

1071

FLORIDA PANTHER DISTRIBUTION AND CONSERVATION STRATEGY

by

David S. Maehr

Final Report

Study Number: 7572

Study Period: 1 July 1990 - 30 June
1992

Bureau of Wildlife Research
Florida Game and Fresh Water Fish Commission
620 South Meridian Street
Tallahassee, Florida 32399-1600

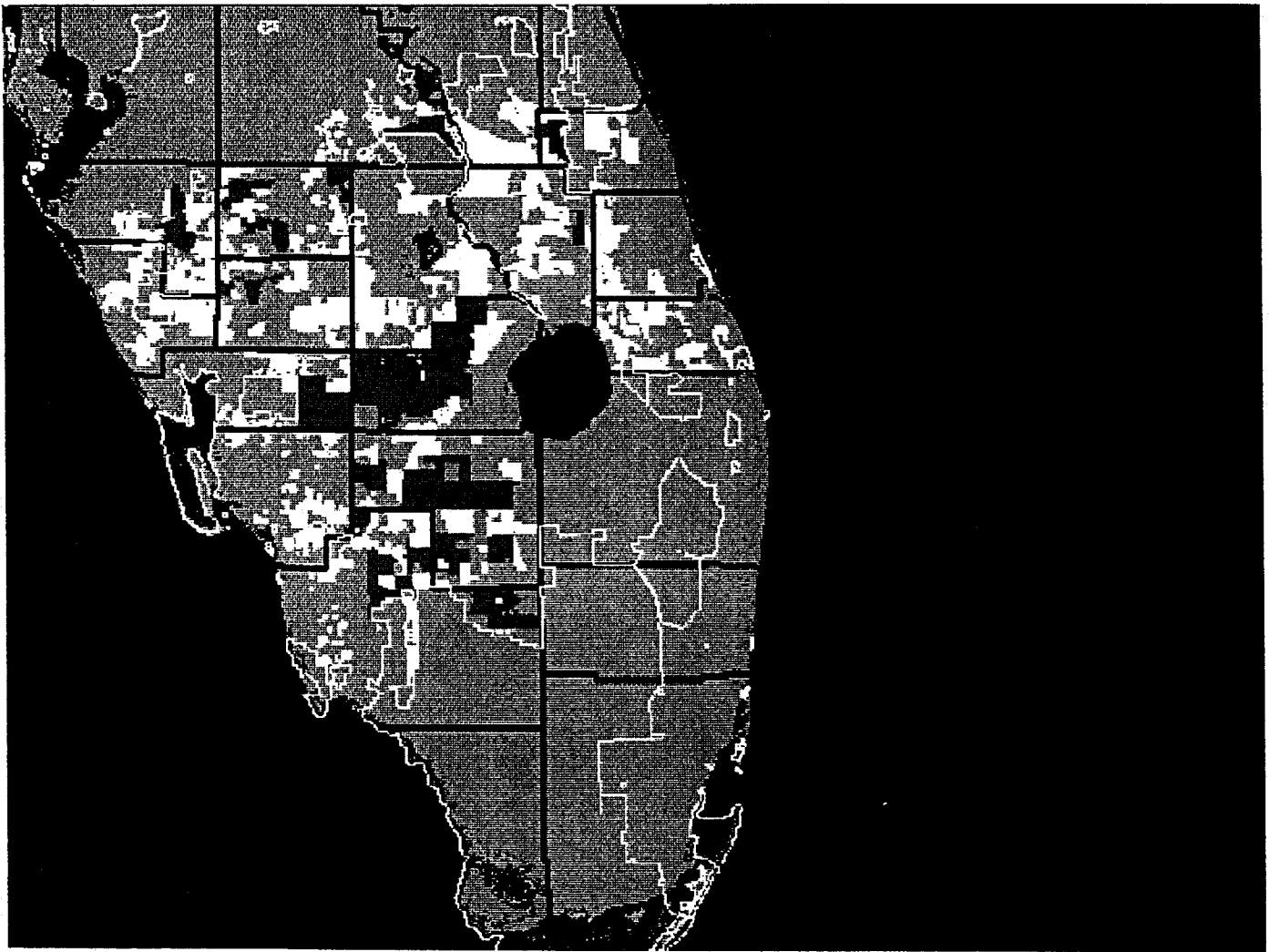


Fig. 9. Distribution of private lands containing potential panther habitat (dark gray and white polygons). Dark gray represents ownerships exceeding 50 km² (see Table 5).

FLORIDA PANTHER DISTRIBUTION AND CONSERVATION STRATEGY

DAVID S. MAEHR

Biological Administrator I, Florida Game and Fresh Water Fish Commission, Big Cypress Wildlife Field Office, 566 Commercial Boulevard, Naples, FL 33942-4709

Abstract: Panther occurrence in south Florida may be a product of landscape island size as defined by highways, large property ownerships with restricted access, and a predominance of undevelopable wetlands. Hardwood hammocks and mixed swamps correlated positively with increasing panther use. Freshwater marsh, cypress swamp, hardwood swamp, and agricultural lands accounted for 62% of the area in panther home ranges. Habitats avoided by panthers included agricultural, barren land, shrub and brush, and dry prairie. The areas most heavily used by panthers occur on private lands, and are in need of protection. Twelve private ranches covering 2,357 km² account for most of this land.

INTRODUCTION

Rapidly increasing human populations and expanding agriculture in southwest Florida are compromising the ability of natural habitats to support a self-sustaining Florida panther (Felis concolor coryi) population. Because home range requirements are extensive (female = 100 km², males = 500 km²) (Maehr et al. 1991), large, contiguous landscapes are needed to permit panthers to function in a demographically-normal manner. Private lands represent about 50% of occupied panther range in south Florida. If panther habitat is lost on private lands, resource managers will be forced to manage from 9-22 wild panthers on public lands (Maehr 1990). Despite our increased knowledge of panther distribution via radio-telemetry, there are still large areas of private land in Charlotte, Collier, Hendry, Lee, and Glades counties where uncollared individuals may reside. Difficulty in obtaining access to private land is the primary reason for the lack of distribution data from these areas.

A summary of data reflecting the distribution of panthers in southwest Florida is needed in order to assist land managers and land policy decision makers in maintaining panther habitat, especially on private lands. Further, examining the relationship between panther occurrence and available occupiable habitat will provide insight for managing a landscape containing panthers and areas chosen for reintroductions. Because of their wide-ranging movements and extensive spatial requirements, panthers are particularly sensitive to habitat fragmentation (Harris 1984), and because of their low numbers have a high theoretical risk of extinction in the next few decades (Vrijenhoek 1989). Although recent acquisition efforts have resulted in significant land purchases, much of panther range remains in private ownership. These areas, due to soil and drainage features, generally are more suitable for intensive agriculture and urban growth than public lands. They also include some of the most productive panther habitat in the region. A

