

DENNING AND RELATED ACTIVITIES OF BLACK BEARS IN THE COASTAL PLAIN OF NORTH CAROLINA¹

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Abstract: Black bear (*Ursus americanus*) activities in southeastern North Carolina were determined by radiotelemetry, trapping success, track counts, scat collections, and hunter harvests from May 1974 to January 1977. All data indicated that bear activity decreased progressively in autumn. The only significant winter movement was by males, 3 years old and younger. Four bears denned on the ground in dense Carolina bay vegetation. One adult female denned in a bald cypress (*Taxodium distichum*) with an entrance cavity approximately 25 m above the water. The earliest date for denning by radio-monitored bears was 5 December and latest emergence was 22 April. Five bears remained inactive for periods ranging from 85 to 113 days, averaging 102. An adult male had the shortest period of inactivity. Two subadult males remained active throughout the midwinter. Postdenning movements gradually increased and reached a peak during breeding season in June and July.

Black bears are most often associated with mountainous areas of the western and eastern United States, but there are also well-established populations in swampy areas throughout the Coastal Plain of the Southeast. A black bear study in the North Carolina Coastal Plain was conducted from May 1974 to January 1977. Information on behavior and ecology associated with denning in a relatively mild climate is presented in this paper. Our study is the first documented report of native black bears denning in the southeastern coastal region.

We are grateful to private landowners, personnel of the North Carolina Wildlife Resources Commission and Bladen Lakes State Forest, and to many friends and sportsmen for their cooperation and assistance throughout this study.

STUDY AREA

The study area, located in Bladen County, North Carolina, consisted of about 55,930 ha, including 13,051 ha in Bladen Lakes State forest (Fig. 1). Elevation varies from 9 to 30 m above sea level, and local relief averages less than 1 percent fall over the 45-km-long study area. Annual rainfall averages approximately 135 cm and the growing season averages about 220 days per year. Snowfall is uncommon and did not occur during the study period. The climate is mild and pleasant with temperatures seldom reaching 38 C in summer and below -12 C in winter.

The largest single habitat component (41 percent) was Carolina bays. These elliptical craters commonly occur

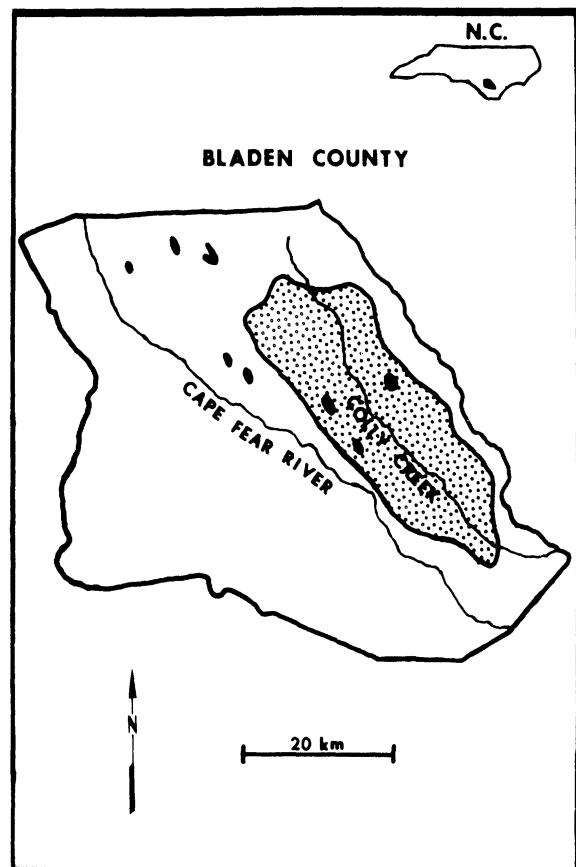


Fig. 1. Location of the 55,930-ha study area in Bladen County, North Carolina. Illustration shows 8 of the many Carolina bay lakes characteristic of this region.

from north-central Georgia to southeastern North Carolina (Murray 1961:512-519). Bays contain extremely dense thickets of evergreen woody plants matted with laurel-leaf greenbrier (*Smilax laurifolia*) and related species. The name bay apparently was derived from the bay trees (e.g., loblolly bay, *Gordonia lasianthus*; sweet bay, *Magnolia virginiana*; and red-bay, *Persea borbonia*) frequently scattered throughout

