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MANAGEMENT STRATEGIES FOR FLORIDA BLACK BEARS BASED ON HOME RANGE HABITAT COMPOSITION

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Abstract: Florida black bears (*Ursus americanus*) were radio-monitored from October 1976 through July 1978. Composite home range of 11 animals was evaluated to identify important habitat components in the Osceola National Forest (ONF), Florida. Large swamp systems and surrounding pine flatwood communities were major components of bear habitat. The composite home range, which covered 49% (303 km²) of ONF, included 7.5 of the 10 major swamps. Pine forest cover/stand types accounted for 60% of the composite home range. The composite home range also included 60% (19,003 ha) of forest stand types classified as sawtimber and 35.5% (6,946 ha) classified as poletimber in ONF. Preservation and restoration of the interconnectivity of large swamps and forested upland buffers surrounding these swamps, and maintaining longer timber rotation would encourage bear use and reduce the vulnerability of bears to overharvest.

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Encroaching human and agricultural development of black bear habitat has caused population fragmentation and has restricted bears to more remote, inaccessible areas of Florida. Continuing destruction of bear habitat and illegal hunting prompted the Florida Game and Fresh Water Fish Commission to list the black bear as a threatened species (McDaniel 1974). This threatened status applies to all bears except those found in Apalachicola National Forest (ANF) and Baker and Columbia counties (including ONF) where legal bear hunting occurs. The ANF and ONF are important population centers for bears in north Florida (Maehr and Brady 1984a) and provide habitat for 2 of the 4 major bear populations in the state (Brady and Maehr 1985). Between 1976 and 1978, at least 40 bears were known to use the ONF (U.S. Department of Interior 1978). The bears were distributed mainly in the central portion of ONF. The identification of habitat components that contribute to the survival of these bears would help insure that future forest management practices do not jeopardize existing bear populations or bear hunting.

In ONF, bears are currently a featured species in the northern half of the forest. Featured species management for bears as practiced by the U.S. Forest Service (USFS) is intended to limit human access, reduce disturbance, provide adequate escape cover and promote habitat diversity. Habitat management for black bears in the national forests is currently based on Standard Management Practices and Guidelines that are identified in the USFS Wildlife Habitat Management Handbook (U.S. Forest Service 1981) and the Land and Resource Management Plan for National Forests in Florida (U.S. Forest Service 1985).

The USFS habitat management guidelines are general in nature and are applicable throughout the southeastern United States in areas where bears are featured. Whether these guidelines are adequate for maintaining viable bear populations in ONF is uncertain, due to the lack of appropriate published studies. Published information on black bears in ONF has been related to status and distribution (U.S. Department of Interior 1974, 1978), food habits and general habitat use (Harlow 1961; U.S. Department of Interior 1978; Maehr and Brady 1982, 1984a, 1984b), movements and home range sizes (U.S. Department of Interior 1978, Mykytka and Pelton 1989). Without detailed analysis, the USFS may not be able to continue classifying the bear as a featured species in particular stands due to the multiple-use policy of the agency. This in turn may jeopardize the existence of bears or bear hunting in ONF. Presently, featured status is not fixed within compartment stands and is continually reviewed for potential changes.

We evaluated the habitat composition of the composite home range of 11 monitored bears from October 1976 through July 1978. The composite home range was considered representative of the areas bears used in ONF during this period because it encompassed 98% of the 108 observations of bears and bear signs (i.e., tracks and scats) from monthly road surveys, 98% of the 394 radio-telemetry locations collected on bears during this period, and the locations of 8 bears killed by hunters during 1976 and 1977. The area of bear use during this period was evaluated to examine the habitat factors affecting bear distribution. The habitat components examined included forest cover types, stand conditions, road densities, and the number of major wetland systems. We describe bear use areas to identify habitat components that should be managed or protected for black bears and recommend management strategies for maintaining a viable bear population.

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STUDY AREA

The ONF consists of 635.8 km² in northeast Florida and is bisected by approximately 450 km of paved and graded roads (Fig. 1). The terrain is flat with elevations ranging from 30 to 59 m above sea level. According to Avers and Bracy (1975) the soils are acidic (pH 4.0 to 5.5), low in plant nutrients, and are seasonally or permanently wet. The climate is humid and subtropical. The coldest month is January, which averages 13 C, and the warmest month is August, which averages 27 C. Annual precipitation averages 129 cm.