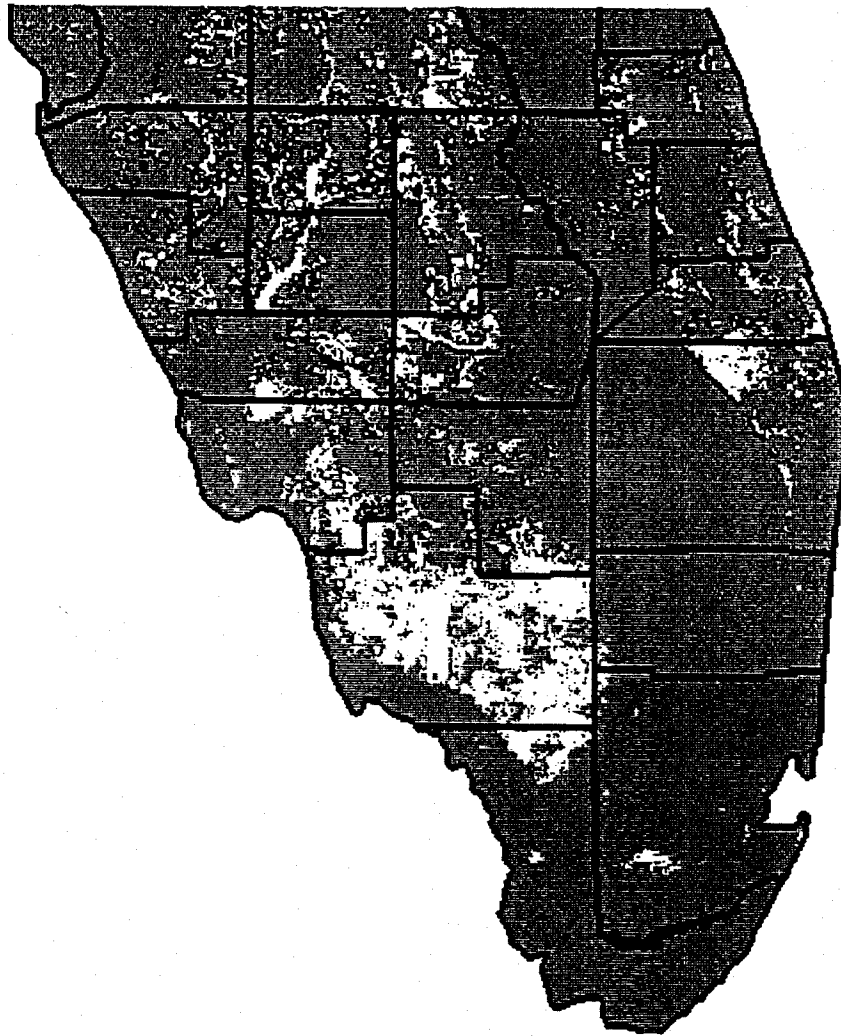


Fig. 8. Potential panther habitat in south Florida.

detailed range map is the first step in organizing efforts to conserve panther habitat on a regional scale.

Acknowledgments.-----The analyses of landscape variables and the production of graphics would not have been possible without the hard work and assistance of M. Ramsey and M. Simonic with Collier Enterprises, Immokalee and J. Cox and E.D. Land with the Florida Game and Fresh Water Fish Commission. Commission employees J.C. Roof, E.D. Land, and J.W. McCown were instrumental in data collection efforts. This study was funded through Section 6 of the Endangered Species Act of 1973 (P.L. 93-205) and the Florida Nongame Wildlife Trust Fund.

STUDY AREA

South Florida is a relatively flat, expansive landscape stretching from Avon Park Bombing Range in Polk and Highlands Counties south to Flamingo in Monroe County, and from the Gulf of Mexico to the Atlantic Ocean. About half of occupied panther range is in public ownership (Maehr 1990) including Big Cypress National Preserve (BCNP), Everglades National Park (ENP), Fakahatchee Strand State Preserve (FSSP), Big Cypress Seminole Indian Reservation (BCSIR) and Florida Panther National Wildlife Refuge (FPNWR). A detailed description of important vegetative communities and climate can be found in Maehr et al. (1991), and Smith and Bass (in press).

METHODS

Land-cover types were plotted with a resolution of 0.10 ha using Landsat Thematic Mapper (TM) data collected from 1987-89. Raw TM data were classified using an unsupervised classification procedure (Colwell 1983), and low-altitude aerial photography was used to interpret initial classifications and consolidate data into 22 land-cover classes corresponding to descriptions in Davis (1967), Hartman (1978), and Soil Conservation Service (1979). Florida panther telemetry data were linked to the TM data via a geographic information system. Telemetry data and sign collection and analysis procedures can be found in Maehr et al. (1991), and Roof and Maehr (1988). We considered occupied or potential habitat in south Florida as those areas preferred or tolerated by panthers (Maehr et al. 1991).

To evaluate relationships between habitat composition and intensity of panther use, a grid containing 1188 cells was set up over inhabited range in Collier and Hendry counties. Land-cover composition was compiled and compared with the frequency of panther relocations within each 2.62 km² (1 mi²) cell. Because this grid was developed using township-range-section lines, there was slight variation in the size of individual cells. While the use of section lines was a biologically arbitrary decision for analysis purposes, they represent practical references that make quantitative habitat data more useful to planners and regulators.

We related land-cover types and home range sizes by calculating non-parametric Spearman correlation



Fig. 7. Distribution of landscape islands as defined by state and federal highways in Florida (black islands are $> 1000 \text{ km}^2$, gray islands are $100\text{--}1000 \text{ km}^2$, and light gray islands are $< 100 \text{ km}^2$).

statistics (Hollander and Wolfe 1973). Because the family-wide error rate associated with 44 comparisons precluded a precise estimation of P-values, no effort was made to assess the "significance" of individual correlations. To analyze panther use per grid cell we used only those cells with ≥ 3 sightings ($n=412$).

We transformed relocation frequencies for each cell into contour lines and cross-tabulated the contours around frequently used areas with the land-cover types found within each contour. The contour map was generated using the "Plot-Map" algorithm (Tydac Technologies, Inc., Ottawa, Canada) and was divided into 10 arbitrary increments (Table 1). Bivariate line graphs were made for the percent area of the most common cover types within the contour increments (1-10). Percentages were used because of the variable area covered by each contour increment.

Influence of highways on panther distribution in Florida was examined by plotting state and federal roads and measuring areas defined by their boundaries. Size categories were < 10 km², 10-50 km², 50-100 km², 100-500 km², 500-1000 km², 1000-1500 km², 1500-2000 km², 2000-2500 km², 2500-3000 km², and > 3000 km². Presence or absence of radio-collared panthers for each landscape "island" was then determined.

RESULTS AND DISCUSSION

Analysis of land-cover distribution within individual panther home ranges revealed great variation among cover types (Table 1). Six cover types were not found in home ranges of female panthers in southwest Florida. These were associated with maritime ecosystems (coastal strand) or made up a very small amount of the study area (sandhill, bay swamp). Males used more cover types but have larger home ranges than females and dispersing males wander widely through unforested and disturbed areas. Four cover types (freshwater marsh, cypress swamp, hardwood swamp, and grass and agricultural lands) accounted for 62% of the area in panther home ranges. Cover types that constituted relatively large proportions and were consistently represented (i.e. exhibited low coefficients of variation) were hardwood hammock, mixed hardwood pine, freshwater marsh, cypress swamp, and hardwood swamp.

