7 October 1992

Robert C. Belden
Florida Game and Fresh Water Fish Commission
Wildlife Research Laboratory
4005 South Main Street
Gainesville, FL 32601
904-336-2230

RH: Panther Translocation Feasibility · Belden and Hagedorn

FEASIBILITY OF TRANSLOCATING PANTHERS INTO NORTHERN FLORIDA

ROBERT C. BELDEN, Florida Game and Fresh Water Fish Commission, Wildlife Research Laboratory, 4005 S. Main Street, Gainesville, FL 32601

BRUCE W. HAGEDORN,[1] Florida Game and Fresh Water Fish Commission, Wildlife Research Laboratory, 4005 S. Main Street, Gainesville, FL 32601

Abstract: Seven mountain lions (Felis concolor stanleyana) captured in western Texas were released in northern Florida and used as surrogates for evaluating the feasibility of translocating Florida panthers (F. c. coryi). Using radio telemetry, they were monitored daily, except Sundays, from 15 June 1988 to 19 April 1989. The lions established overlapping home ranges, killed large prey at a predicted frequency, and settled into routine movement and feeding patterns before the hunting season. However, during the hunting season the lions were either killed, or abandoned their home ranges. Subsequent wanderings into urban areas and livestock operations necessitated the early removal of study animals. We cannot recommend the introduction of Florida panthers into northern Florida at this time. Instead, we recommend further study of techniques for establishing viable populations that are compatible with the expanding human population.

J. WILDL. MANAGE. 00(0):000-000

Key words: Felis concolor, Florida panther, food habits, home ranges, reintroduction, translocation.

The only documented breeding population of Florida panthers occurs in southern Florida, primarily in the Big Cypress Swamp and Everglades physiographic regions. An estimated 30-50 animals remain. The Florida Game and Fresh Water Fish Commission (FGFWFC) has committed to manage this population and to reintroduce panthers into other suitable areas within the state, if feasible. Successfully introducing panthers into such areas would reduce the risk of extinction for the subspecies. Thus, we wanted to determine the feasibility of using translocated wild panthers to re-establish Florida panther populations.

We acknowledge T. H. Logan and J. R. Brady for constructive criticism, guidance, and support. Mountain lions were provided by R. T. McBride of Ranchers Supply, Inc., in Alpine, Texas. Lion sterilization was coordinated by project veterinarian M. E. Roelke. We gratefully acknowledge the support and assistance of L. L. Martin, S. K. Stafford, and D. A. Weaver. Law enforcement support was generously provided by L. F. Rossignol, L. R. Johnson, and their staffs. H. D. Couch, P. D. Southall, D. D. Weiffenbach, and J. B. Wooding assisted with aerial tracking. M. C. Conner, J. H. Garrison, A. W. Gaylard, C. T. Lee, C. L. McKelvy, and A. W. Stockle gave much needed assistance during all aspects of the study. We also greatly appreciate the cooperation and support provided by the Georgia Department of Natural Resources Game and

Fish Division, particularly that of J. C. Kurz. We thank J. R. Brady, P. E. Moler, C. T. Moore, and S. A. Nesbitt for reviews of the manuscript, and C. T. Moore for statistical assistance. The Buckeye Cellulose Corporation agreed to indemnify the Commission for any liability for livestock losses caused by introduced mountain lions. Primary funding was provided by the FGFWFC through Florida's Nongame Wildlife Trust Fund and 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).

STUDY AREA

We chose the study area based on a questionnaire survey of wildlife biologists of the FGFWFC (Belden 1987). Advantages of this area were its relatively large size; abundance of deer and wild hogs; relatively low density of humans, landowners, and paved highways; and its proximity to the panther captive breeding facilities at Gilman Paper Company's White Oak Plantation and the FGFWFC's Wildlife Research Laboratory. The study area occupies approximately 12,392 km^2 in parts of 11 counties in Florida (Baker, Columbia, Duval, Hamilton, and Nassau) and Georgia (Brantley, Camden, Charlton, Clinch, Echols, and Ware) (Fig. 1). Hot, wet summers and cool, dry winters characterize the climate. Rainfall averages 131 cm annually and is greatest during June-September when afternoon and evening thunderstorms prevail (Avers and Bracy 1973). Elevations range from 4 to 50 m.