Vegetation and corresponding forest cover types were described by Avers and Bracy (1975) and U.S. Department of Interior (1978). The ONF is dominated by pineland communities (66%) interspersed with cypress (24%) and bay swamps (10%). The major forest cover types in ONF include: slash pine (*Pinus elliottii*) flatwoods (29,498 ha or 48.3%), longleaf pine (*P. palustris*) flatwoods (10,937 ha or 17.9%), bald cypress (*Taxodium distichum*)-water tupelo (*Nyssa aquatica*) swamps (9,092 ha or 14.9%), slash pine-hardwood swamps (5,486 ha or 9.0%), mixed bay swamps [sweet bay (*Magnolia virginiana*)-swamp tupelo (*Nyssa biflora*)-red maple (*Acer rubrum*)] (4,106 ha or 6.7%), and fetterbush

(*Lyonia lucida*) swamps (1,914 ha or 3.2%). Swamps range from 23 km² (Big Gum Swamp) to less than 4 ha (cypress domes). The pineland communities represent a continuum from wet slash pine flatwoods to dry longleaf pine flatwoods to very high pinelands [longleaf pine-turkey oak (*Quercus laevis*) association]. The ecotones between swamps and flatwoods are wide and usually contain components of both vegetational types.

Ten major (>150 ha) swamp systems are present in ONF (Fig. 1). These primarily are centrally located and range in size from 1.5 km² to 23 km². Buckhead Swamp and portions of Big Gum Swamp represent the largest contiguous swamp system (approximately 29 km²).

The ONF is managed on a multiple-use sustained yield basis for timber (87%), wildlife, range, water, and recreation (U.S. Forest Service 1978). Timber management plans for 1976 to 1985 proposed even-aged forest management with 60-year rotations for both slash pine and longleaf pine stands (U.S. Forest Service 1975). The plan proposes that approximately 7.3 km² of pine forest are to be cut and regenerated annually. The latest Land and Resource Management Plan (U.S. Forest Service 1985) recommends a 40- to 90-year rotation for these timber types.