Male home range size was influenced by the percentages of hardwood hammock, hardwood swamp, water, grass and agricultural land, barren land, and shrub and brush. Smaller male home ranges had greater percentages of hardwood hammocks and hardwood swamp, and larger home ranges had greater percentages of water, grass and agricultural land, barren land, and shrub and brush

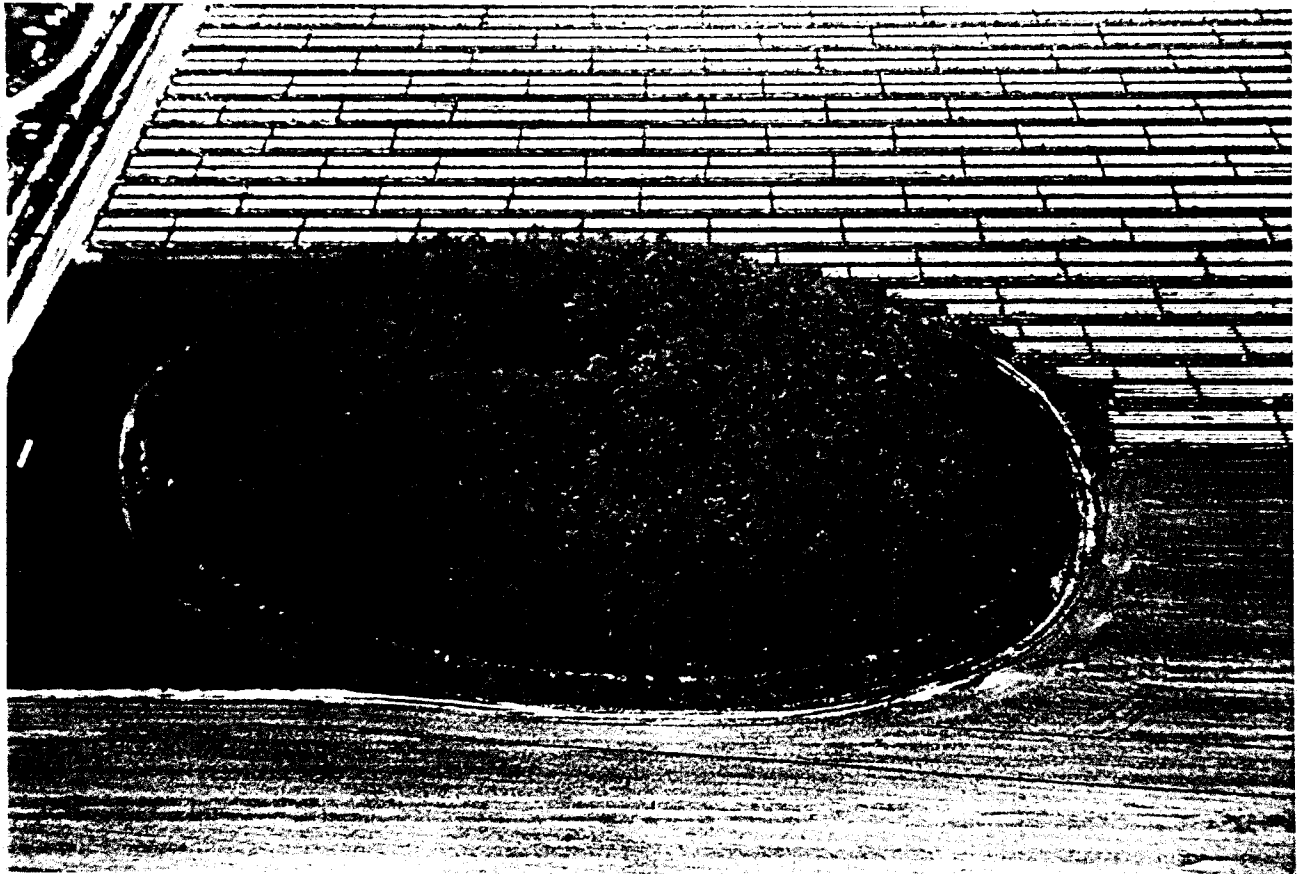


Fig. 6. An isolated stand of cypress within a sea of agriculture.

(Table 2). Higher percentages of dry prairie, shrub swamp, and shrub and brush correlated positively with female home range size; larger home ranges of females had greater amounts of these cover types. Maehr et al. (1989) found that female panther home range size was inversely related to habitat quality and may also influence reproductive success.

The frequency of panther relocations per 2.62 km² cell ranged from 0 to 169, and had a non-normal distribution (Fig. 1). Uninterrupted blocks of cells receiving panther use were associated with large forested wetland systems; Fakahatchee Strand, Okaloacoochee Slough, Corkscrew Swamp, Camp Keais Strand, and Kissimmee Billy Strand (including its tributaries: Gum Swamp, Tony Strand, Rocky Lake Strand, Lard Can Slough, Dark Strand, Cow Bell Strand, and California Slough)(Fig. 2). The north-south hiatus between the 2 largest blocks is primarily a freshwater herbaceous wetland (Little Marsh in the Bear Island Unit of BCNP). Of the 4 blocks containing cells with >45 relocations, 3 occurred totally or in part on private land. The largest was located on a 16 section (4250 ha) ranch where at least 2 female panthers have raised several litters of kittens and adult male use has been periodically high. The greatest concentration of unprotected, occupied panther cells is in eastern Collier County and southern Hendry County. This land is dominated

by large private ranches and the BCSIR, where future land uses are uncertain.

Hardwood swamp and hardwood hammock were positively correlated with relocation frequency, but only the correlation with hardwood hammock was > 0.20 (Table 3). Conversely, the amount of pine forest and cypress swamp showed the strongest negative correlations when compared to frequency of relocation. These findings appear to contradict a recent analysis of panther habitat use (Maehr et al. 1991), which found that hardwood hammock, pine forest, and cypress swamp were preferred, and hardwood swamp was tolerated or avoided. However, these analyses differ in that the previous study compared actual use patterns with the amount of habitat available in individual panther home ranges. Our analysis was a region-wide examination that compared habitat composition in an artificial geographic gridwork with weighted panther distribution data. In this context it is possible to show habitat avoidance when examining relocations on an individual panther scale, yet show the importance of the same habitat when viewed from a landscape perspective. For example, although Maehr et al. (1991) found that hardwood swamps were avoided by most panthers, our landscape analysis indicates that hardwood swamps were important in explaining panther presence. This widespread vegetation type in