Three major vegetative communities are interspersed throughout the area: pine flatwoods, mixed hardwood and pine, and mixed hardwood swamp (U.S. Dep. Agric. Soil Conservation

Service, unpubl. data). Slash pine (Pinus elliottii) and longleaf pine (P. palustris) dominate the overstory in the pine flatwoods. This community occurs on level, poorly drained soils. Dominant trees in the mixed hardwood and pine community are loblolly pine (P. taeda), American holly (Ilex opaca), eastern hophornbeam (Ostrya virginiana), southern magnolia (Magnolia grandiflora), and water oak (Quercus nigra). This community is successional, with hardwoods replacing pines. The mixed hardwood swamp community occurs in association with river floodplains and natural depressions. This community includes river swamps, cypress domes, and bay heads. Cypress (Taxodium distichum) and tupelo (Nyssa spp.) often dominate in the overstory. Other tree species associated with this community are sweetbay (Magnolia virginiana), loblolly bay (Gordonia lasianthus), and redbay (Persea borbonia).

METHODS

Belden and Frankenberger (1988) described public notification procedures and survey results demonstrating nonexistence of panthers in the area. Two adult male (T-16 and T-18), 2 adult female (T-13 and T-15), and 1 yearling female (T-14) mountain lions were captured with hounds in western Texas during 28 April - 26 May 1988 and flown to Gainesville, Florida on 27 May 1988. Between 31 May and 3 June 1988, they were sterilized and equipped with radio collars. The animals were moved to the release site on the study area and held in the release pens 7-15 June 1988. Three of these original 5 cats were lost (killed) during the first half of the study, and 2 additional cats (1 adult male [T-21] and 1 adult female [T-19]) were captured in western Texas during December 1988 and flown to Florida. They were held in quarantine until they were

moved to release pens on 14 March 1989 and released on 22 March 1989. One of the original 5 cats (T-16) had established a home range between Folkston and Winokur, Georgia. He was recaptured, held in the release pens, and released with the last 2 cats. We suspected that the presence of other mountain lions would hold him closer to the release site.

We radio-monitored all animals daily except Sundays (Table 1) from a Cessna 172 airplane fitted with 2 H-configuration antennas. When a lion was located, its latitude and longitude were estimated using a Loran-C navigation receiver. Each location was plotted on a 1:100,000 topographic map. Latitude and longitude were converted to Universal Transverse Mercator coordinates (0.1 km). We analyzed telemetry data using the computer program TELEM (Coleman and Jones 1986). Total areas used by lions and home ranges were calculated using the minimum convex polygon method (Mohr 1947). A home range was considered established when a lion restricted ³95% of its movements in a predictable area for ³3 months. Movements out of and back to these areas were classed as "excursions." A home range was considered abandoned if the lion left the area and never returned. We assessed habitat use during flights through classification of each lion's location by dominant cover type.

We measured total linear road distance by class (A = primary hard-surface highway, B = secondary hard-surface highway, C = light-duty road, and D = other roads and trails) within each mountain lion's home range and within the study area as a whole. The ratio of road density (km/km^2) within each home range to road density within the study area was then calculated for each road class. We used the sign test (Hollander and Wolfe 1973) for each road type to test the

null hypothesis that the median ratio = 1.0 against the alternative that the median ratio <1.0. The 2-sided alternative (median ratio ¹ 1.0) was not used because there was no reason to believe that lions would set up home ranges containing greater densities of roads than that of the study area.

We estimated frequency of road crossings for each lion and road class by counting all intersections of roads by straight lines drawn between consecutive locations on a 1:100,000 survey map. The distribution of road crossings was compared with the distribution of road distance, where each distribution was calculated as percentage of the total quantity within a lions's home range. We used Friedman's test (Hollender and Wolfe 1973) to test the hypothesis that within-lion rankings of the differences between distributions were equal for all road types.

