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Scale-dependent Habitat Selection by Female Florida Black Bears in Ocala National Forest, Florida

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Abstract - Habitat selection influences many aspects of a species' ecology, and can have substantial management implications. We studied habitat selection by female *Ursus americanus floridanus* (Florida black bears), a threatened species in Florida, at two different scales: selection of home ranges within the population range and selection of habitat types within home ranges. At the scale of home range selection within the population range, bears showed preference for xeric habitats (xeric oak scrub and *Pinus clausa* [sand pine] forest) during summer; there was no evidence of habitat selection during fall. At the scale of habitat selection within the home range, bears showed preference for mesic (pine flatwood and swamp forest) and preference against xeric (xeric oak scrub and sand pine forests) habitats; again, there was no evidence of habitat selection during fall. Contrary to expectations, bears did not show preference for habitats that contained hard mast-producing plants. This was at least in part because habitats rich in mast producing plants composed 68% of the total habitat area. Strategies for management of Florida black bears should encourage management practices that enhance quality and diversity of mast- and berry-producing plants.

Introduction

Understanding why animals occur where they do is a cornerstone of ecology (Krebs 1978). Animals do not use all of the available landscape within their geographic range, nor do they use different features of the landscape with equal intensity. Species-habitat associations are the product of both evolutionary and ecological processes. However, distribution of animals within their geographic range is often influenced by an individual's habitat selection (Krebs 1978, Morrison et al. 1992). It is presumed that habitat quality influences fitness, and that animals will choose high-quality habitat over low-quality habitat when available (Manly et al. 1993).

Selection behaviors often occur across multiple scales and result in a hierarchical nature of habitat selection (Johnson 1980, Orians and Wittenberger 1991). An individual will select a home range from the population range, and will also select patches of habitat to use within that home range. Different habitat attributes may be selected for at different spatial scales. Rettie and Messier (2000) suggest that the most limiting factors affecting individual fitness should be selected for at the coarsest scales. Finer-scale habitat selection, therefore, is based on less-critical factors. Evaluation of habitat selection without

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considering hierarchical effects could lead to inadequate or misleading conclusions regarding the species' habitat requirements (Orians and Wittenberger 1991). A simple example is proposed by Conner et al (2003) where an avoided habitat completely surrounded by a preferred habitat will appear to be used at a broad scale, but will be interpreted as avoided at a narrower scale. Thus, formal testing of habitat and resource selection at multiple scales is essential for a complete understanding of the relationship between animals and their environments (Aebischer et al. 1993, Alldredge and Ratti 1992, Johnson 1980, Manly et al. 1993, Morrison et al. 1992). In this study, we considered habitat selection of *Ursus americanus floridanus* Merriam (Florida black bear), a subspecies of *Ursus americanus* Pallas (American black bear), at two spatial scales. The Florida black bear is listed by the state of Florida as a threatened species. It is currently restricted to 17% of its former range in Florida due to habitat loss and fragmentation (Wooding 1993).

The American black bear historically occupied a wide variety of forested habitats throughout the United States and Canada (Hall 1981). Although their geographic range has contracted, black bears have retained their affinity to forested areas. As omnivores, though, they use many different habitat types (Maehr 1984, Schoen 1990, Smith and Pelton 1990, Wooding and Hardisky 1994). The black bear also is considered to be a landscape species in that it utilizes a large home range and many different habitats within that home range (Schoen 1990). These habitats must contain all the requirements for the bears' survival and reproduction, including habitat types with adequate food resources and cover for concealment (Pelton 1986).

Black bear habitat selection has been studied extensively throughout their geographic range. Previous studies have found that black bears use habitat types disproportionately to availability, indicating preferences for some habitat types (Hellgren et al. 1991, Heyden and Meslow 1999, Hirsch et al. 1999, Jonkel and Cowan 1971, Lindzey and Meslow 1977, Unsworth et al. 1989, Wooding and Hardisky 1994). Preferred habitat, however, varies widely depending on geographic region, diversity of available habitats, and seasonality due to vegetation structure and plant phenology (Fecske et al. 2002, Rogers 1987, Samson and Huot 1998, Stratman et al. 2001).