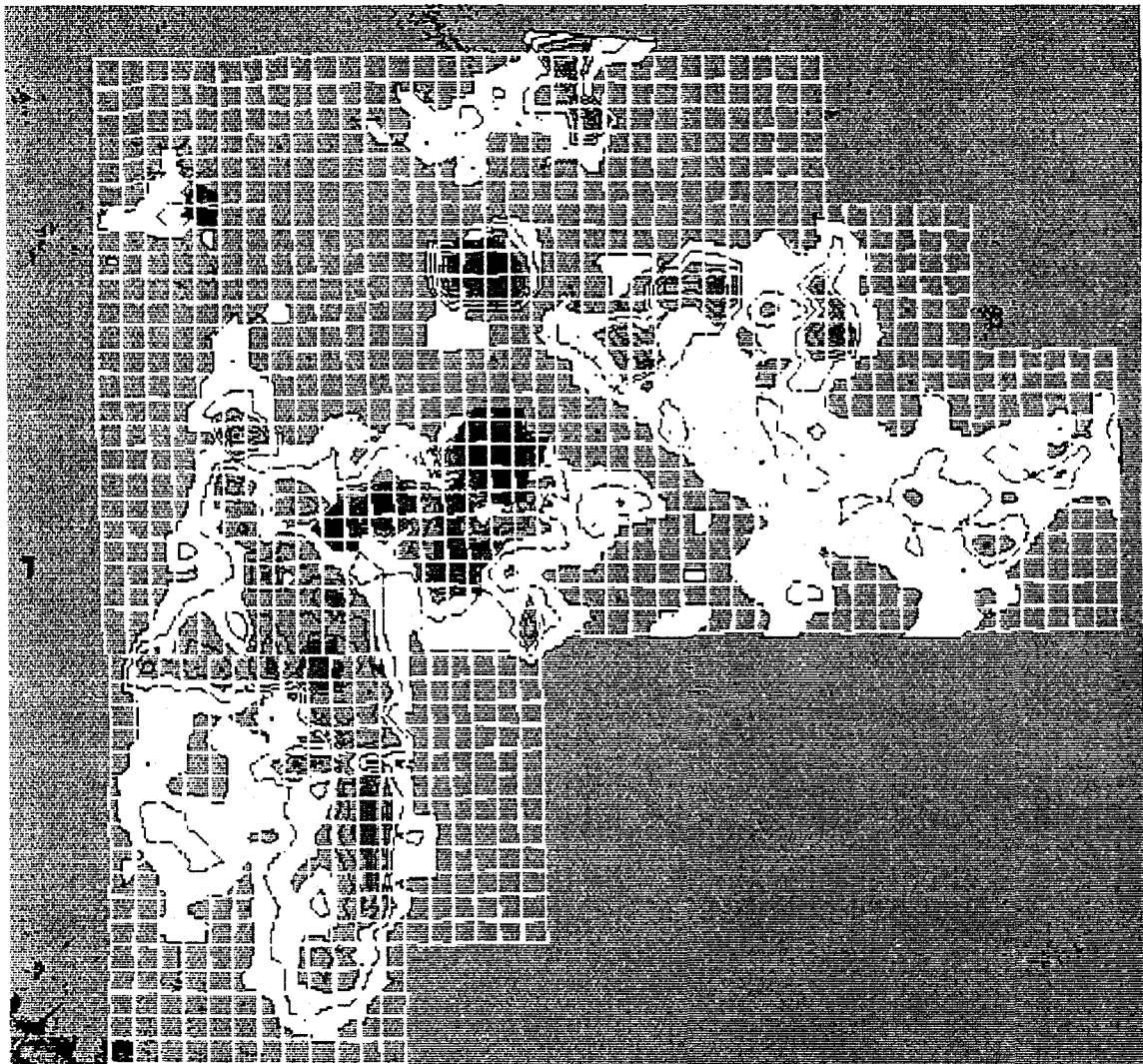


Fig. 5. Contour map (1:500,000) of panther relocations according to the distribution of 2.62 km² cells in southwest Florida. Horizontal and vertical lines represent section lines. Increasingly dark shading represents greater documented panther use.

southwest Florida, while not sought by panthers, probably serves as a landscape matrix within which a variety of other plant communities such as hardwood hammock occur. An analogy would be habitat use by mountain lions in rugged, mountainous terrain. While Wyoming mountain lions prefer habitats such as mixed conifers and mountainmahogany, this vegetation occurs in a matrix of rugged, steep topography (Logan and Irwin 1985). In this comparison mountainous topography is analogous to hardwood swamp in providing the background for preferred habitat. This study, as well as Maehr et al. (1991) and Belden et al. (1988), were unanimous in identifying hardwood hammock as the most preferred habitat of Florida panthers.

Several other aspects of this analysis suggest the importance of hardwood hammocks to Florida panthers. First, there is a strong positive slope between the percent hardwood hammock and the number of relocations per cell depicted on the section/contour map (Fig. 3). The average coverage of hardwood hammock throughout the grided area was 9.11%, yet highly used cells consisted of as much as 30% of this cover type. Secondly, there was little variation in the amount of hardwood hammock among individual panthers, thus it was a consistently large component of individual home ranges. Thirdly, male home range size

decreased with increasing percentages of hardwood hammock (Fig. 4). This is probably a function of the relatively high fertility and primary productivity of hammock soils, which provide higher quality prey and cover resources than other habitats. Females appeared to be less influenced by amount of hammock because they sampled smaller landscape units and because a large proportion of their time is spent in pine/palmetto habitats when raising kittens at dens (Maehr et al. 1990). Harlow (1959) found that among major vegetation types in Florida, hammocks had the greatest potential for producing white-tailed deer (*Odocoileus virginianus*), an important panther prey species (Maehr et al. 1990a).

The darker shaded contours in Fig. 5 represent the most highly used areas in southwest Florida. In the western portion of this map, most of the land is in public ownership; primarily FSSP, FPNWR, and BCNP (Bear Island). The northwestern contour indicating concentrated use is just west of Lake Trafford on land under consideration for public acquisition by the Corkscrew Regional Ecosystem Watershed (CREW). The northeastern corner of the largest contour block, as well as the remaining high use contours, all occur on private lands. Large portions of these lands are undergoing conversion to citrus and other agricultural uses. When ranking conservation needs, lands