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the oval depressions (Johnson 1944:1). Other common trees were red maple (*Acer rubrum*), white cedar (*Chamaecyparis thyoides*), and pond pine (*Pinus serotina*). The shrub layer grew from a peat bog floor and contained fetterbush (*Lyonia lucida*) and various berry-producing shrubs such as huckleberries (*Gaylussacia* spp.), sweet gallberry (*Ilex coriacea*), winterberry (*I. verticillata*), and blueberries (*Vaccinium* spp.). Occurring in association with bays and having an elliptical shape, bay lakes covered 3 percent of the area (Fig. 1).

Ridges of fine-grained, sandy loam soils, constituting 33 percent of the study area, partially surrounded the bays. These sand ridges were dominated by long-leaf pine (*Pinus palustris*) and scrub oaks (*Quercus* spp.). Persimmon trees (*Diospyros virginiana*) were common. Shrubs such as small gallberry (*Ilex glabra*), wax myrtle (*Myrica crifera*), and blackberry (*Rubus cuneifolius*) were sparse. Ground story vegetation included clumps of legumes (e.g., *Baptisia* sp., *Lupinus* spp.) and grasses (e.g., *Aristida stricta*, *Panicum* spp., *Sporobolus* spp.).

Colly Creek and an 8,000-ha swamp system, over 2 km wide in places, comprising 14 percent of the study area, bisected the area. A dense canopy formed by red maple, yellow poplar (*Liriodendron tulipifera*), blackgum (*Nyssa sylvatica*), red bay, and bald cypress shaded such common shrubs as pepperbush (*Clethra alnifolia*), titi (*Cyrilla racemiflora*), and fetterbush. Greenbrier vines were common and usually occurred with patches of shrubs. The organic, black, mucky loam soil was covered by decaying plant matter on sites above water, while some openings, associated with timber harvests on wet sites, supported stands of emergents.

Residential areas (2 percent) and farmlands (7 percent) composed the remainder of the study area. Major crops produced were corn, soybeans, and blueberries. Approximately 45 percent of the private land (42,600 ha) was owned by timber companies practicing short-rotation even-age management with clearcutting followed by replanting of slash pine (*Pinus elliottii*). During a 20-year span from the mid-1930s to the mid-1950s, sawtimber was harvested from the Colly Swamp system.

METHODS

Bears were captured in box-type traps constructed of a metal frame covered with chain-link wire. Traps were permanently mounted on trailers to aid in transportation. All captured bears were immobilized with M99

(Etorphine) injected intramuscularly by a dart from a CO₂-powered gun. The antidote used was M50-50 (Diprenorhine). Each bear was ear-tagged, lip-tattooed, weighed, and measured. An upper first premolar was extracted for age determination by counts of tooth cementum layers (Stoneberg and Jonkel 1966).

Selected animals were fitted with collars containing radio transmitters with a frequency range of 150.850-151.125 MHz. Radio-tagged bears were located daily, if possible, by triangulation with a 12-channel receiver and directional 4-element, hand-held yagi antenna. Sudden changes in location or movement into an inaccessible area often resulted in unsuccessful attempts to locate bears from the ground. A Piper Supercub with a 4-element yagi antenna attached to a wing strut was invaluable in locating "missing" bears. Seasonal activity patterns, habitat preferences, and range sizes were determined by repeatedly radiotracking individual bears during 24-hour periods.

A 55-km track census route was traveled 1-3 times each month for 2 years as an aid in determining seasonal activity patterns. Weather permitting, track counts were conducted at least 3 days after a rain. The number of tracks observed was divided by the number of 24-hour periods since the last rain. Results expressed in tracks/track-night gave an overall view of monthly activity. Scats were collected daily throughout the study period and the monthly totals were used to indicate activity patterns. Data were collected from legal harvests during 3 bear-hunting seasons to gain insight into sex ratio, age structure, and population density. Changing sex ratio and age structure throughout each hunting season were used to estimate vulnerability resulting from differential activity patterns between sexes and between age-classes (adults, >3 years old; sub-adults, <3 years old).