Conservation of remaining black bears in Florida requires knowledge of this subspecies' habitat use at multiple spatial scales and how selection changes between seasons. Although habitat selection by other subspecies of the American black bear has been thoroughly investigated, little is known about habitat selection of Florida black bears. Near the southern tip of their geographic range, Florida black bears have access to different habitat types and persist in isolated populations within a human-dominated landscape (Dixon et al. 2006, 2007)

Our objective was to investigate habitat selection by female Florida black bears in Ocala National Forest in north-central Florida. We tested the null hypothesis that female black bears did not show habitat preference when selecting a home range within the population range of Ocala National Forest and when utilizing habitat types within that home range.

Field-site Description

We conducted our study in the Ocala National Forest (ONF) in north-central Florida, which is located along a ridge of sand dunes and is bisected by a multi-lane paved road (State Road 40). The forest sloped downward toward the St. John's River to the east and the Ocklawaha River to the west. The lower elevations closer to the rivers corresponded to increasing mesic forests. Human disturbance, due to selective-logging, clear-cutting, prescribed-burning, and road-building practices within the forest, provided much of the heterogeneity in forest-cover type and stand age.

We defined 7 habitat types within the study area based on the forest-cover types presented in the Florida Vegetation and Land Cover map (FVLC; Table 1, Florida Fish and Wildlife Conservation Commission 2003). We refined the original FVLC map by merging similar cover types. We did not include two forest-cover types, present in discrete patches at the periphery of the study area and contributing less than 2% of the total area, because these were potentially only available to a few individuals. The 7 remaining habitat types were *Pinus clausa* Chapman ex Engelm. Vasey ex Sarg. (sand pine) forest, xeric *Quercus* spp. (oak) scrub, *Pinus* spp. (pine) flatwoods, swamp forests, marshes/open water, disturbed areas, and high-impact urban areas.

The most prominent forest-cover type within ONF was sand pine forest (Fig. 1). The overstory of this cover type was predominantly sand pine, while the shrub layer consists of six species in approximately the following order of abundance: *Quercus myrtifolia* Willd. (myrtle oak) or *Q. inopina* Ashe (scrub oak), *Serenoa repens* (Bartr.) Small (saw palmetto), *Q. geminata* Small (sand live oak), *Q. chapmanii* Sarg. (Chapman's oak), *Lyonia ferruginea* (Walt.) Nutt. (rusty lyonia), and *Ceratiola ericoides* Michx. (Florida rosemary) (Myers and Ewel 1990). Density of sand pine in the overstory can vary greatly from dense stands to widely scattered trees and is inversely related to density of the scrub oak, the predominant understory species. The xeric oak scrub was similar to sand pine forest, though it lacked the overstory

Table 1. Percent composition of habitat types in the Ocala National Forest (ONF), FL. Seven habitat types were defined within the study area from the original forest-cover types identified in the Florida Vegetation and Land Cover Map (FVLC; Florida Fish and Wildlife Conservation Commission 2003). Original FVLC cover types corresponding to each of our habitat types also are given.

Habitat type	% Composition	Original FVLC cover types
Xeric oak scrub	23.9	Xeric oak scrub
Sand pine forest	44.3	Sand pine scrub
Pine flatwoods	3.2	Pinelands
Marsh/open water	7.0	Fresh water marsh and wet prairie, sawgrass marsh, cattail marsh, open water
Swamp forest	8.6	Shrub swamp, bay swamp, cypress swamp, mixed wetland forest, hardwood swamp
Disturbed	10.0	Shrub and brushland, grassland, bare soil/ clearcut, agriculture, low-impact urban
High-impact urban	1.4	High-impact urban, mining (extractive)

of sand pine and constituted the second largest portion of the study area. This forest was intensively managed for timber and stands of 50–100 ha were regularly clearcut. We classified these as recent clearcuts (less than 5 years old) and other open, disturbed areas such as roadsides and forest logging roads as disturbed. These three cover types (disturbed, xeric oak scrub, and sand pine scrub), represented three successional stages within ONF, and their distribution created a mosaic of stand ages.