When a lion was sedentary for ³2 days, we assumed it had killed a large prey animal in the area. On the second day, the lion's location was estimated as accurately as possible from the ground by triangulation. The location was thoroughly searched after the cat left the area. A portable loran unit was used to find assumed kill sites in remote areas where triangulation from the ground was not possible. We recorded vegetation cover type and prey species, sex, age, and percent consumed for each kill found. Frequency of large prey in the diet was estimated for each lion following kill site investigations.

RESULTS

Movements and Home Ranges

The 7 mountain lions released into northern Florida were monitored for varying periods from 15 June 1988 to 19 April 1989, and 812 locations were recorded in the 306-day period (975

lion-days). All 4 lions that were in the wild >35 days (T-14, T-15, T-16, and T-18) established home ranges (range 96-930 km^2) that overlapped one another in a 2,000-km^2 area (Table 1; Fig. 2), a density of 0.2 lions/100 km^2. Mean distance from each home-range center was 16.6 km (range = 2.8-32.7 km) to the release site and 20.4 km (range = 9.6-31.9 km) to other home-range centers. The mountain lions were located frequently (90%) in hardwood swamp and pine flatwoods habitats.

All lions except male T-21 moved westward when first released. T-21 moved north and then southeast, eventually to a subdivision in Duval County, Florida, where he was recaptured. His southeastward movement continued after his second release on the western side of the Suwannee River until his recapture and removal from the study area on 17 April 1989. The other lions settled in well-defined areas after their early westward movements. They made excursions from these areas, then usually returned after 7-10 days. After ³2 excursions, the lions settled into stable home ranges.

Unlike the other lions studied, subadult female T-14 established a home range without preliminary excursions. She was the first to establish and the first to abandon a home range. On 19 November 1988, the opening day of the general gun hunting season, she left her home range occupied for 5 months and began a 2-week excursion (Fig. 3).

On 20 November 1988, the day following T-14's departure, T-16 left his home range along the Suwannee River, where he had spent the previous 5 months (Fig. 4). He moved east and remained outside of Macclenny, Florida, for 2 weeks before continuing to the outskirts of

Jacksonville, Florida, where he killed 5 domestic goats (Capra sp., 2 kids, 2 nannies, 1 billy). He then moved north to Waycross, Georgia, and set up a home range along Little Buffalo Creek between Folkston and Winokur, Georgia. He was recaptured on 10 March 1989 and re-released on 22 March 1989 with 2 new study animals.

On 25 March 1989, Saturday of the first weekend following the opening of the spring turkey hunting season, T-15 left her home range, which she had established in September 1988 along the Little Alapaha River north of Jasper, Florida, and Fish Scaffold Branch north of Needmore, Georgia (Fig. 5). Her 27-km eastward excursion took her to a 486-ha pen containing exotic ungulates, where she killed 5 blackbucks (Antilope cervicapra). She was recaptured on 4 April 1989 and was moved 32 km back to her home range. However, her eastward movement resumed after release, and she returned to the exotic ungulate pen within 5 days. She was again recaptured and removed from the study area.

Mortality

Three mountain lions died during the study. Lion T-13 was found floating in the Suwannee River on 20 July 1988, 32 days after release. Cause of death could not be determined. The radio collar of T-18, which was cut off, was found on 17 October 1988 in a pond 33 km from his previous location on 15 October. His carcass was never recovered. T-14 was found dead on 9 December 1988 just south of her home range. A necropsy revealed she had died of infection resulting from a gunshot wound to her left rear leg. Based on location data, she was probably shot ³7 days before she died.

Highway Effects

Median home range/study area road density ratios were 0.24, 0.37, 0.82, and 0.36 for road classes A - D respectively. Densities of road classes A and D within home ranges tended ($\underline{P} = 0.063$) to be less than respective densities within the study area; whereas densities of road classes B and C within home ranges were not less ($\underline{P} = 0.313$) than those within the study area (Table 2).

The 7 mountain lions released into northern Florida crossed roads an estimated 2,612 times during their movements within the study area (2.7 crossings/lion-day). The within-lion rankings of the differences between distributions of road crossings and of road distances within home ranges differed among road classes ($\underline{P} = 0.001$). In multiple comparisons among difference rank sums, we detected a difference between road classes C and D ($\underline{P} < 0.005$) but not between any other pair of road classes. Differences between percent road crossings and percent road distances were less than zero for class C roads ($\bar{x} = -10.3\%$) and were more than zero for class D roads ($\bar{x} = 13.1\%$).