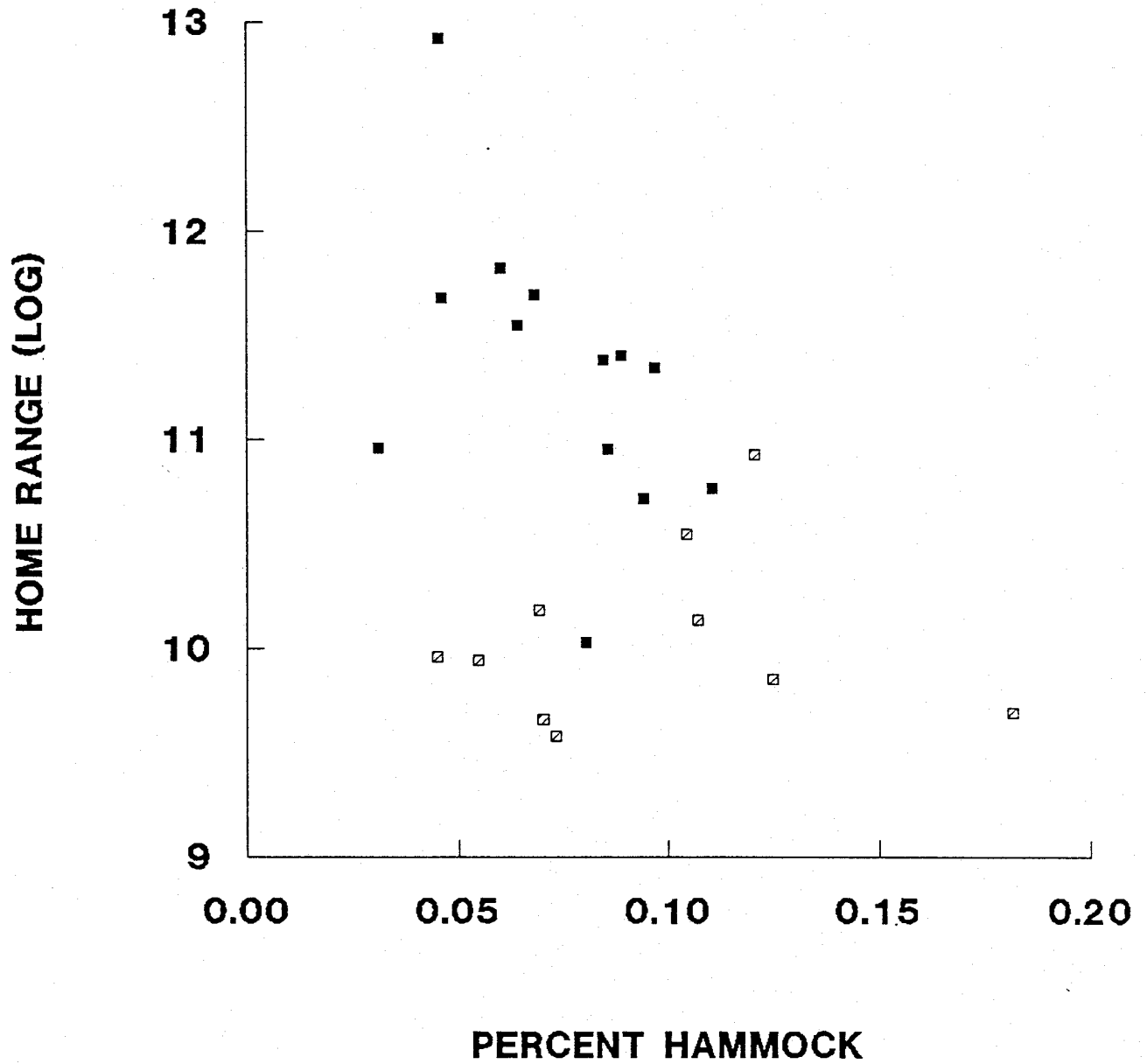


Fig. 4. Influence of hardwood hammock on panther home range size in southwest Florida. Solid and open squares represent male and female home ranges, respectively.

indicated as high use contours should be identified as most important.

The "U"-shaped curve for agricultural lands (Fig. 3) probably represents the influence of different land uses that were lumped under this classification as well as its uneven distribution in southwest Florida. Agriculture accounted for over 20% of the grid area but never accounted for more than 15% of frequently used cells. Areas characterized by abundant agriculture and low panther relocations probably reflect high intensity farming on a large scale (vegetables, citrus) at the fringes of occupied range. Frequent panther relocations and abundant agriculture probably resulted from lower intensity use such as improved pasture situated in a forested setting near a panther core use area. Maehr et al. (1991) found that agricultural lands of all types were avoided by panthers throughout southwest Florida. However, in some areas, large improved pastures contain islands of hardwood hammock where prey and cover are still available, and remote, fertile pastures may benefit deer on a local scale.

Cypress swamp was important to panthers on an individual basis (Maehr et al. 1991), but it did not appear as important from our landscape analysis. Because many cypress forests exist on wetlands protected by state and federal regulations, this cover type is still found widely through the study area. In many cases, woodlands

dominated by cypress are located within large freshwater marshes or extensive farms. Treeless habitats created by agricultural development are mostly avoided by panthers and contain many isolated cypress stands, which also are not used by panthers. As legal development occurs, the loss to panthers is not just the more fertile and productive uplands, but also forested wetlands that have been excised from a once contiguous forested landscape. Typical examples of isolated cypress in a matrix of agriculture occur around Immokalee in Collier County's largest farming area (Fig. 6).

Negative relationships between relocation frequency and barren lands, shrub and brush, and freshwater marsh suggest panthers avoid these areas. Barren lands and shrub and brush constitute about 5.7% of the grided area, but highest use grids all contained <5% of either land-cover type. Freshwater marsh made up 12% of the study area and was distributed proportionally in all of the cells where panther use was recorded. High percentages of these cover types were associated with large home range sizes for both males and females, suggesting that they were avoided. Maehr et al. (1991) found that these habitats were tolerated or avoided by panthers.

Barren lands and shrub and brush are disturbed cover types that have replaced native vegetation during the last 50 years. The amount of land

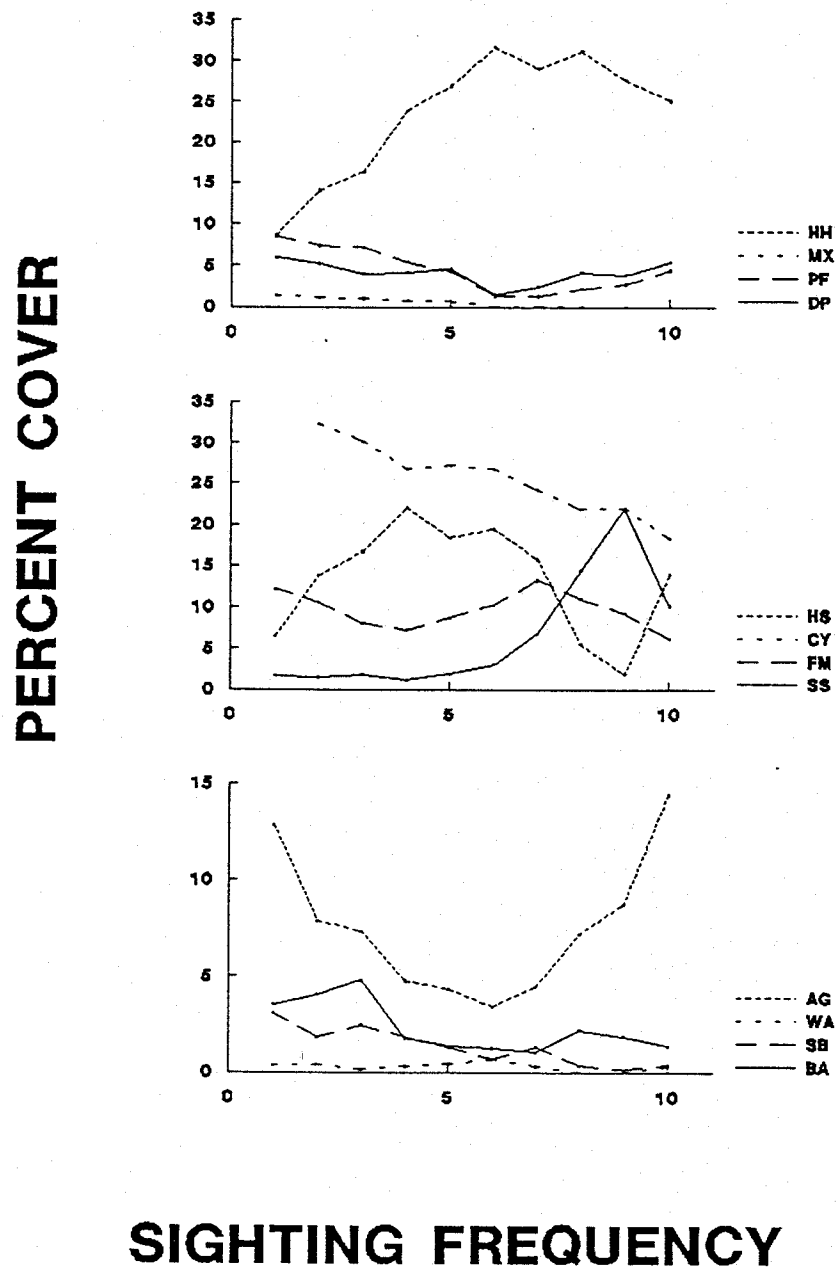


Fig. 3. Correlation between percent habitat type and panther relocations per 2.62 km² cells (HH=hardwood hammock, MX=mixed hardwood/pine, PF=pine forest, DP=dry prairie, HS=hardwood swamp, CY=cypress, FM=freshwater marsh, SS=sand pine scrub, AG=agricultural/grassland, WA=open water, SB=shrub and brush, BA=barren/developed).