The remaining land-cover types were found more frequently at lower elevations and were mesic or hydric in nature. Pine flatwoods had an overstory composed of *Pinus elliottii* Engelm. (slash pine) or *P. serotina* Michx. (pond pine), while saw palmetto, *Ilex glabra* (L.) Gray (gallberry), and *Lyonia lucida* (Lam.) K. Koch (fetterbush) were frequent understory species. We merged the FVLC land-cover types, hardwood swamp, bay swamp, cypress swamp and mixed wetland forest, to define our category swamp forests. Swamp forests had standing water or saturated soils for at least part of the year and a hardwood component (Ewel 1990). Major tree species included *Taxodium distichum* (L.) L.C. Rich (cypress), *Sabal palmetto* (Walt.) Lodd. ex J.A. & J.H. Schultes (sabal palmetto), *Gordonia lasianthus* (L.) Ellis (loblolly bay), and *Magnolia grandiflora* L. (sweet bay).

We combined open water and freshwater marshes into a single habitat type because of the tendency for one to grade into the other with variation in annual and seasonal rainfall. High-impact urban areas included major paved roads (e.g., State Road 40) and developed areas. Although the proportion of this cover type within the study area was low, it was readily available to most bears.

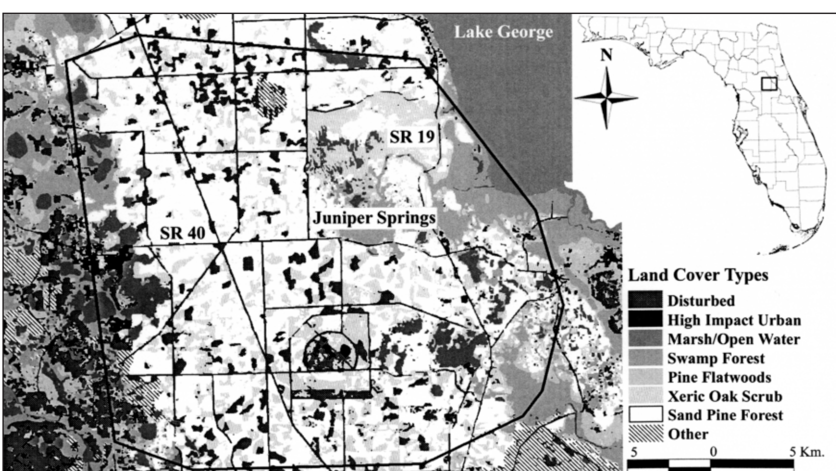

Figure 1. Map of habitat types in Ocala National Forest in north-central Florida. Forest-cover types of the Florida Vegetation and Land Cover Map (FWC 2003) were merged to form seven habitat types in the ONF study area (represented by the thick black polygon). State road 40 (SR 40) bisects the study area and state road 19 (SR 19) is near the eastern edge. Much of the swamp forest in the center of ONF is associated with Juniper Springs, which flows toward Lake George shown in the upper right corner.

Methods

Field methods

We captured black bears from 1999 through 2002 using spring-activated Aldrich foot snares (Aldrich Snare Co., Clallam Bay, WA) disguised in natural vegetation and baited with donuts or a combination of corn and donuts. Although we trapped bears from May through December, the most intensive trapping occurred during summer months. We anesthetized bears with Telazol® delivered through a CO_2-charged, low-impact dart delivery system. Once sedated, bears were ear-tagged and lip-tattooed for individual identification. We collected hair and blood samples for genetic analyses, and we extracted a pre-molar tooth to estimate age (Willey 1974). We recorded morphometric measurements, body mass (kg), and physical and reproductive condition. We fitted female bears with a motion-sensitive radiocollar (150–151 MHz; Telonics®, Mesa, AR). Radiocollars included a leather connector, which would allow the collar to fall off within two to three years. We considered reproductive females or those ≥3 years of age as adults, and these were included in analyses (Garrison et al. 2007).