Five mountain lions encountered limited-access federal interstate highways. Only two adult males, T-18 and T-21, crossed these highways. They crossed 5 times shortly after their release and before establishing home ranges. On 29 June 1988, a car reportedly grazed T-18 as he crossed at the intersection of I-75 and I-10 for the second time.

Diet

The mountain lions made 105 assumed kills of large prey during their 975 lion-days of liberty (1 kill/9.3 lion-days). The hypothesis that a large prey had been killed when a lion was sedentary for ³2 consecutive days was supported by 45 kills of large prey found at 42 (75%) of the 56 assumed kill sites investigated. Kills comprised 30 deer (Odocoileus virginianus) (67%), 10 wild hogs (Sus scrofa) (22%), and 5 domestic goats (11%). Of the 47 sites investigated where lions had only been radio-located 1 time, only 2 kills, a raccoon (Procyon lotor) and an armadillo (Dasypus novemcinctus) were located. At some assumed kill sites where thick understory might have concealed a large prey kill, the odor of decay and presence of vultures (Cathartes avra and Coragyps atratus) indicated that a kill was nearby. Most kills were found in thickets, often in low tunnels or game trails, in ecotones (e.g., cypress pond edge in the pine flatwoods).

Prey were always eviscerated, with the stomach and intestines usually buried £6 m from the carcass. Kills seldom were covered when found, but the presence of debris piles suggested that most of the carcasses had been covered at one time. Vultures were partially responsible for the condition in which the carcasses were found. Consumption percentage varied (50-90), and the remains usually consisted of head, hide, and bones. Yearling buck deer were taken most often.

DISCUSSION

Adaptation of Translocated Mountain Lions

Average home range of translocated Texas mountain lions was larger than for Florida panthers (Belden 1988, Maehr 1988) but much smaller than for mountain lions in Texas (McBride

1976). Individual home ranges were within the extremes of mountain lion home ranges in other parts of the western U.S. (Anderson 1983). Also, the estimated density of established lions was lower than any published estimate for the western United States (range = 0.3 lions/100 km^2 [Hemker et al. 1984, Koford 1978] to 5 lions/100 km^2 [Currier et al. 1977, Neal et al. 1987]). At the reported mean of 2.9 lions/100 km^2 (Anderson 1983), the 2,000-km^2 area enclosing the translocated mountain lion home ranges could have supported 60 lions.

Released lions established home ranges that followed major river drainages or contained 32 smaller drainages. The lions usually were located in or near the edges of these drainages. Most kills also were found in the flatwoods and the hardwood swamp habitat ecotones. These edges may have provided a greater abundance of prey and other more suitable conditions for hunting. Harlow and Jones (1965) reported that deer sign (tracks, sightings, browsing, and rubbing activity) was more common near swamp edges than in most other habitats, suggesting higher deer densities in swamp edges. Panthers in southern Florida also appeared to prefer mixed swamp habitats (Belden et al. 1988). Among 16 studies of mountain lion diet, deer (Odocoileus sp.) was the major item by occurrence in 14 (Anderson 1983). Principal food items in stomach contents and scats of panthers in southern Florida were white-tailed deer, wild hogs, and raccoons (Belden 1986, Maehr et al. 1990).

The released mountain lions had no apparent difficulty killing large prey. Even T-14, who was 1 year old when released, regularly killed deer. Wild hogs were an additional source of large prey. The percentage of deer in the kill dropped from 90% at the beginning of the study to 63%

by December. Concurrently, the hog kill percentage increased from 5 to 21%. Replacement of deer by hogs in the lion diet coincided with the winter deer population decline prior to spring births and the onset of the hog farrowing season which peaks in late winter (Belden and Frankenberger 1990).

Ackerman et al. (1986) developed a predictive model of energy cost (expressed as number and types of animals consumed) of free existence for mountain lions. Their model predicted the interval between kills of mule deer (O. hemionus) to be 8-11 days for a resident male and 14-17 days for a resident female lion. However, a female with 3 13-month-old kittens would require a deer every 3.3 days to fulfill energy needs of herself and her young. Excluding adult male T-18, which appeared to subsist primarily on smaller prey, we found no difference between male and female lions in average interval between kills ($\bar{x}$ = 8.7 days).

