

DEN SELECTION AND USE BY BLACK BEARS IN MICHIGAN'S NORTHERN LOWER PENINSULA

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Abstract: I located 51 different black bear (*Ursus americanus*) den sites (28 of males, 23 of females) in Michigan's Northern Lower Peninsula between September 1977 and March 1980. During the 3-winter period, 10 radio-tagged males denned in swamp habitat 24 times, lowland habitat 2 times, and upland habitat 2 times; 7 females denned in swamp habitat 11 times, lowland habitat 5 times, and upland habitat 7 times. Habitat selection for den sites between sexes differed significantly ($X^2 = 8.29$, $df = 2$, $P < 0.002$). Of 31 dens visited on foot, 5 were unprotected snow "nests" lined only with vegetation, 17 were located in depressions or chambers under downed trees or root masses, 3 were in underground cavities, 1 was a nest next to a tree, and 4 were excavated under stumps. The den floor of 1 adult female with 2 cubs contained 2–3 cm of water. Dens of all bears except 1 male were lined with varying amounts of vegetation. The 3 most heavily used, and probably critical winter habitat types were swamp conifers (24 dens for males, 11 for females), upland hardwoods (2 dens for males, 7 for females), and lowland brush and hardwoods (2 dens for males, 5 for females).

The average distance of dens from a center of human activity was greater for males ($\bar{x} = 1.26$ km) than for females ($\bar{x} = 0.55$ km, $P < 0.01$). Two males denned close to active oil wells ($\bar{x} = 0.32$ km), whereas 2 females denned near active snowmobile trails ($\bar{x} = 0.08$ km). The activity most disruptive to denning appeared to be human encroachment. Residential and commercial development increased during the study, including land-filling of swamps, construction of wastewater treatment facilities, and expansion of a gravel pit.

Int. Conf. Bear Res. and Manage. 7:317–322

Black bears show considerable flexibility in selecting winter dens (Lindzey and Meslow 1976). In Michigan's Upper Peninsula, Erickson (1964) found that most bears favored dens excavated beneath logs or stumps, or holes excavated into hillsides. Bears expended considerable effort constructing dens, lining them with leaves, bracken fern (*Pteridium aquilinum*), and marsh grass. Seven percent of the Upper Peninsula bears denned in unsheltered depressions. Tietje and Ruff (1980) found bears denned in mixed stands of mature aspen and spruce or mature spruce stands in east-central Alberta. They reported 35 of 37 dens were excavated below ground level or under root masses of fallen trees and were lined with grasses and litter from the den vicinity.

Human structures used by black bears as dens in Yellowstone National Park included storm drainage culverts (Barnes and Bray 1966) and foundations of old buildings (Skinner 1925). Jonkel and Cowan (1971) also reported bear dens in basements of abandoned buildings in Montana.

Cahalane (1954) reported black bears denning in caves; in hollow trees or fallen logs; under windfalls, roots, or thickets; in geyser-steam-heated caves; and in the open. Skinner (1925) even reported black bears denning in openings of nonactive geysers and old hot springs in Yellowstone Park. In Montana, preferred den sites included bases of hollow trees, rock caves, and holes excavated in the ground (Jonkel and Cowan

1971). On Long Island, Wash., Lindzey and Meslow (1976) found 10 bear dens associated with dead trees and 2 with live trees.

The principal function of dens in the Northwest appears to be protection from heavy winter rains. Erickson (1964), Lindzey and Meslow (1976), Johnson and Pelton (1980), Lentz et al. (1983), and Alt (1984) reported that female bears were more selective in choosing dens than were males.

Lentz et al. (1983) concluded from a mathematical simulation developed by Johnson et al. (1978) that tree dens afforded a 15.05% savings in energy expended for body maintenance compared to open ground dens in generally snow-free environments. Thorkelson and Maxwell (1974) reported that dens were capable of providing protection from conductive, convective, and radiant heat losses while Craighead et al. (1971) observed that the microclimate provided by bear pelage and bedding material reduced heat loss by convection and conduction.

