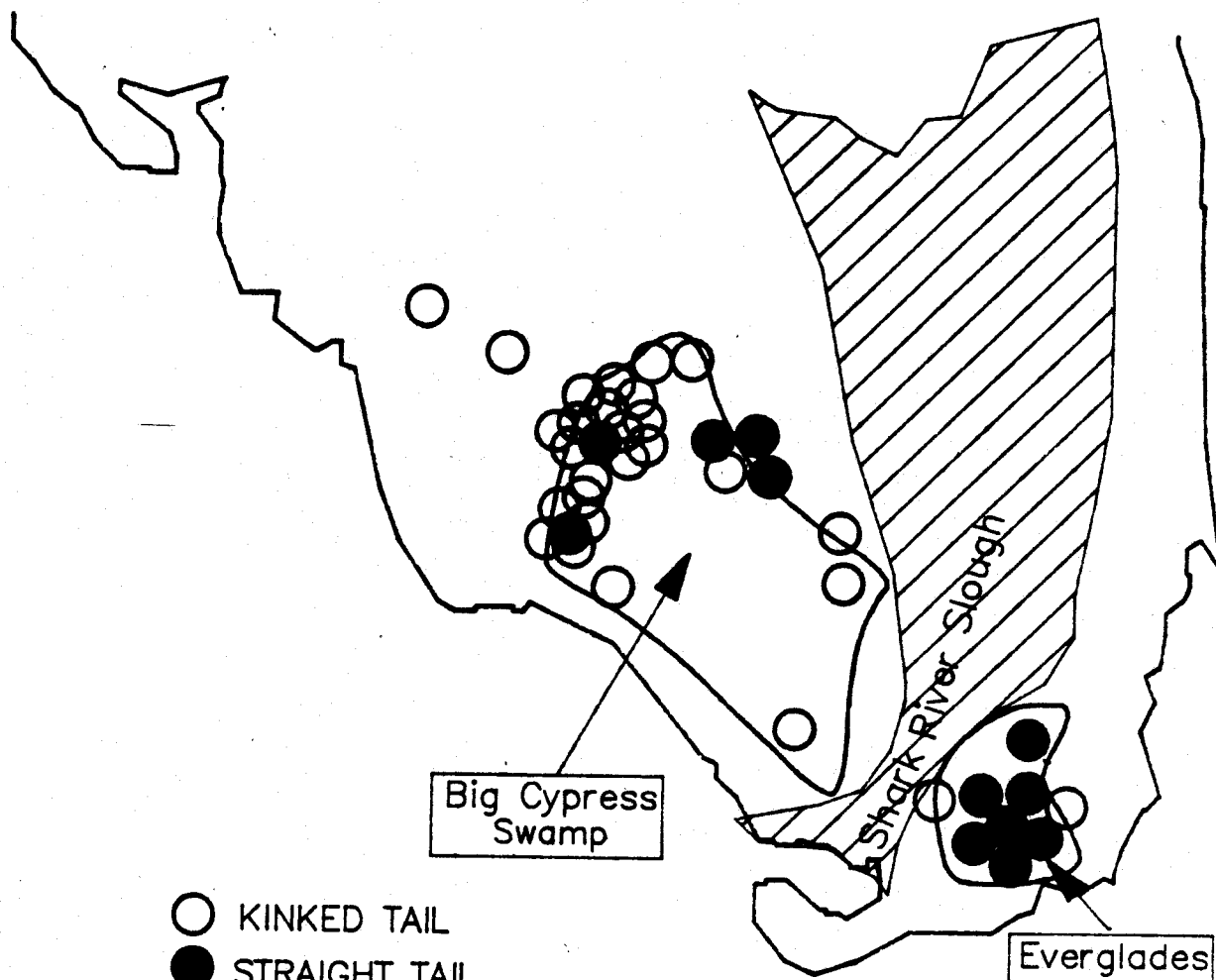
1981 - 1987

Figure 13. Geographic distribution of tail morphologic traits, straight v.s. kinked between Big Cypress Swamp and Everglades populations of Florida panthers, 1981-1989.