Deer densities, estimated from track counts conducted on public wildlife management areas in the study area, were 1 deer/8.5-59.5 ha (S. K. Stafford, FGFWFC, unpubl. data). Mean estimated deer density on the 2,000-km^2 area encompassing mountain lion home ranges was 1 deer/12.1 ha (C. L. McKelvy, FGFWFC, unpubl. data), or 4,132 deer/released lion. At a potential lion density of 3 lions/100 km^2 we would expect a 275:1 deer/lion ratio. Sixty lions, each killing a deer every 8.7 days (42 deer/lion/year), would harvest roughly 15% of the deer population/year. Because lions appeared to take all sex and age classes of deer, this predation rate should allow a

sustained annual hunter harvest of approximately 15%. A 10% harvest rate is considered average for bucks-only hunting (Harlow and Jones 1965).

The area where released mountain lions established home ranges contained approximately one-half the density of roads as in the entire study area, and the lions tended to avoid crossing more heavily-travelled roads (classes A-C) in favor of more lightly-travelled roads (class D) within these ranges. Of 26 lion home ranges examined by Van Dyke et al. (1986), 22 (85%) included unimproved dirt roads, 15 (58%) included improved dirt roads, but only 6 (23%) included hard-surfaced roads ($P < 0.01$, X^2 test of independence).

Translocation Considerations

Release site.--Upon release, most translocated mountain lions traveled in the direction from which they were captured. Lions established home ranges in 0.5-6.0 months. The highest risk of encounter with humans or livestock occurred during the immediate post-release period and during subsequent excursions from home ranges. Placing release pens as far as possible from humans and livestock and careful lion monitoring are, therefore, important.

Interactions of lions with livestock.--Released mountain lions were often near cattle (Bos taurus), but we do not know of any cattle killed by lions. One (T-16) killed domestic goats and another (T-15) killed blackbucks on a private game ranch. Both depredations occurred after the lions left their established home ranges. Anticipating landowner concerns for the potential loss of livestock, FGFWFC planned, before release of the lions, to compensate any livestock losses to

introduced lions. Thus, both owners of depredated livestock were reimbursed for their economic losses.

Hunting.--During the 10-month study, we noted several indications that hunting may reduce the success of panther reintroduction. Shooting was suspected or documented for 2 of 7 animals, and changes in the animals' movement patterns coincided with hunting activity.

Deer, hog, and turkey (Meleagris gallopavo) were primary game in northern Florida. Deer were mostly hunted with dogs, but still-hunting over feeding stations and food plots also was common. Movement data indicated that the released mountain lions soon took advantage of prey attracted to feeding stations. The last location of T-18 was near a feeding station where we believe he was shot. Truck tracks and footprints found there appeared to match those found at the pond where the cat's collar was recovered. Subadult female T-14 also died from a gunshot wound.

Noting that T-14, T-15, and T-16 left established home ranges as hunting seasons began, we speculate that the intense human activity associated with hunting exceeded the lions' tolerance for disturbance and caused them to leave their home ranges (Figs. 3, 4, 5). Upon leaving an established home range, the lions wandered, possibly looking for another suitable home range and increasing the potential of human or livestock encounter.

The public was highly supportive of the study and of the possibility of eventually reintroducing Florida panthers into northern Florida. A minority expressed fears in public meetings and interviews that panthers would compete for game and that tighter regulations

associated with panther presence would further restrict public hunting opportunities. We have shown, however, that the present deer density can support both recreational hunting and panthers. When the study began, the FGFWFC responded to concerns of tighter regulations by publicly stating that "no established hunting season will be curtailed, nor will restrictive hunting regulations be promulgated, for the sole benefit of introduced panthers."