In northern Maine, Hugie (cited in Allen 1978) reported 1 den at the base of an old white pine (*Pinus strobus*) lined with evergreen boughs, another underneath the root mass of a white pine, and a 3rd in a shrub-protected opening. In Washington, Poelker and Hartwell (1973) tracked 3 radio-tagged bears to their dens. An adult female denned in 4 different locations, moving each time she was disturbed. Sites included 2 dens in hollow logs, 1 in an excavated cavity at the base of a large rotten stump, and 1 in a natural cavity at the base of a maple (*Acer* sp.) tree; no bedding material was used. Bears reused vacated dens 3 times. Dense ground cover appeared to be preferred for

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denning. Three dens were within 91 m of forest roads. Even during western Washington's relatively mild winters, some black bears had dormant periods of nearly 3 months. Fuller and Keith (1980) reported that at least 5 of 6 bears excavated dens in the Fort McMurray, Alberta, area. Leaves were scraped into 4 of the dens.

The length of the denning period in the Great Smoky Mountains, Tenn., ranged 50–116 days (\bar{x} = 90 days), but upon entering dens, bears did not intermittently leave and return (Johnson and Pelton 1980). They found that 14 of 17 instrumented bears denned between the last week in December and the 1st week in January. In Alberta, dens were constructed over a 5- to 10-day period (Tietje and Ruff 1980). In 1975, bears entered dens during a 4-week period starting 7 October, whereas in 1976 bears denned over a 5-week period starting 1 October. Adult females and subadults denned 1st and adult males last.

STUDY AREA

The study, including a separate analysis of human impacts on bears reported by Manville (1983), was conducted in Kalkaska, Missaukee, and Roscommon counties in the Northern Lower Peninsula of Michigan. Field work centered in the Higgins-Houghton Lake-Dead Swamp region (Fig. 1), although some bears were captured and others made seasonal movements outside this area. See Manville (1983) for details.

Vegetative cover types in the study area consist of swamp, lowland, and upland sites (designations modified from Kuchler [1964]). Swamps contained more than 50% white cedar (*Thuja occidentalis*), mixed swamp conifers (including larch [*Larix laricina*], black spruce [*Picea mariana*], and white cedar), or more than 50% black spruce. Lowlands contained lowland hardwoods (dominated by red maple [*Acer rubrum*]), lowland sedges, lowland balsam fir (*Abies balsamea*), or lowland shrubs (alder [*Alnus* spp.], dogwood [*Cornus* spp.], willow [*Salix* spp.], huckleberry [*Gaylussacia* spp.], blueberry and cranberry [*Vaccinium* spp.]). Upland sites consisted of upland northern hardwoods dominated by sugar maple (*A. saccharum*), yellow birch (*Betula alleghaniensis*), beech (*Fagus grandifolia*), hemlock (*Tsuga canadensis*), oak (*Quercus* spp.), upland grass and weeds such as bracken fern, or upland shrubs including cherry (*Prunus* spp.), hazel (*Hamamelis* spp.), serviceberry (*Ame-*

lanchier spp.), and willow.

Climate for the area is cool and humid, with fewer than 100 clear days per average year. In most years snow stays on the ground more than 120 days, and the growing season is short. The topography of more northern areas varies from lowland swamps to rolling, glaciated hills. North of Houghton Lake, ponds and lakes are more numerous than in the Higgins-Houghton lakes area.

METHODS AND MATERIALS

Bears were captured in culvert and barrel traps, modified Aldrich foot snares, and in their dens; they were ear-tagged and instrumented with fitted or expandable radiocollars (Manville 1983). Ages of captured bears were determined from premolar cross-sections (Stoneberg and Jonkel 1966, Willey 1974).