1981 — 1989

Figure 14. Geographic distribution of tail morphologic traits, straight v.s. kinked between Big Cypress Swamp and Everglades populations of Florida panthers, 1981-1990.



1981 — 1990

Figure 15. Geographic distribution of mitochondrial DNA (mtDNA) haplotypes in North and South America. Similarly shaped symbols indicate identical mtDNA. Open symbols belong to a North American clade and darkened symbols belong to a South American clade.

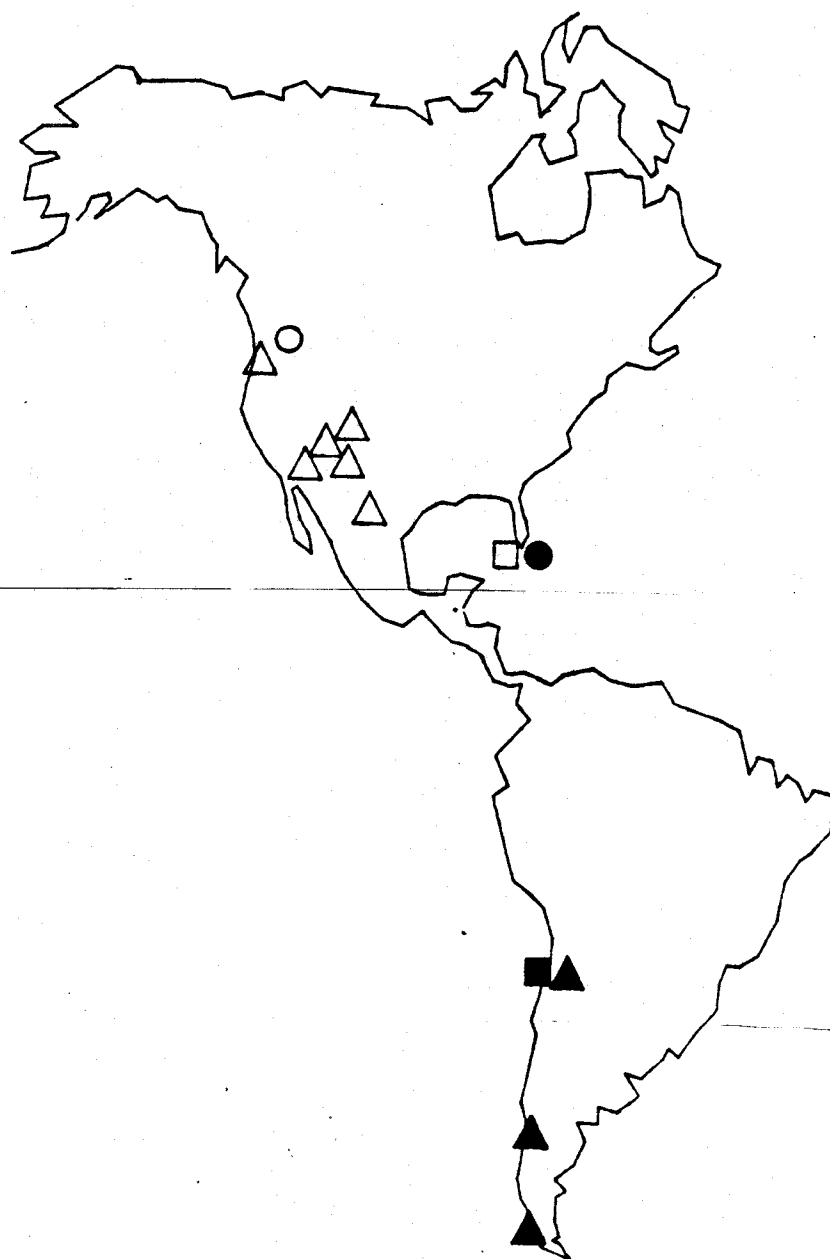


Figure 16. Geographic distribution of mitochondrial DNA (mtDNA) between Big Cypress Swamp and Everglades populations of Florida panthers, 1981-1989.