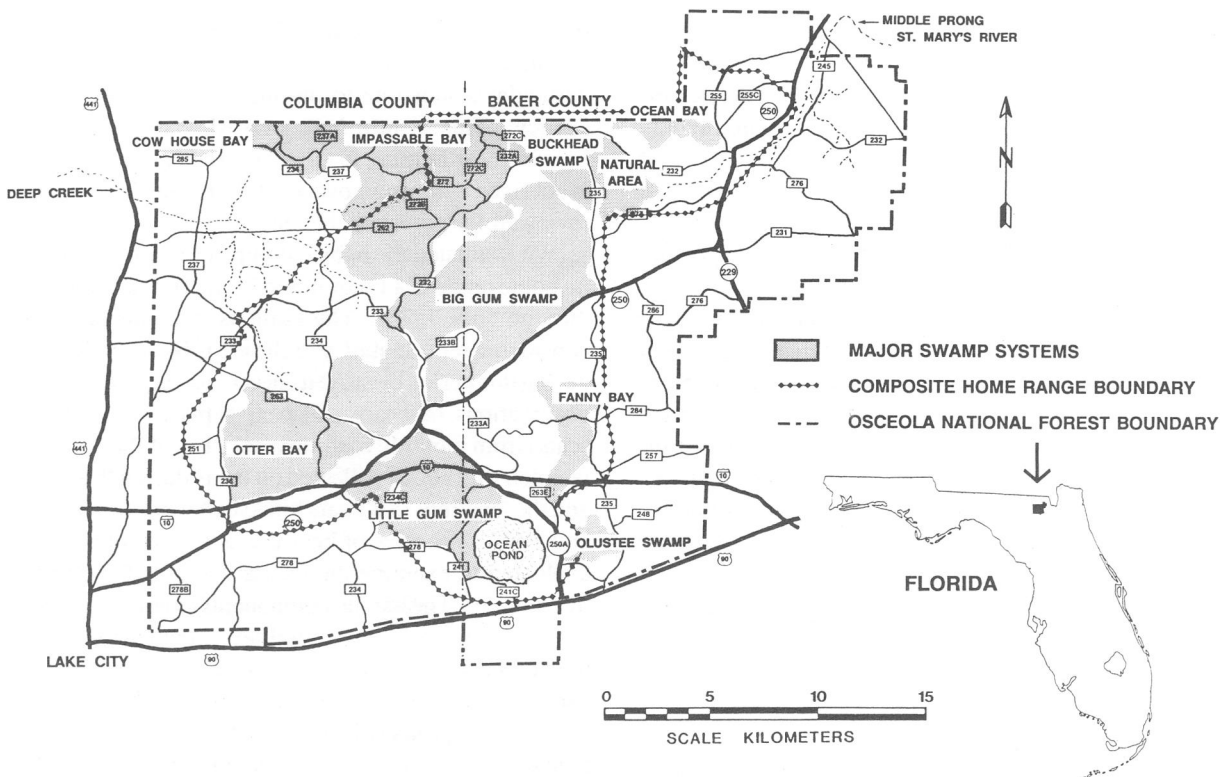


Fig. 1. Study area showing major swamps and composite home range of 11 black bears monitored in Osceola National Forest from October 1976 through July 1978.

Black bears are hunted during open deer season and with dogs during a 9-day period in October. The regular season begins the first week in November and ends the first week in January. The number of bears killed between 1974 and 1979 ranged from 2 to 6 in the special hunts and 0 to 3 in the regular hunting season (Maehr and Brady 1984c).

METHODS

Important habitat elements were identified by evaluating the composite habitat use of 11 bears monitored from October 1976 to July 1978. The area was derived from a composite of the home ranges of 2 adult females, 5 adult males, 2 subadult males and 2 yearling males. The home ranges were defined by the 95% harmonic mean method (Dixon and Chapman 1980). The home ranges mainly were restricted to ONF. However, approximately 10 to 20% of the home ranges of 4 males occurred to the north of ONF and all the males were located outside ONF at least once. Due to the lack of stand data, home range areas outside ONF were not analyzed.

Habitat composition/road density were determined from the USFS Continuous Inventory of Stand Condition (CISC) maps and prescriptions for 1978 (U.S. Forest Service 1978) and the 1988 USFS Transportation Plan Maps (U.S. Forest Service 1988), respectively. The CISC stand data were summarized to determine the percent occurrence and area (ha) of the forest cover/stand types, stand condition classes, forested/non-forested stands, upland/wetland stand types, and the number of major wetland systems within each of these areas (Table 1).

Forest stands were divided into major and minor types for habitat analysis. Major forest cover types represented at least 3% (1,835.0 ha) of ONF. Major stand types represented at least 300 ha and the minor stand types represented less than 300 ha.

Electivity index (EI) values (Ivlev 1961) were calculated for each of the major forest cover/stand types within the composite home range to facilitate comparisons between these areas. EI values represent a ratio of the percent of occurrence of forest cover/stand types (i.e., within the composite home range) versus the percent of availability (i.e., within the ONF). EI values were determined by dividing the percent occurrence minus the percent of availability by the percent of occurrence plus the percent available. The index ranges from -1.0 to 1.0. EI values of 0.0 indicate occurrence is in proportion to availability. Values between 0.0 and 1.0 indicate occurrence is greater than expected based on percent availability, and values between 0.0 and -1.0 indicate occurrence is less than expected based on percent availability. EI

values were used to determine the relative occurrence of particular forest cover types within the composite home range.

RESULTS

Composition of Composite Home Range

The composite home range was centrally located (Fig. 1) and contained approximately 302.9 km² (49% of ONF). The upland forest cover types (pine stands) represented 60% of the composite home range. The wetland forest cover types (bald cypress-water tupelo, slash pine-hardwood, mixed bay, and fetterbush stands) represented 40%.

The composite home range included 6 of the 11 cover types and 29 of the 38 stand types occurring in ONF (Table 1). All 6 major forest cover types were represented. None of the 5 minor forest cover types were included. The composite home range also included all 20 major stand types and 9 of the 18 minor stand types. The total area of these 18 minor stand types represented approximately 1,355 ha (2.2% of ONF).

The percent occurrences of major cover and stand types within the composite home range varied. Slash pine and bald cypress-water tupelo were the most prevalent cover types representing 47.2 and 19.4%, respectively. Longleaf pine and sweetbay-swamp tupelo-red maple (mixed bay) stands represented 13.0 and 10.3%, respectively. The least prevalent cover types were slash pine-hardwood and fetterbush (7.7 and 2.4%, respectively).

The percent occurrences of the 20 major stand types within the composite home range ranged from 0.2 to 21.7%. Two stand types (slash pine classified as immature sawtimber, and bald cypress-water tupelo classified as immature sawtimber) together represented more than 34.7%.