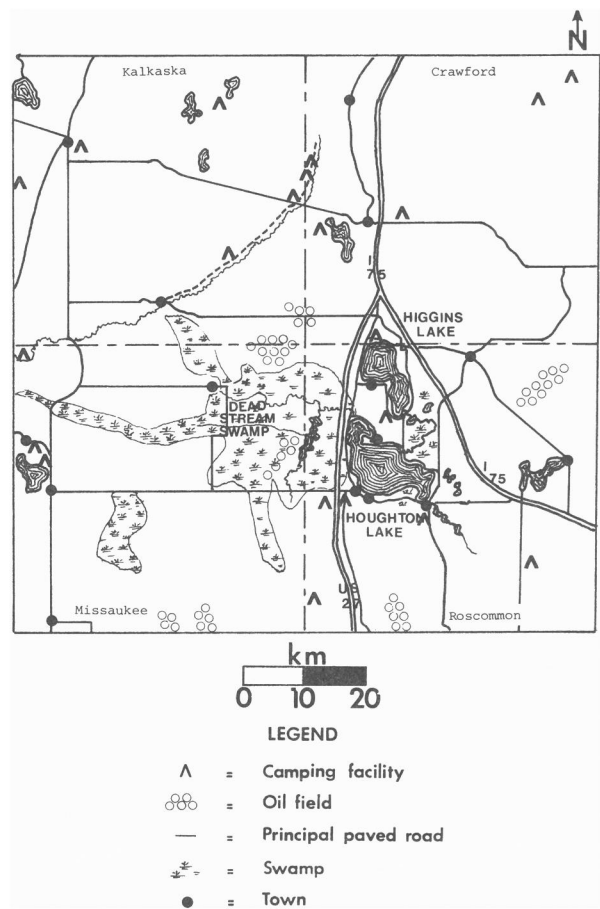


Fig. 1. The Dead Stream Swamp (west of Houghton and Higgins lakes) and adjacent wetlands in Roscommon, Missaukee, and adjoining counties in the study area.

Most dens were located by radiotracking marked bears, although 2 dens were located by sportsmen and 1 by an aircraft pilot. Den locations and distances from centers of human activity (defined as an area with daily or at least triweekly human use) were determined, and denning materials were classified. All dens were photographed. Habitat types where dens were situated (upland, lowland, or swamp) and use of different vegetation cover types were compared between sexes using the chi-square test for k independent samples (Siegel 1956). Average distances of bear dens from centers of human activity were compared between sexes using the randomization test for 2 independent samples (Siegel 1956). Movements of bears from dens and numbers of dens used were assessed.

RESULTS AND DISCUSSION

Den Selection and Use

Ten radio-tagged male bears denned in 24 swamp, 2 lowland, and 2 upland dens during the winters of 1977–78 to 1979–80; 7 females denned in 11 swamp, 5 lowland, and 7 upland dens during this same period (Table 1). There was a significant difference between sexes in the use of swamp, lowland, and upland habitats for den sites ($X^2 = 8.29$, $df = 2$, $P < 0.002$). Therefore, based on incidence of use and apparent den habitat preference, the 3 most heavily used winter habitat types for Lower Peninsula bears were swamp conifers, upland hardwoods, and lowland shrubs and hardwoods.

Of the 31 dens (16 of males, 15 of females) actually

Table 1. Den site locations for black bears by habitat type, winters of 1977–78 to 1979–80, Kalkaska, Missaukee, and Roscommon counties, Michigan.

Bear	Winter of	Swamp habitat ^a	Lowland habitat ^b	Upland habitat ^c	Total
Males					
ES	1977–78	1	—	—	1
SB	1977–78	1	—	—	1
DH	1977–78	3	—	—	3
	1978–79	3	—	—	3
LS	1978–79	2	1	—	3
	1979–80	—	1	—	1
LA	1978–79	2	—	1	3
	1979–80	3	—	—	3
OC	1978–79	2	—	—	2
	1979–80	2	—	—	2
BK	1978–79	—	—	1	1
	1979–80	1	—	—	1
LV	1978–79	1	—	—	1
Go	1979–80	2	—	—	2
MP	1979–80	1	—	—	1
		<u>24</u>	<u>2</u>	<u>2</u>	<u>28</u>
Females					
Ge	1977–78	—	1	1	2
ML	1977–78	—	—	1	1
An	1977–78	—	—	1	1
DM	1978–79	2	1	2	5
	1979–80	1	1	1	3
Rh	1978–79	2	—	—	2
Lu	1978–79	1	1	—	2
	1979–80	4	—	—	4
Ta	1978–79	—	—	1	1
	1979–80	1	1	—	2
		<u>11</u>	<u>5</u>	<u>7</u>	<u>23</u>

^a More than 50% white cedar, mixed swamp conifers, or more than 50% black spruce.

^b Lowland hardwoods, lowland sedges, lowland balsam fir, or lowland shrubs.