RESULTS

Twenty-one different bears were captured 38 times. Ten animals (6 males, 4 females) were selected for radio-monitoring. Seasonal activity patterns and denning behavior were determined by daily locations and by monitoring individual bears during 68 complete 24-hour periods. Telemetry provided information on the activities of specific animals whereas trapping success, monthly track counts, scat collections, and harvest data served as indicators of activities at the population level.

Winter Inactivity

The scarcity of tracks and scats indicated that most bears were inactive during the winter (Fig. 2). No

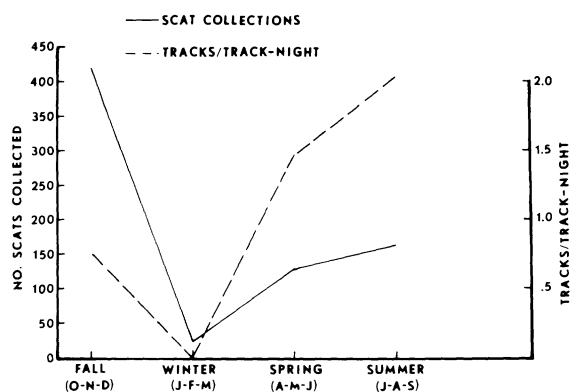


Fig. 2. Predenning, denning, and postdenning activity indicated by track count and scat collection data compiled on a season basis for a 2-year period.

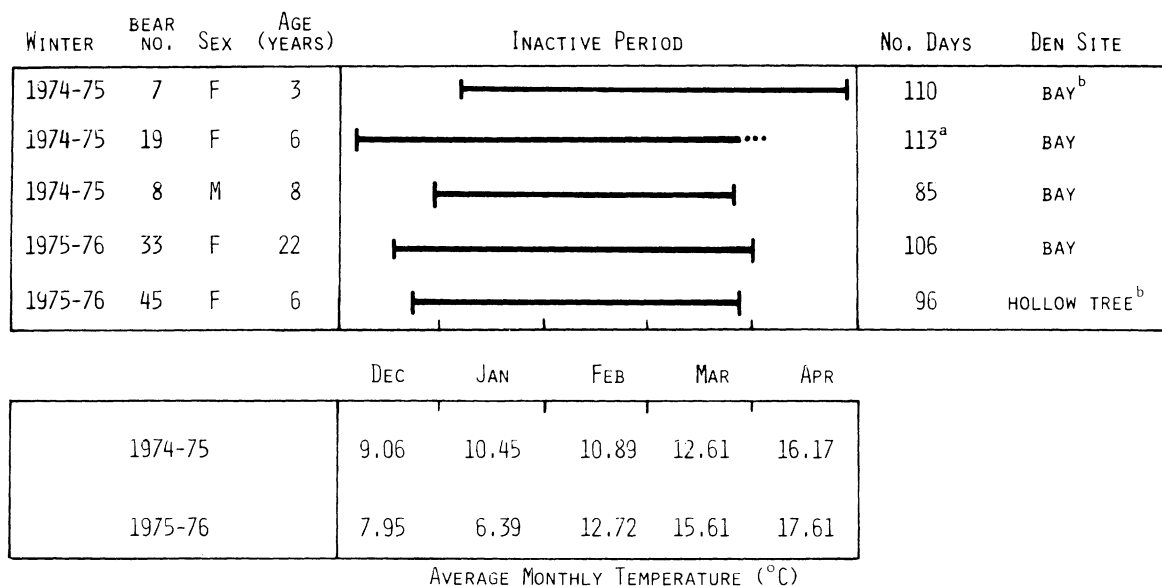
tracks were observed on the regular census route during winter although several small tracks (apparently those of young bears) were found in other parts of the study area. Three subadult males were the only bears trapped from January through March during both winters.

The 3 bears radio-monitored through the winter of 1974-75 and 2 of the 4 monitored the next winter remained inactive for extended periods despite relatively mild temperatures (Fig. 3). The earliest date for denning of radio-tagged bears was 5 December and the latest emergence was 22 April. Periods of inactivity ranged from 85 to 113 days, averaging 102 (Fig. 3).

Three adult females began denning between 5 December and 21 December. An adult male became inactive by 28 December and a young female bedded down for the winter on 3 January. Two young males (2 and 3 years old), tracked for only short periods during mid-winter (6 January — 28 January, and 15 January — 9 February 1976, respectively), remained active during those periods. None of the 4 females were lactating or accompanied by cubs when trapped, and there was no evidence that any bore cubs during the radio tracking period.