We located adult female bears 1–3 times per week during 2000–2003. We obtained most of the locations from the ground during daylight hours (0900–1800) using a 4-element hand-held antenna and a Telonics® receiver, but we also tracked bears 1–4 times per month from a fixed-wing aircraft. We did not locate bears on any two consecutive days to avoid autocorrelations, and we spread our sampling effort evenly across the sampling period. For each bear, we obtained ≥3 compass bearings within 30 minutes. We estimated point locations from ground telemetry using the program Locate II (Pacer 1990). We estimated telemetry error by comparing estimated locations of test collars, dropped collars, and natal dens of female bears to their actual locations.

Data analysis

We used radiolocations of all female bears over the duration of our study to define the 620-km^2 ONF study area (Fig. 1) by using the composite minimum convex polygon (MCP) of these bear locations, excluding distant outliers. For each bear, we used the program CALHOME (Kie et al. 1994) to estimate the 95% MCP for three categories of home ranges: a) overall home ranges, b) summer home ranges, and c) fall home ranges. To have a home range included, each bear needed at least 30 locations over the given time period. Data were pooled over years to increase the number of bears and locations that could be included in the analysis. Our goal was to assess habitat associations across a broad temporal scale, although we recognize that annual variations may have been missed.

We estimated overall (or multi-annual) home ranges for each bear from locations collected during May–December over the four years of the study. Bears denned from January–April; thus, we did not include locations during these months. We estimated summer home ranges for each bear from locations collected between May and August combined over the four years of the study. May was selected as the beginning of the study period because this was the first month after all bears emerged from their dens. We estimated fall home ranges for each bear from locations collected between September and December during the course of the study. September was chosen as the transition between summer and fall based on the start of the availability of acorns at this time and to equalize sampling effort across seasons. We used estimates of home ranges based on MCP method so that all intervening habitat among telemetry locations would be included in the home range and thus considered available.

We used a distance-based method to identify habitat preferences within ONF (Conner and Plowman 2001, Conner et al. 2003). This method compares actual distances from radio-telemetry locations to each habitat type to expected distances to each habitat type to test the null hypothesis of no selection (Conner et al. 2003). Locations closer to a given habitat type than expected indicate preference of that habitat type. When compared to a classification-based method (e.g., compositional analysis; Aebischer et al. 1993), inferences based on the distance-based analysis are more robust with respect to habitat misclassifications (Bingham and Brennan 2004, Conner et al. 2003).

The coarse-scale of habitat selection analysis was selection of the home range from the population range (2nd-order selection of Johnson [1980]). To evaluate habitat selection at this level, we generated random points with a uniform distribution at the density of 300 points per km^2 using the Animal Movement extension of ArcView 3.2 (ESRI, Redlands, CA; Hooge et al. 1999). We selected this density of points because it was where the variance of the average distance to each habitat type began to stabilize, indicating that it adequately represented the habitat types present (Fig. 2). Habitat availability was represented using random points within the study area. Habitat use was represented using random points within each bear's home range. We measured the distance from each random point to the nearest patch of each habitat type. Our null hypothesis was that mean distance to each habitat did not differ between the study area and the home range. Rejection of the null hypothesis of no habitat selection ($p < 0.05$) indicated that bears had preference for at least one habitat.

If the null hypothesis was rejected, we used a paired t-test to determine which habitat types were preferred and which were avoided. We ranked the habitat types in order of preference and determined significant differences between habitat types using a paired t-test. These analyses were performed using the SAS code (SAS Inc 1999) adapted from Conner and Plowman (2001).