^c Upland northern hardwoods, oak, upland grass and weeds, or upland shrubs.

visited, 6 (2 of males, 4 of females) were open snow "nests." These were unprotected by trees, shrubs, or root masses but were lined with vegetation from the immediate area. Females Lu and Ta and males DH and LS denned in open snow nests. One of 2 open dens female Lu used was lined with alder, spirea (*Spiraea* sp.), and willow branches and was shared with her 2 cubs. The other was next to a balsam fir and lined with twigs and branches. One of the dens of female Ta was an open depression lined with sedges and bracken fern located next to an elm (*Ulmus americana*). An unmarked female with 2 yearling cubs also was located in an open, unprotected snow nest lined with tag alder branches.

Harger (1974) also reported that bears denned in Lower Peninsula, Mich., sites that afforded no protection. He found that bears denned in leatherleaf (*Chamaedaphne calyculata*) bogs and, for 2 years in a row, a bear denned on top of a muskrat (*Ondatra zibethicus*) house in a cattail (*Typha* sp.) marsh. Tietje and Ruff (1980) concluded that the use of excavated dens by black bears was correlated with decreasing winter temperatures and the need for increased insulation. In Alberta, where the mean daily minimum temperature was -20°C , 35 of 37 dens were excavated. In this study, even though protected and underground sites are extensively available and average winter temperatures were -23.5°C (Lehr et al. 1975), some bears denned in open, unprotected conditions.

Dens of other marked males included 5 depressions under downed trees or upended root masses, 5 chambers underneath downed trees or upended root masses, and 3 underground cavities (2 under root masses and 1 excavated into the north-facing slope of a hill). Only 1 den of male LS was unlined; it consisted only of a dirt chamber under a root mass and was open on 2 sides.

Dens of other marked females included 7 depression under downed trees, shrubs, or upended root masses; 1 vegetation nest next to a white cedar lined with bracken fern; and 4 underground dens excavated under stumps (2), root masses (1), or underground burrows (1). Curiously, the bottom of the den of female Lu contained water several centimeters deep, but she did not abandon this den until our approach. Dens of all females were lined with varying amounts of vegetation from the immediate vicinity. Dens of males and females were concentrated in the Dead Swamp area (Fig. 2), although 12 of the 25 radio-tagged bears spent time away from the swamp during the spring, summer, or fall.

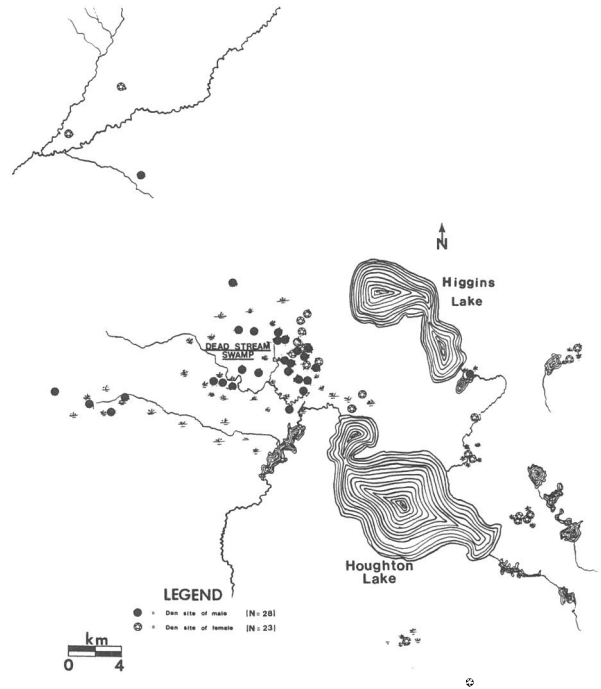


Fig. 2. Den site location of 10 males (28 dens) and 7 females (23 dens) in Kalkaska, Missaukee, and Roscommon counties, winters of 1977-78 to 1979-80.

The average distance from a den site to a center of human activity was 1.26 km for male den sites ($N = 28$ dens, range 0.16-2.74 km) and 0.55 km for female den sites ($N = 23$ dens, range 0.01-1.17 km); for both sexes, 0.94 km (Manville 1983). Female selection of den sites closer to centers of activity than swamp sites selected by males may have accounted for the statistically significant difference between sexes of dens from centers of human activity ($X^2 = 2.951$, $df = 2$, $P < 0.01$).