The percent occurrences of stand condition classes within the composite home range varied from 62.7 to 1.9%. Sawtimber, which represented 62.7%, was the most prevalent stand condition class. This was followed by poletimber (21%), seedling and sapling (10.3%), unproductive forest (2.4%), and regenerating (1.9%).

The composite home range consisted of approximately 95.7% forested and 4.3% non-forested areas. The non-forested categories included fetterbush swamps and stands that were classified as regenerating.

Comparisons of Habitat Composition

The percentage of forested and non-forested areas within the composite home range and the ONF were similar. Forested areas represented approximately 92.6%

Table 1. The area (ha), percent occurrence, and electivity index (EI) values (Ivlev 1961) of U.S. Forest Service forest cover/stand types in the Osceola National Forest (ONF) and the composite home range (CHR) of 11 black bears monitored from October 1976 through July 1978.

Forest cover/ (Code) Stand type	ONF		CHR		EI values ^a	Forest cover/ (Code) Stand type	ONF		CHR		EI values ^a
	ha	%	ha	%			ha	%			
Loblolly Pine-Hardwood/ (1312)						Slash Pine/ (continued) (2213)					
Immature sawtimber	41.7	0.06	—	—	—	Seedling & sapling	4837.3	7.90	2878.5	9.52	0.09
Slash Pine-Hardwood/ (1406)						(2214)					
Sparse sawtimber	25.9	0.04	—	—	—	Seedling & sapling - inadequately stocked	130.3	0.21	13.4	0.04	—
(1407)						(2215)					
Low quality poletimber	274.9	0.44	—	—	—	Non-stocked	28.7	0.04	28.7	0.09	—
(1410)						Subtotal					
Mature sawtimber	418.2	0.68	272.0	0.89	0.13		29489.2	48.20	14292.9	47.26	-0.01
(1411)						Pond Cypress/ (2311)					
Immature poletimber	1284.2	2.09	379.3	1.25	-0.25	Immature poletimber	18.2	0.03	—	—	—
(1412)						Loblolly Pine/ (3111)					
Immature sawtimber	3482.6	5.69	1679.8	5.55	-0.02	Immature poletimber	33.2	0.05	—	—	—
Subtotal	5485.8	8.96	2331.1	7.70	-0.08	(3112)					
Longleaf Pine/ (2101)						Immature sawtimber					
In regeneration	741.7	1.21	63.9	0.21	-0.70	Subtotal	62.3	0.10	—	—	—
(2106)						Sweet Gum-Willow/ (6212)					
Sparse sawtimber	71.6	0.11	17.8	0.05	—	Immature sawtimber	12.9	0.02	—	—	—
(2107)						Laurel Oak-Willow Oak/ (6412)					
Low quality poletimber	16.1	0.02	16.1	0.05	—	Immature sawtimber	14.9	0.02	—	—	—
(2110)						Bald Cypress-Water Tupelo/ (6705)					
Mature sawtimber	8202.8	13.40	2698.7	8.92	-0.20	Sparse poletimber	63.9	0.10	59.5	0.19	—
(2111)						(6707)					
Immature poletimber	336.4	0.55	148.9	0.49	-0.06	Low quality poletimber	180.1	0.29	105.3	0.34	—
(2112)						(6711)					
Immature sawtimber	1202.8	1.96	901.6	2.98	0.20	Immature poletimber	4546.1	7.43	1755.8	5.80	-0.12
(2113)						(6712)					
Seedling & sapling	365.2	0.59	86.2	0.28	-0.36	Immature sawtimber	4275.3	6.98	3935.2	13.01	0.30
Subtotal	10936.6	17.87	3933.2	13.00	-0.16	(6713)					
Slash Pine/ (2201)						Seedling & sapling					
In regeneration	1886.2	3.08	515.7	1.70	-0.29	Subtotal	9091.7	14.86	5882.1	19.45	0.13
(2205)						Sweetbay-Swamp Tupelo-Red Maple/ (6811)					
Sparse poletimber	151.8	0.24	115.4	0.38	—	Immature poletimber	1843.7	3.01	1221.0	4.03	0.15
(2206)						(6812)					
Sparse sawtimber	326.7	0.53	208.9	0.69	0.13	Immature sawtimber	2262.3	3.69	1902.4	6.29	0.26
(2207)						Subtotal					
Low quality poletimber	400.4	0.65	83.8	0.27	-0.41		4106.0	6.71	3123.4	10.33	0.21
(2208)						Fetterbush/ (9000)					
Low quality sawtimber	28.3	0.04	—	—	—	Non-stocked	1914.1	3.12	731.2	2.41	-0.13
(2209)						Total					
Mature poletimber	207.3	0.33	207.3	0.68	—		61173.4		30293.9		
(2210)											
Mature sawtimber	1251.0	2.04	810.1	2.67	0.13						
(2211)											
Immature poletimber	10193.5	16.60	2853.8	9.43	-0.28						
(2212)											
Immature sawtimber	10047.7	16.42	6577.3	21.75	0.14						