We also evaluated habitat selection within the individual home range (3rd-order selection of Johnson [1980]). In this case, habitat availability was defined using random points within each home range, while habitat selection was defined by the radio-telemetry locations for each bear within the home range. We performed statistical tests as described above. Again, each habitat type was evaluated independently, and a matrix of rankings was generated if the null hypothesis of no habitat selection was rejected.

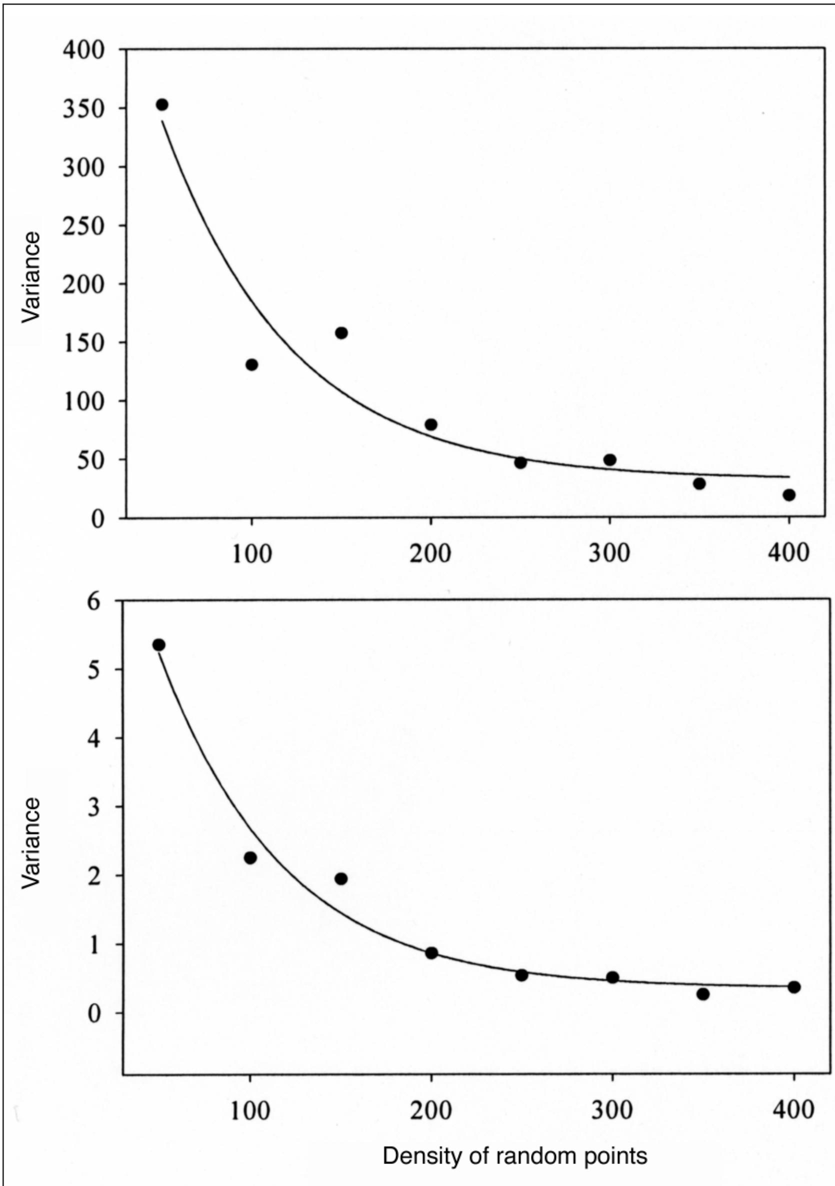

Figure 2. The relationship between density of random points per km^2 and variance of the mean distance to individual habitat types. Curves for the remaining 5 habitat types are similar to those for the swamp forest (top) and xeric oaks scrub (bottom) presented here.

Results

The mean number of locations (± SE) used to estimate each home range was 83 ± 11 locations from 22 bears for overall, 61 ± 6 locations from 20 bears for summer, and 56 ± 6 locations and 19 bears for fall. The mean home-range size was 25.74 ± 7.99 km^2 for overall home ranges, 11.09 ± 2.48 km^2 for summer home ranges, and 35.17 ± 11.14 km^2 for fall home ranges. The mean ground radio-telemetry error was 152.6 m (n = 312, SD = 180.1), and the mean aerial radio-telemetry error was 251 m (n = 25, SD = 270.3).