converted to these 2 cover types is likely to increase over time and reduce native upland forests, such as hardwood hammocks. Wetlands will be converted to a lesser extent because development in wetlands is already restricted by state and federal regulations. In light of continued land use changes, losses in preferred uplands will continue as hardwood hammocks and other uplands are converted to habitats avoided by panthers.

The distribution of highways in Florida has resulted in a landscape island pattern that changes with latitude (Fig. 7). The majority of small fragments defined by roads occurred in central and north Florida. There were no habitat islands smaller than 100 km² containing panthers, while all habitat islands greater than 3000 km² contained them (Table 4). The 1.4% to 50.0% occupancy rates in the few areas ranging in size from 100 to 1500 km² were due to their locations adjacent to areas > 3000 km². The only 1000-1500 km² area that was not occupied in south Florida is mostly Conservation Area 2 which is dominated by vegetation that usually is avoided by panthers.

None of the relatively large (1500-2500 km²) areas in south central Florida is known to be permanently occupied by panthers. However, the lack of access for research and recent, credible sightings of panthers on these private lands (J. McGrady pers. comm.),

prevents us from making a conclusion on the panther's local status.

All known reproducing panthers reside within the largest fragments, or smaller areas immediately adjacent to them. If presence of panthers is related to size of suitable range as defined by roads, then the ability of Florida north of Lake Okeechobee to support the species may be compromised. While roads may not be the actual disturbing influence explaining the lack of panthers in smaller islands, increasing total road length and highway intersections are a reflection of denser human populations and easier access to woodlands for recreation. Large private property ownerships, a predominance of undevelopable wetlands, extensive, contiguous mixed hardwood forests, and large (>3000 km²) public refuges may be the most important geographic factors explaining the persistence of panthers in south Florida. Efforts should be made to protect panther habitat on private lands, especially well-drained and productive forested uplands.

Potential Habitat Map

Our model for potential panther habitat involved several steps and was based on the analyses of panther habitat use described above. First, we isolated patches of land-cover types that were essential features of panther habitat. We then isolated all

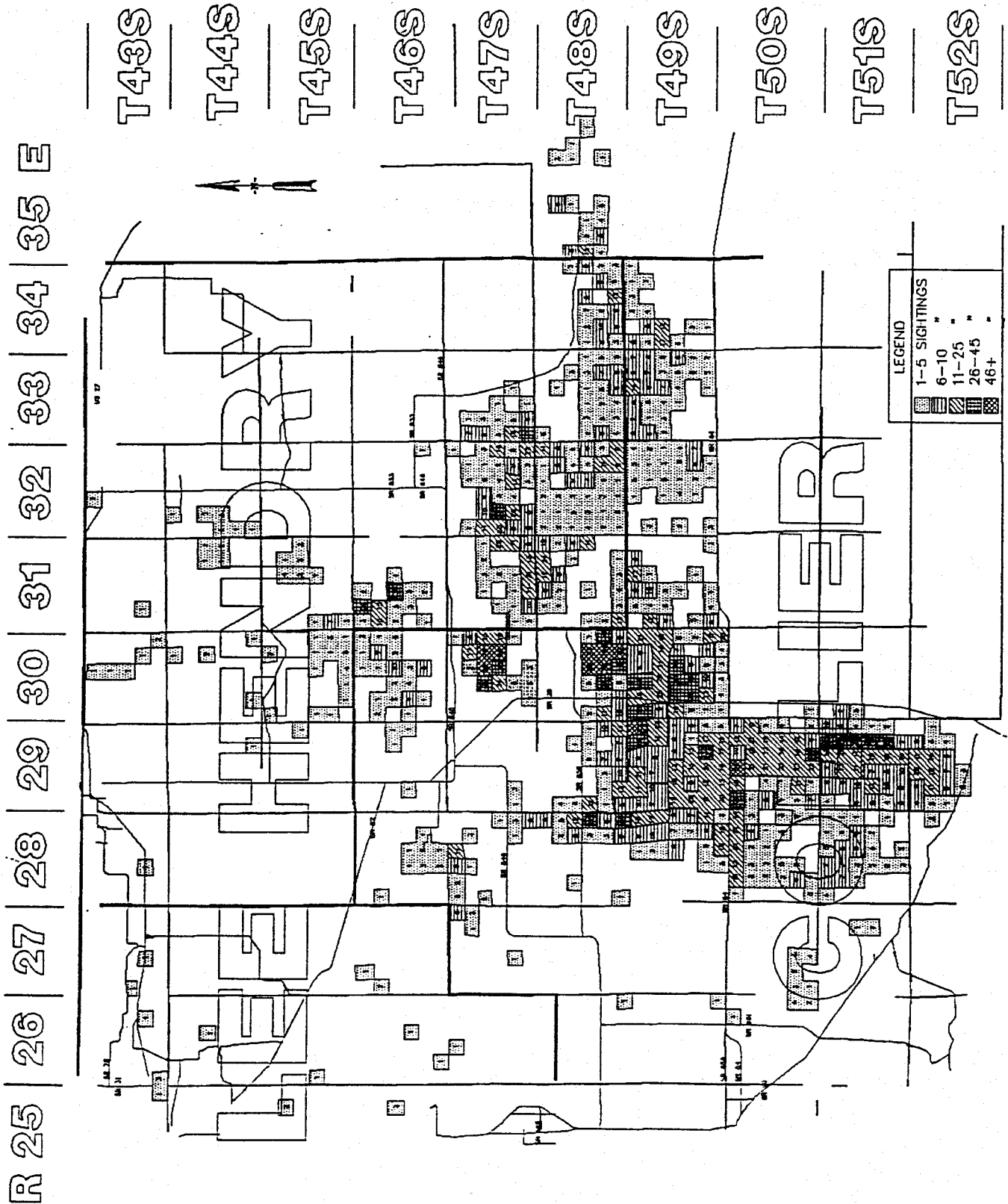


Fig. 2. Density of panther relocations according to 2.62 km² cell distribution.

contiguous patches of these 5 land-cover types and estimated the area covered by each patch. A total of approximately 5000 patches was identified in the region. We then eliminated patches that were smaller than 50 ha, reducing the number of patches by about 60%. Our final refinement to the habitat map reflects the effects of large blocks of barren land on panther distribution. All blocks of barren land >20 ha include a 300 m zone of disturbance. We subtracted this area to avoid overestimating the availability of preferred habitat.