^a + EI values indicate stand type occurs in greater proportion than in ONF; - values indicate that the type occurs in smaller proportion than in the ONF.

of the ONF and 95.7% of the composite home range.

The percent composition of the major forest cover/stand types within the composite home range differed from the ratio within ONF. The EI values for the major cover types varied from -0.16 to 0.21 (Table 1). The inclusion of mixed bay and bald cypress-water tupelo in the composite home range was greater than expected and accounted for 9,005 of the 13,197 ha (68%) of these stand types in ONF. The occurrence of fetterbush and longleaf pine was lower than expected. Slash pine and slash pine-hardwood were included in proportion to availability in ONF.

The EI values for the major forest stand types also were variable (Table 1). The occurrence of bald cypress-water tupelo, mixed bay and longleaf pine stands as immature sawtimber was greater than expected. The composite range included 92%, 84% and 75%, respectively, of these stand types in ONF. Twelve stand classes, primarily pine uplands, occurred in proportion to their availability in ONF. Young-age pine stands were included less than expected. Clearcuts had the lowest EI value. Sawtimber stands represented 63% (19,003 ha) of the composite home range, 52% (31,694 ha) of ONF and 40% (12,691) of the area bears did not occupy in ONF. In general, the occurrence of sawtimber stands was greater than expected and the occurrence of poletimber stands was less than expected.

The percentages of wetland/upland forest cover types within the composite home range and the ONF differed slightly. ONF was 33.8% in wetlands and 66.2% in upland forest cover types. The percentage of wetland and upland forest cover types in the composite home range (302.9 km²) was 39.8% and 60.2%, respectively. The area outside the composite home range (309.1 km²) was 27.8% wetlands and 72.2% uplands.

The occurrence of large swamp systems within the composite home range was greater than expected. The composite home range included 7.5 of the 10 major swamps in ONF (Fig. 1). This includes all of Big Gum Swamp, Otter Bay, Little Gum Swamp, Fanny Bay, Natural Area, and Buckhead Swamp, the eastern portion of Impassable Bay and the southern portion of Ocean Bay. These swamps represented the central portion of the composite home range and represented all the major bald cypress-water tupelo and mixed bay swamps classified as immature sawtimber. The remaining portion of ONF (approximately 51%) included 2.5 of the large swamps. This included Cow House Bay (approximately 200 ha) and Olustee Swamp (approximately 265 ha), which are 2 of the smallest of the major swamps and are dominated by bald cypress-water tupelo stand classified as immature

poletimber, and the western portion of Impassable Bay, which is a fetterbush swamp. This portion of Impassable Bay is dominated by dense stands of fetterbush and includes few mast-bearing trees.

Road densities in ONF and the composite home range were similar (Table 2). However, since the composite home range included more large wetland systems, the road density in the uplands was higher. For example, the overall road density of the Big Gum Swamp compartment (60.6 km²) is 1.46 km/km². However, since 40% of the compartment is one contiguous roadless area, the road density in the remaining portion is 2.5 km/km². The road density in the upland areas of the remaining 51% of ONF is slightly higher than the average (1.97 km/km²). This area is predominately uplands and the 2 of the 2.5 major swamps included are less than 300 ha.

DISCUSSION

The composite home range centered around swamp systems greater than 300 ha and included adjacent pine forests. The occurrence of bears around large swamps and surrounding pinelands can be explained by food availability and presence of escape cover. Food habits studies indicate that hardwood swamps and pinelands provide important seasonal food resources for black bears in ONF (Maehr and Brady 1982, 1984a). Also, large swamps have been identified as important escape cover for bears that are hunted (Hamilton 1978). The lack

Table 2. The length (km) and density (km²) of roads in the Osceola National Forest, the composite home range of 11 black bears monitored from October 1976 through July 1978 and the Big Gum Swamp Compartment.