At the scale of home-range selection within the landscape, no habitat preference was found for the overall or the fall home ranges, indicating that habitat selection did not occur at these spatial and temporal scales (Table 2). However, habitat selection did occur as bears selected a summer home range ($p = 0.026$). In particular, mean distances to xeric oak scrub and sand pine forest were significantly less than expected ($p < 0.001$, and $p = 0.014$, respectively). Mean distances to all other habitat types were as expected. The order of preference was: xeric oak scrub > sand pine forest > disturbed > pine flatwoods > swamp forest > marsh/open water > high-impact urban. Pairwise comparisons suggested that xeric oak scrub was preferred over disturbed, pine flatwoods, and high-impact urban patches (Table 3).

Analysis of habitat selection within the home range indicated that mean distances to habitat types were similar and habitat selection did not occur (Table 2). During summer, however, habitat selection was detected ($p = 0.026$). For summer home ranges, individual comparisons indicated that bears were located significantly farther away from xeric oak scrub than the random points within the home range ($p = 0.005$). The order of habitat preference at this scale was: high-impact urban > pine flatwoods > swamp forest > marsh/open water > disturbed > xeric oak scrub > sand pine forest. Radio-telemetry locations were significantly closer to high-impact urban and pine flatwoods than to xeric oak scrub and disturbed cover types (Table 4).

Table 2. Results of the multivariate analysis of variance testing for habitat selection by female Florida black bears based on distance-based method (Conner and Plowman 2001) in Ocala National Forest, FL. Results of analyses at two spatial scales are shown: selection of the home range from the landscape (home-range selection) and selection of habitat types within the home range (habitat selection within the home range) for overall (multi-annual), summer, and fall home ranges. The F value and significance level (p) are given for each analysis. A significant p value ($p < 0.5$) indicates that bears exhibited habitat selection. N represents the number of home ranges included in each analysis.

Test	N	df	F	p
Home-range selection				
Overall	22	7,15	0.90	0.530
Summer	20	7,13	3.46	0.026
Fall	19	7,12	0.70	0.674
Habitat selection within the home range				
Overall	22	7,15	1.60	0.210
Summer	20	7,12	3.46	0.026
Fall	19	7,12	1.85	0.166

Table 3. Ranking matrix of habitat types used by female black bears when selecting a home range in Ocala National Forest during summer (May–August). The habitat types are listed in order of preference, and *t* statistics (*p*-value) are given for each pair of habitat types. A negative *t*-statistic indicates that the column cover type was preferred to the row cover type.

Cover type	Xeric oak scrub	Sand pine forest	Disturbed	Pine flatwoods	Swamp forest	Marsh/open water	High-impact urban
Xeric oak scrub		0.05 (0.961)	3.89 (0.001)	3.10 (0.006)	1.66 (0.114)	2.07 (0.053)	2.65 (0.016)
Sand pine forest	-0.05 (0.961)		1.57 (0.132)	1.86 (0.078)	1.30 (0.208)	1.66 (0.113)	2.66 (0.015)
Disturbed	-3.89 (0.001)	-1.57 (0.132)		0.78 (0.443)	0.49 (0.632)	0.85 (0.406)	1.41 (0.175)
Pine flatwoods	-3.10 (0.006)	-1.86 (0.078)	-0.78 (0.443)		0.15 (0.880)	0.65 (0.523)	1.10 (0.287)
Swamp forest	-1.66 (0.114)	-1.30 (0.208)	-0.49 (0.632)	-0.15 (0.880)		0.75 (0.463)	0.89 (0.386)
Marsh/open water	-2.07 (0.053)	-1.66 (0.113)	-0.85 (0.406)	-0.65 (0.523)	-0.75 (0.463)		0.41 (0.683)
High-impact urban	-2.65 (0.016)	-2.66 (0.015)	-1.41 (0.175)	-1.10 (0.287)	-0.89 (0.386)	-0.41 (0.683)	

Table 4. Ranking matrix of habitat types used by female black bears when selecting habitat within a home range in Ocala National Forest during summer (May–August). The habitat types are listed in order of preference and *t* statistics (*p*-value) are given for each pair of habitat types. A negative *t* statistic indicates that the column cover type was preferred to the row cover type.