When adjusted by adding buffers of tolerated habitat, subtracting a zone around barren land, and eliminating isolated tracts of preferred habitat <50 ha, our best estimate of potential habitat emerged. This map (Fig. 8) exhibits moderately-sized patches of preferred land-cover types, as well as smaller patches of preferred and tolerated land-cover types found within 1 km of larger patches. Clearly, the largest contiguous tract of panther habitat is dominated by the Big Cypress National Preserve with connecting forest extending into Lee, Monroe, and Hendry counties. Yet, 2 of the largest public preserves in the eastern U.S. (BCNP and ENP), which account for >50% of occupied panther range, support only 29% of the current study sample (7 of 24 known individuals). It is possible that the natural fragmenting influence of

extensive prairie and marsh vegetation within a relatively infertile cypress forest in the eastern Big Cypress Swamp is analogous to the ephemeral panther population noted for the Everglades (Bass and Maehr 1991). Due to the nature of parent soil materials and their influence on primary productivity, it is unlikely that this area can approach lands in northern and western Collier County in terms of panther health, reproduction, and density.

While a combination of fragmentation and poor primary productivity may explain the low panther numbers in southeast Florida, subtly different forces have affected landscape conditions for panthers north of the population core in southwest Florida. Potential panther habitat along the Lake Wales Ridge and Atlantic Coastal Ridge has become a system of islands and capillary-like corridors within a mosaic of agriculture and urbanization. Fragmentation of native forests has undoubtedly reduced the suitability of these areas to panthers, but, in general, soils are more productive and prey can be abundant. Among these archipelagos of once-occupied panther range, patterns of human use and disturbance appear to be more important in explaining infrequent panther use than any combination of natural phenomena. Nonetheless, where soils are productive, and forest cover remains, the land's responsiveness to management is

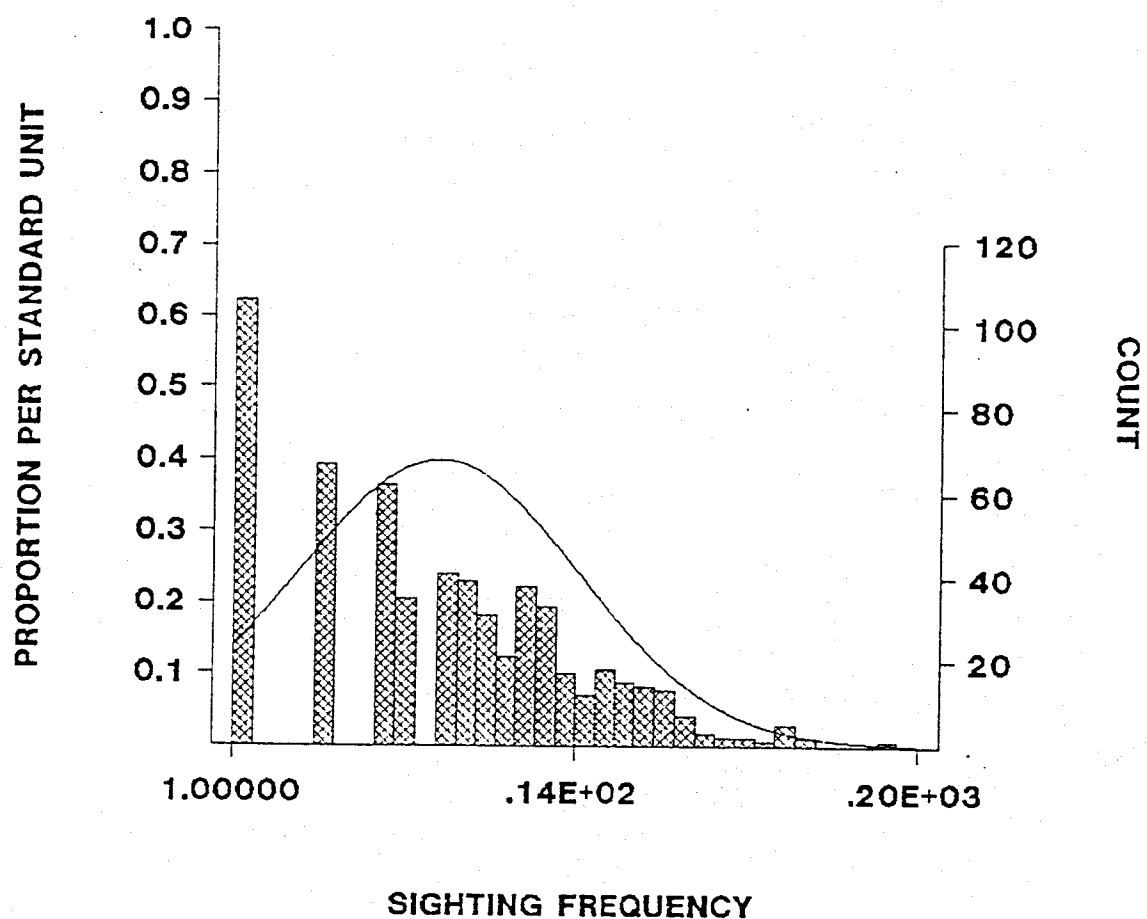


Fig. 1. Panther relocation distribution per 2.62 km² cell in Collier and Hendry counties.

potentially great (in contrast to southeastern Florida).

One of the greatest threats to the persistence of the panther in the wild is the continued elimination and fragmentation of preferred habitat. Where land is owned by government agencies, management options are limited only by soils and the management philosophies of agency stewards. Aside from fee title acquisition, potential management options are relatively inexpensive. It is the vast array of private lands that is the largest stumbling block to panther conservation efforts. The need for land to be economically productive and help offset taxes places a burden on private owners to develop their property in ways incompatible with panthers. For this trend to change, strategic tracts of private land must be targeted for long-term panther management. Where current uses on these lands are compatible with panthers, owners must be economically encouraged to continue these practices. Of more immediate importance is persuading landowners engaged in or planning to initiate incompatible land uses to alter their activities to benefit panthers. To this end, we have identified private land owners of >50 km² which represent the largest amount of potential habitat in south Florida that is unprotected from the perspective of Florida panther conservation (Table 5, Fig. 9). At the same time that private landowners are

being enlisted as stewards of panther habitat, managers of currently occupied public lands must be encouraged to maintain habitat quality where panther density is high (FPNWR), and improve habitat conditions where panther density is low (BCNP, ENP). Although panther density may be limited by inherent environmental conditions on some public lands, their importance as panther range in light of decreasing habitat on private lands is a compelling reason for improving conditions for panthers on these vast preserves. Schortemeyer et al. (1991) presented several land management strategies that could be used to affect significant improvements.