MANAGEMENT AND RESEARCH IMPLICATIONS

We believe that the primary considerations for panther reintroduction are area size, prey density, and human population density. Extrapolating from our study, the re-establishment area should be [3]2,590 km^2 and should support a deer population of [3]1 deer/36 ha. We believe such habitat could easily support 50-60 Florida panthers (2-3/100 km^2). The human population should be minimal within 64 km of the release site to minimize lion-human encounters. Counties enclosing our study area averaged 3.5 occupied housing units/km^2. Cattle presence on the candidate study area may be of no concern, but goats, sheep, and other smaller ungulates may be especially vulnerable to depredation.

The only areas in Florida, other than our study area and areas in southern Florida, that might meet these criteria are the Kissimmee/St. Johns watersheds and the Apalachicola National Forest and vicinity. Transient Florida panthers may already move through the Kissimmee/St. Johns area (Belden et al. 1991). The Apalachicola National Forest and vicinity is surrounded by a minimal buffer zone and is used intensively by humans. Therefore, the present study area remains the best choice for establishing an additional panther population in Florida.

Our study indicated that human compatibility also limits successful panther reintroduction. Our translocated wild mountain lions established overlapping home ranges, killed large prey at a predicted frequency, and established routine activity patterns in their new environment prior to the opening of the hunting season. However, coincident with human hunting activity, our study animals were either killed or sufficiently disturbed to leave their established home ranges. Subsequent wanderings resulted in otherwise anomalous encounters with urban areas and livestock operations. Thus, animals should be released shortly after the close of the general gun hunting season to allow maximal time between hunting seasons for establishment of home ranges.

Other considerations in a translocation study should include public education and resolution of depredation complaints. Study animals should be sterilized, radio-instrumented, moved to soft-release pens as quickly as possible, and held with a minimum of human contact. Releases should be preceded with an intensive public education program, and a professional mountain lion houndsman should be available to hasten response to lion/human and lion/livestock encounters. Also, an unambiguous protocol for payment of depredation claims should be developed.

We suspect that home-range establishment at higher densities may encourage normal social interactions and, as a result of mutual avoidance with neighboring lions, reduce the extent of excursions. A higher initial stocking rate also would offset expected mortality. Therefore, we

recommend conducting additional research on feasibility of panther translocation with a larger initial stocking rate of 10-20 mountain lions.

LITERATURE CITED

Ackerman, B. B., F. G. Lindzey, and T. P. Hemker. 1986. Predictive energetics model for cougars. Pages 333-352 in S. D. Miller and D. D. Everett, eds., Cats of the world: biology, conservation, and management. Natl. Wildl. Fed., Washington, D.C.

Anderson, A. E. 1983. A critical review of literature on puma (Felis concolor). Colo. Div. Wildl. Spec. Rep. 54. 91pp.

Avers, P. E., and K. C. Bracy 1973. Soils and physiography of the Osceola National Forest. USDA For. Serv. 94pp.

Belden, R. C. 1986. Florida panther recovery plan implementation--a 1983 progress report. Pages 159-172 in S. D. Miller and D. D. Everett, eds. Cats of the world: biology, conservation, and management. Natl. Wildl. Fed., Washington, D. C.

_____. 1987. Florida panther captive breeding/reintroduction feasibility. Annual Performance Report, Endangered Species Project E-1-11. Fla. Game and Fresh Water Fish Comm. 14pp.

_____. 1988. The Florida panther. Pages 514-532 in W. J. Chandler, ed., Audubon Wildlife Report - 1988/1989. Natl. Audubon Soc. New York, N.Y.

_____, and W. B. Frankenberger. 1988. Florida panther captive breeding/reintroduction feasibility. Annu. Perf. Rep., Endangered Species Project E-1-12. Fla. Game and Fresh Water Fish Comm. 13pp.

_____, and _____. 1990. Biology of a feral hog population in south central Florida. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 44:231-242.

_____, _____, R. T. McBride, and S. T. Schwikert. 1988. Panther habitat use in southern Florida. J. Wildl. Manage. 52:660-663.

_____, _____, and J. C. Roof. 1991. Florida panther distribution. Final Report, Endangered Species Project E-1-15. Fla. Game and Fresh Water Fish Comm. 25pp.

Coleman, J. S., and A. B. Jones, III. 1986. User's guide to TELEM: computer analysis system for radio-telemetry data. Dep. Fish. and Wildl., Va. Polytech. Inst. and State Univ., Blacksburg. 44pp.