Cover type	High-impact urban	Pine flatwoods	Swamp forests	Marsh/open water	Disturbed	Xeric oak scrub	Sand pine forest
High-impact urban		1.10 (0.286)	1.06 (0.301)	1.16 (0.260)	2.86 (0.010)	2.62 (0.017)	1.16 (0.259)
Pine flatwoods	-1.10 (0.286)		0.38 (0.708)	0.57 (0.576)	2.97 (0.008)	2.76 (0.012)	1.04 (0.310)
Swamp forests	-1.06 (0.301)	-0.38 (0.708)		0.22 (0.825)	2.06 (0.053)	1.97 (0.063)	0.98 (0.342)
Marsh/open water	-1.16 (0.260)	-0.57 (0.576)	-0.22 (0.825)		2.03 (0.056)	2.14 (0.046)	0.97 (0.346)
Disturbed	-2.86 (0.010)	-2.97 (0.008)	-2.06 (0.053)	-2.03 (0.056)		0.68 (0.504)	0.70 (0.493)
Xeric oak scrub	-2.62 (0.017)	-2.76 (0.012)	-1.97 (0.063)	-2.14 (0.046)	-0.68 (0.504)		0.64 (0.533)
Sand pine forest	-1.16 (0.259)	-1.04 (0.310)	-0.98 (0.342)	-0.97 (0.346)	-0.70 (0.493)	-0.64 (0.533)	

Discussion

There was no evidence to suggest that Florida black bears selectively used habitat types when selecting overall and fall home ranges, or when using habitats within those home ranges. However, during the summer, the null hypothesis of no habitat selection was rejected for 2nd- and 3rd-order selection.

For 2nd-order selection, summer home ranges included more xeric oak scrub and sand pine forest than expected, while other habitat types were included in expected proportions. These scrub oak habitats frequently have a very dense understory, which provides excellent escape cover. Given the importance of hard mast for black bears during fall (Maehr and Brady 1984, Roof 1997), we expected a preference for habitat types containing hard-mast producing plants in that season. Contrary to this expectation, however, we found no evidence of habitat selection during fall or when data for fall and spring were pooled. Although black bears did not select home ranges to include proportionately more acorn-producing habitat types than available, this finding requires careful interpretation. Sand pine forest and xeric oak scrub combined comprised ca. 68% of available habitat in the study area (Table 1), and were thus heavily used.

While sand pine forest and xeric oak scrub were the most preferred habitats for summer home ranges at the coarse scale of analysis, these same habitats were the least preferred within the home range. Within summer home ranges, black bears were more closely associated with pine flatwoods and swamp forests than expected. The scrub habitats may have been least preferred during summer because they primarily produce hard mast available during fall. Pine flatwoods and swamp forests have a higher vegetation diversity, abundant berry producing species, and saw palmetto shoots which are the largest components in the summer diet (Roof 1997). Surprisingly, high-impact urban habitat was the most preferred habitat type during summer, but this may be due to the proximity of paved roads to pine flatwoods and swamp forest (Fig. 2). Within the study area, these two habitat types are most abundant near SR 40 and Juniper Springs and south of SR 40 along SR 19. Areas near roads also may have contained edge habitat that provided more food. Regardless of the ultimate cause for habitat use near paved roads, it is important to note that black bears did not avoid roads at this scale of selection.