Study area	km	km/km ²
Osceola National Forest (635.8 km ²)		
Paved/Graded Roads	454.6	0.68
Unimproved Roads (Jeep Trails)	818.9	1.22
Total	1273.5	1.90
Composite home range (302.9 km ²)		
Paved/Graded Roads	211.1	0.67
Unimproved Roads (Jeep Trails)	406.1	1.29
Total	617.2	1.96
Big Gum Swamp Compartment (60.6 km ²)		
Paved/Graded Roads	37.0	0.61
Unimproved Roads (Jeep Trails)	51.7	0.85
Total	88.7	1.46

Note: For areas where bears are featured, the U.S. Forest Service Wildlife Management Handbook (U.S. Forest Service 1981) recommends a road density of no more than 0.62 km/km².

of large contiguous swamp systems, which limit hunter access, and the lack of large stands of mast-bearing hardwoods, which are important fall mast producers, likely limited bear activity outside the composite home range.

The heterogeneous landscape dominated by sawtimber stands is consistent with food habits studies of the Florida black bear (Maehr and Brady 1984a, 1984b). These studies indicated that a variety of habitats are required to satisfy the diet of bears. The diversity of forest types and the high percentage of forested areas within the composite home range also are consistent with Harlow's (1961) description of bear habitat. He characterized black bear habitat as consisting of large tracts of forested areas that contain a mixture of vegetation types including pine flatwoods, cypress swamps, bayheads, scrub oak ridges and oak hammocks. In ONF, oak hammocks are not prevalent and represent less than 125 ha.

Based on field observations, road density was a major factor affecting bear vulnerability during the 1976 through 1978 hunting seasons (i.e., the 9-day bear hunting season that allows the use of dogs). Bears utilizing upland areas were more vulnerable than bears using one of the major swamps. We attribute the increased vulnerability of bears utilizing upland areas to the road density and thus increased access to hunters. The road densities in the ONF and upland areas of the composite home range were at least 3 times the 0.62 km/km² recommended by the USFS guidelines for areas where bears are featured. Telemetry data collected on the 11 radio-collared bears during the 1977 hunting season also indicated higher vulnerability of bears in upland areas. Eight of the 11 bears monitored were located in Big Gum Swamp and 1 was located in Little Gum Swamp. Movements by these animals outside the swamps were not observed during this period; none of these bears were encountered by hunters. Monitoring of the remaining 2 collared bears, both adult males, indicated that they traveled through upland areas between Big Gum Swamp, Impassable Bay and Ocean Bay during the hunting season. Their tracks were located by bear hunters and several unsuccessful attempts were made to harvest them. Also, the 6 bears harvested by hunters during the 1976 and 1977 hunting seasons suggest that uplands bisected by roads makes bears more vulnerable. Before harvest, these bears were located by their tracks on upland roads. A study on the effects of roads on bear movement in North Carolina also indicated that, as road density increases, the potential for hunters to encounter bears increases (Brody and Pelton 1989). The increased survival rate of bears foraging in large swamp systems and/or roadless areas during the

hunting season would help explain the observed centralized distribution of bears and the lack of bear use toward the periphery of ONF, an area with limited escape cover and fall mast.

The differences in habitat composition between the composite home range and the remaining portion of ONF suggest that large hardwood swamp systems, heterogeneous landscapes, sawtimber stands and roadless areas are important habitat components within ONF. These components in combination with the undeveloped condition of ONF help to maintain a viable bear population.

MANAGEMENT RECOMMENDATIONS

Swamps greater than 300 ha and adjacent pine uplands are black bear habitat components that should be protected in ONF. To insure viable bear populations and bear hunting in the future, it is recommended that the USFS preserve and restore the contiguity of large swamp systems and upland buffers surrounding these swamps by limiting construction of new roads and closing others that currently bisect these areas.

To insure habitat diversity in the future, it is recommended that the USFS maintain forest management practices that promote stand diversity and mast production. USFS guidelines recommend that stand sizes range from 10 to 40 ha, at least 2 stands should be regenerated in each compartment within each 10-year period, regeneration cuts should be separated by a minimum of 90 m, sawtimber rotations should be used for both pine and hardwood forest cover types, stands should be prescribed burned on a 3- to 5-year cycle, and mast-bearing hardwood species should be promoted during thinning operations (U.S. Forest Service 1981, 1985).

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