Bears often used more than 1 den during a winter; 10 males averaged 2.8 dens per winter, whereas 7 females averaged 3.3 (Table 2). Larger than normal numbers of dens were due in part to our disturbances (6 males and 4 females abandoned their dens upon our approach). The mild, snow-deficient, and food-abundant winter of 1979-80 may have resulted in the late denning of several bears; 1 male and 2 females did not den until 11 January, and another male not until 28 February. During the other 2 winters, 1 bear denned as early as 10 November, although most ($N = 8$) denned by early to mid-December. Bears usually emerged from dens by early to mid-March ($N = 5$), but 1 adult female did not emerge until 16 April.

Table 2. Characteristics of bear dens in Michigan's Lower Peninsula, winters 1977-78 to 1979-80.*

Bear	Winter den used	Number of dens used	Avg. no. dens per winter	Distance (km) of den sites from center of human activity	Average distance (km) of den sites from center of human activity
Males					
ES	1977-78	1	1	1.53	1.53
SB	1977-78	1	1	2.57	2.57
DH	1977-78	3	3	2.74, 1.24, 0.42	1.64
LS	1978-79	3	2	0.98, 2.38, 2.11	1.26
	1978-79	3		1.32, 1.43, 2.11	
LA	1979-80	1	3	0.16	1.11
	1978-79	3		0.15, 1.00, 2.20	
OC	1979-80	3	2	1.45, 0.72, 1.11	1.13
	1978-79	2		0.80, 1.71	
BK	1979-80	2	1	0.48, 1.51	1.09
	1978-79	1		0.56	
LV	1979-80	1	1	1.63	0.51
	1978-79	1		0.51	
Go	1979-80	2	2	0.49, 0.65	0.57
MP	1979-80	1	1	1.29	1.29
Total		28			
Females					
Ge	1977-78	2	2	0.38, 0.24	0.31
ML	1977-78	1	1	0.68	0.68
An	1977-78	1	1	0.51	0.51
DM	1978-79	5	4	0.14, 0.14, 0.85, 0.01, 1.11	0.47
	1979-80	3		0.56, 0.15, 0.82	
Rh	1978-79	2	2	0.61, 1.06	0.84
	1978-79	2		1.04, 0.68	
Ta	1979-80	4	1.5	0.32, 0.23, 0.34, 0.37	0.50
	1978-79	1		0.37	
	1979-80	2		1.17, 0.98	
Total		23			

* No attempt made to attribute den use to research activities.

Several bears left and then re-entered dens during the winter. One subadult female (DM) had 8 different dens during 2 winters, although movements of this bear were related in part to our disturbances.

Two females denned less than 100 m from actively used snowmobile trails, whereas 2 males denned 160 and 480 m from active oil wells as previously reported by Manville (1983). Extensive seasonal treks of 3 adult males also were reported by Manville (1983). All 3, along with 3 other collared bears, returned to the Dead Stream Swamp to prepare for denning. In Maine, Hugie (1980) noted that 3 adult males moved extensively following breeding season, returning just before denning. Rogers (1977) in Minnesota found

that males and females in late summer and early fall often left their usual ranges to exploit distant sources of seasonally abundant food. Some males and females there moved as far as 201 and 92 km, respectively, from their usual ranges; all returned for denning.

Due to the onslaught of human development in and around the Dead Stream Swamp and the significance of the swamp and adjoining uplands for denning, feeding, and loafing habitat (Manville 1983), several management recommendations are in order. Extensive continuous stands of swamp, lowland hardwoods, lowland shrub, and adjacent upland hardwoods wherever found should be preserved as critical habitat for bears in Michigan's Lower Peninsula. If

black bear populations are to be maintained here, a habitat protection program should be initiated. Specifically, the lands around Higgins and Houghton lakes must be held in trust for this and other species and the public. The State must continue to preserve the Dead Stream Swamp area and, when possible, purchase additional critical swamp and adjacent upland habitats. Funds for additional land acquisition could be acquired in part from sales of bear hunting licenses.

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