No habitat selection was detected within the home range for fall or overall home ranges. When contrasted with habitat preference within summer home ranges, bears were often found closer to sand pine forest and xeric oak scrub during fall and on an annual basis. During fall, the primary food sources are the acorns of various scrub oak species (Roof 1997). However, while scrub oaks may provide the most abundant fall food source, selection of other habitat types and alternative food sources also was observed. Habitat selection also was not detected for overall home ranges, suggesting that on a year-round basis there was no preference for habitat type.

Results of this study suggest parallels between habitat use in ONF and in other black bear populations, although the unique habitat composition of ONF makes direct comparison difficult. Other bear populations in the southeastern United States use riparian and wetland habitats for both food and cover (Hellgren et al. 1991, Maehr and Wooding 1992, Wooding and Hardisky 1994), especially upon den emergence because wetlands provide one of the first available sources of food (Fecske et al. 2002). Other studies also have confirmed that black bears rely heavily on acorns in hardwood stands during fall (Garshelis and Pelton 1981, Powell et al. 1997, Smith and Pelton 1990). Study areas that have a conifer component to the landscape often report avoidance of this cover type because of a lack of food (Stratman et al. 2001), although in some cases, conifer forests can be utilized as escape cover (Fecske et al. 2002).

The use of more mesic cover types during summer in ONF, especially the swamp forests, reflects what has been found in other black bear populations. However, ONF is different from most of the southeastern forests in that hardwood forests dominated by *Quercus rubra* L. (red oak) and *Quercus alba* L. (white oak) are not common. Instead, abundant fall mast is available in the sand pine forest and xeric oak scrub from the scrub oak species, especially myrtle oak and scrub oak. Although sand pine forest and xeric oak scrub are not considered preferred habitat types, mast of these species is used as a fall food source (Maehr and Brady 1984, Roof 1997).

Responses to the human-modified habitat types (disturbed and high-impact urban areas) were mixed. Random points within the home range were closer to sand pine and xeric oak scrub than to both disturbed and urban features of the landscape, indicating that when selecting a home range, bears appear to avoid both paved roads and disturbed areas. At the finer scale, however, disturbed habitat was still one of the least-preferred habitat types, but bears selected high-impact urban habitat. Female bears most likely selected against disturbed areas within their home ranges because they do not provide necessary cover. Bears do appear to be somewhat tolerant to human disturbance as long as they have adequate escape cover such as the dense roadside vegetation of ONF.

Habitat selection in this study for summer home ranges of female bears was different at different spatial scales. Rettie and Messier (2000) suggest that the most important, or most limiting, factors affecting individual fitness should be selected for at the coarsest scales. At the coarse scale, other studies have found that habitats were selected for predator avoidance in *Rangifer tarandus caribou* Gmelin (woodland caribou; Rettie and Messier 2000), den-site availability in *Canis lupus* L. (gray wolf; McLoughlin et al. 2004), and prey availability in barren-ground *Ursus arctos* Linnaeus (grizzly bears; McLoughlin et al. 2002), while habitat types with higher food availability were selected at the finer scale in each of these cases. It has been suggested that black bears in Washington selected home ranges from the study area to include sufficient food; however, they used habitat types within the home range for both food and escape cover (Lyons et al. 2003). In our study, the primary differences between habitat selection of black bears at two spatial scales during summer were that at the coarser scale, densely forested habitat types were primarily selected for while human-impacted habitat types were generally avoided, and that this order was reversed within the home range. Strongest selection for forested habitat types used for food and cover may indicate that these factors are most limiting. Specific food resources may be less limiting and so only selected for at a finer scale.

In ONF, a primary goal of habitat managers should be to maintain a diversity of habitats. This is critically important as bears use food resources from different habitats on both a seasonal and annual basis. Reduced diversity may increase the likelihood that mast failure of one species will have a dire impact on the population as a whole. At the scale of a stand within the forest, female bears selected against open disturbed areas. However, these areas may regenerate to xeric oak scrub over time, which provides both food and cover. A balance of stand ages should be maintained so that overall abundance of acorn-producing species in the forest will remain high.

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