LITERATURE CITED

- Bass, O.L., and D. S. Maehr. 1991. Do recent panther deaths in Everglades National Park suggest an ephemeral population? *Nat. Geogr. Research and Exploration*. 7:427.
- Belden, R.C., W.B. Frankenberger, R.T. McBride, and S.T. Schwikert. 1988. Panther habitat use in southern Florida. *J. Wildl. Manage.* 52:661-663.
- Colwell, R. 1983. *Manual of remote sensing*. American Society of Photogrammetry, Falls Church, Virginia. 763pp.
- Davis, J. H. 1967. *General map of natural vegetation of Florida*. Agricultural Experiment Station, University of Florida, Gainesville.

Table 5. Private landowners with 50 km² or more of potential panther habitat in southwest Florida.

Landowner	Area (km ²)
Lykes Brothers, Glades and Highlands counties	760
Barron Collier, Collier and Hendry counties	320
Babcock, Charlotte County	287
Alico, Collier and Hendry counties	286
Collier Enterprise, Collier and Hendry counties	234
W.R. Grace, Manatee County	104
IMC Fertilizer, DeSoto County	72
Mallory Farms, Hardee County	71
B.H. Griffin, Hardee County	62
Farmland Industries, Hardee County	55
J.R. Price, Collier County	53
GAC Liquidation Trust, Polk County	53

- Harlow, R. F. 1959. An evaluation of white-tailed deer habitat in Florida. Florida Game and Fresh Water Fish Comm. Tech. Bull. 5:1-64.
- Harris, L.D. 1985. The fragmented forest. Univ. of Chicago Press. Chicago, IL.
- Hartman, B. J. 1978. Description of major terrestrial and wetland habitats of Florida, Pages xvi-xix in Kale, H. W. II., (ed.). Rare and endangered biota of Florida. Volume 2: Birds. University Presses of Florida, Gainesville, FL.
- Hollander, M., and D.A. Wolfe. 1973. Nonparametric Statistical Methods. New York: J. Wiley and Sons. 503 pp.
- Logan, K.A., and L.L. Irwin. 1985. Mountain lion habitats in the Big Horn Mountains of Wyoming. Wildl. Soc. Bull. 13:257-262.
- Maehr, D.S. 1990. The Florida panther and private lands. Conserv. Biol. 4:167-170.
- Maehr, D. S., E. D. Land, J. C. Roof, and J. W. McCown. 1989. Early maternal behavior in the Florida panther (*Felis concolor coryi*). Am. Midl. Nat. 122:34-43.
- Maehr, D. S., R. C. Belden, E. D. Land, and L. Wilkins. 1990a. Food habits of panthers in southwest Florida. J. Wildl. Manage. 54:420-423.
- Maehr, D. S., E. D. Land, J. C. Roof, and J. W. McCown. 1990b. Day beds, natal dens, and activity of Florida panthers. Proc. Annu. Conf. Southeast. Fish and Wildl. Agencies. 44:310-318.
- Maehr, D.S., E.D. Land, and J.C. Roof. 1991. Social ecology of Florida panthers. Nat. Geogr. Research and Exploration 7:414-431.
- Picton, H., and R.J. Mackie. 1980. Single species island biogeography and Montana mule deer. Biol. Conserv. 19:41-49.
- Roof, J.C., and D.S. Maehr. 1988. Sign surveys for Florida panthers on peripheral areas of their known range. Fla. Field Nat. 16:81-85.
- Schortemeyer, J.L., D.S. Maehr, J.W. McCown, E.D. Land, and P.D. Manor. 1991. Prey management for the Florida panther: a unique role for wildlife managers. Trans. N. Am. Wildl. Nat. Res. Conf. 56:512-526.
- Smith, T. R., and O. L. Bass. in press. Landscape, white-tailed deer, and the distribution of Florida panthers in the Everglades. Proc. Everglades Symposium. South Florida Water Management District and National Park Service. West Palm Beach, FL.
- Soil Conservation Service. 1979. 26 ecological communities of Florida. U.S. Department of Agriculture, Fort Worth, Texas.
- Vrijenhoek, R.C. 1989. Population genetics and conservation. Pages 89-98 in D. Western and M. Pearl eds. Conservation for the 21st century. Oxford Univ. Press. New York, NY.

Table 4. Occurrence of panthers in landscape islands defined by roads in Florida.

Size Category	Number of Islands	Islands with Panthers	% Occupied
< 10 km ²	611	0	0
10-50 km ²	244	0	0
50-100 km ²	132	0	0
100-500 km ²	216	3	1.4
500-1000 km ²	32	5	15.6
1000-1500 km ²	6	3	50.0
1500-2000 km ²	2	0	0
2000-2500 km ²	1	0	0
2500-3000 km ²	0	0	0
>3000 km ²	3	3	100.0
Total	1,247	14	1.1

Table 1. Habitat composition (ha) of Florida panther home ranges.

Cover Type	Female Mean (N=10)		Male Mean (N=13)	
		Range		Range
Coastal Strand	0	0	0	0
Dry Prairie	1442	6-6439	8480	176-37166
Pine Forest	698	0-2753	5327	0-29673
Sand Pine	0	0	93	0-1210
Sandhill	0	0	0.2	0-2
Oak Scrub	0	0	361	0-4698
Pine/Hardwoods	2503	674-4816	6394	1812-13501
Hardwood Hammock	2474	948-6694	6802	1777-18464
Fresh Water Marsh	2197	138-4718	10822	608-29635
Cypress	8071	2915-13923	22522	1292-62938
Hardwood Swamp	3044	481-8807	5499	1464-11206
Bay Swamp	0	0	44	0-572
Shrub Swamp	304	0-1732	3227	0-12747
Open Water	59	1-212	888	1-5266
Grassland/Pasture	2966	29-18332	21442	267-114721
Shrub and Brush	677	7-4526	6446	53-40152
Exotic	0	0	41	0-303
Barren/Developed	823	45-2474	7658	570-46836
Total	25,262	14,464-55,587	106,052	22,680-408,322

Table 3. Spearman rank correlation statistics for major land-cover classes and the frequency of panther sightings in 412 cells.

Cover Type	Correlation	Cover Type	Correlation
Dry Prairie	-0.045	Cypress Swamp	-0.170
Pine Forest	-0.237	Hardwood Swamp	0.124
Mixed Pine-Hardwood	-0.146	Shrub Swamp	-0.016
Hardwood Hammock	0.280	Water	-0.023
Coastal Saltmarsh	-0.042	Grass and Ag Lands	-0.147
Freshwater Marsh	-0.080	Shrub and Brush	-0.025
		Barren Lands	-0.130

Table 2. Spearman rank correlations of home range size and percentage of land cover type.

Cover type	Male panther home range size (N=13)	Female panther home range size (N=10)
Dry Prairie	0.49	0.77
Pine Forest	0.05	-0.27
Sand Pine	0.23	0.00
Sandhill	0.23	0.00
Oak Scrub	0.23	0.00
Mixed Pine/Hardwood	-0.31	-0.39
Hardwood Hammock	-0.58	-0.01
Freshwater Marsh	-0.12	0.26
Cypress	-0.45	-0.09
Hardwood Swamp	-0.68	-0.27
Bay Swamp	0.23	0.00
Shrub Swamp	0.28	0.72
Open Water	0.70	0.34
Grassland/Pasture	0.61	0.16
Shrub and Brush	0.64	0.61
Exotic	0.14	0.00
Barren/Developed	0.58	0.20