Currier, M. J. P., S. L. Sheriff, and K. R. Russell. 1977. Mountain lion population and harvest near Canon City, Colorado, 1974-1977. Colo. Div. Wildl. Spec. Rep. 42. 12pp.

Harlow, R. F., and F. K. Jones, Jr. 1965. The white-tailed deer in Florida. Fla. Game and Fresh Water Fish Comm. Tech. Bull. 9. 240pp.

Hemker, T. P., F. G. Lindzey, and B. B. Ackerman. 1984. Population characteristics and movement patterns of cougars in southern Utah. J. Wildl. Manage. 48:1275-1284.

Hollander, M., and D. A. Wolfe. 1973. Nonparametric statistical methods. John Wiley and Sons, New York, N.Y. 503pp.

Koford, C. B. 1978. The welfare of the puma in California. Carnivore 1:92-96.

Maehr, D. S. 1988. Florida panther movements, social organization and habitat utilization. Annual Performance Report E-1-12. Fla. Game and Fresh Water Fish Comm. 72pp.

_____, R. C. Belden, E. D. Land, and L. Wilkins. 1990. Food habits of panthers in southwest Florida. J. Wildl. Manage. 54:420-423.

McBride, R. T. 1976. The status and ecology of the mountain lion Felis concolor stanleyana of Texas-Mexico border. M.S. Thesis, Sul Ross State Univ. Alpine, Tex. 160pp.

Mohr, C. O. 1947. Table of equivalent populations of North American small mammals. Am. Midl. Nat. 37:223-249.

Neal, D. L., G. N. Steger, and R. C. Bertram. 1987. Mountain lions: preliminary findings on home-range use and density in the central Sierra Nevada. Res. Note PSW-392. USDA For. Serv. 6pp.

Van Dyke, F. G., R. H. Brocke, and H. G. Shaw. 1986. Use of road track counts as indices of mountain lion presence. J. Wildl. Manage. 50:102-109.

Received 21 October 1991.

Accepted _____.

Associate Editor: Humphrey.

Table 1. Individual characteristics, release chronology, and range estimates for 7 mountain lions released into northern Florida, 1988-89.

Lion	Age	Sex	Dates in wild From	To	Days in wild	n	Range (km^2) Total	Home
T-13	A	F	6/15/88	7/20/88	35	31	635	
T-14	S	F	6/15/88	12/09/88	177	152	484	96
T-15	A	F	6/15/88	4/04/89[a]	293	244	4,027	930
			4/04/89	4/13/89	10	9		
T-16	A	M	6/15/88	3/10/89[a]	268	224	9,136	108
			3/22/89	4/04/89	15	12		
T-18	A	M	6/15/88	10/17/88	124	103	2,462	750
T-19	A	F	3/22/89	4/19/89	26	20	21	
T-21	A	M	3/22/89	4/09/89	18	17		

[a]Lion recaptured for second release.

Table 2. Density of road classes within the study area and median density of road classes within mountain lion home ranges, northern Florida, 1988-89.

Road class[a]	Road density (km/km^2)	
	Study area	Home ranges
A	0.101	0.024
B	0.078	0.029
C	0.500	0.410
D	0.341	0.121
Total	1.020	0.584

[a]A = Primary hard-surface highway.

B = Secondary hard-surface highway.

C = Light-duty road.

D = Other roads and trails.

Fig. 1. Study area used for feasibility of panther reintroduction, northern Florida and southern Georgia, 1988-89.

Fig. 2. Home ranges established by 2 male (T-16, T-18) and 2 female (T-14, T-15) mountain lions released into northern Florida, 1988-89.

Fig. 3. Home range of mountain lion T-14 (established 5 July - 30 September 1988, solid line) and movement pattern during deer season (1 October - 9 December 1988, dashed line).

Fig. 4. Home range of mountain lion T-16 (established 17 June - 30 September 1988, solid line) and movement pattern during deer season (1 October 1988 - 31 January 1989, dashed line).

Fig. 5. Home range of mountain lion T-15 (established 12 September 1988 - 24 March 1989, solid line) and movement pattern during turkey season (25 March - 4 April 1989, dashed line).