Den Site Selection and Related Activity

No movement by denning bears was detected during any of 41 complete 24-hour monitoring periods, indicating that bears rarely ventured from their den sites during the day or night. Several bears were forced from their dens for short periods in midwinter, apparently by rising water or other disturbances. An adult male (No. 8), located in a 1,040-ha bay, vacated his den on 17 February 1975 after several days of heavy rain. He returned to the same location on 21 February and remained there until 23 March 1975. In late January 1976, the same conditions evidently caused a 22-year-old female (No. 33) to leave her den site in a 115-ha bay. Two days later, she settled in the northwestern end



^aSIGNAL LOST 27 MARCH 1975

^bDEN SITE OBSERVED

Fig. 3. Periods of inactivity of 5 radio-monitored black bears and relatively mild average monthly temperatures in Bladen County, North Carolina, during the winters of 1974-76. Temperatures were recorded at the U.S. Army Corps of Engineers Lock and Dam No. 2 on the Cape Fear River approximately 16 km from our study area.

of the same bay, 966 m from the original den site, and remained inactive until 29 March 1976.

A 6-year-old female (No. 45) began denning in a 4-ha bay on 21 December 1975. Disturbance by a pack of deer dogs on 1 January 1976 apparently made her move into nearby Colly Swamp, where she was found in a hollow bald cypress tree on 3 January. The den tree measured 1.1 m in diameter above the butt swell, was approximately 37 m tall, and was surrounded by standing water 1 m deep. The base was not hollow and the cavity entrance was about 25 m above the water. Telemetric signals indicated that the bear was no more than a few meters below the cavity entrance. She removed her collar on 9 April 1976, 2 weeks after leaving the den tree.

A 6-year-old female (No. 19), located in a 910-ha bay, moved 332 m when an unsuccessful attempt was made to find her den. She was still at a "new" location in the same bay when her radio transmitter ceased functioning on 27 March 1975.

On 12 March 1975, we examined the den of a 3-year-old female (No. 7). Vegetation in the 36-ha bay was very dense and we used a machete to open a trail to her location. This disturbance caused her to withdraw when we approached within 15 m. She returned shortly thereafter and did not leave again until 22 April 1975. This animal's "den" was a shallow depression measuring 61 cm x 56 cm with an 11-cm rim of litter and was located at the base of a pond pine approximately 10 m tall. Bedding material consisted of pond pine needles and leaves from surrounding fetterbushes. Instead of using a site with a protective canopy of vegetation, as may have been expected, the female had removed the overhead fetterbush branches evidently by clipping them with her teeth. This open-ground nest is assumed to be representative of the dens located in

Carolina bays, because the bays have homogeneous vegetation and terrain and lack large trees or logs.

A fecal plug expelled as the bear fled was dark green and encased in a sheath of mucus. It weighed 139 g and measured approximately 10 cm long. Contents of the plug measured by volume included leaves of fetterbush (53.8 percent) and laurel-leaf greenbrier (46.1 percent). Occurring in trace amounts (<0.1 percent volume) were sericea lespedeza (*Lespedeza cuneata*), pokeberry (*Phytolacca americana*) seeds, intestinal lining, and unidentified dead leaves and stems.

Predenning and Postdenning Activity

Telemetric data suggested a steady decrease in activity during autumn, prior to denning, and a gradual increase in movements during the spring after leaving the den. These trends are shown by the number of days an individual bear was radio-located relative to the number of different positions mapped for that bear during each month (Table 1). Excluding the winter period of inactivity (late December through March), movement was detected at some time during all 24-hour monitoring periods except 1 occurring in late November and 2 in mid-December.

Monthly track counts and scat collections were compiled by season for the study period. Movement decreased prior to winter inactivity and gradually increased during spring, peaking during the breeding season in June and July (Fig. 2). The combination of limited activity and increased use of bait piles during autumn facilitated collection of scats. In spring and summer, bears ranged more widely and preferred the abundant natural foods; therefore, scats were not concentrated around bait piles—especially during the breeding season.

Table 1. Monthly activity of radio-equipped bears from 1974 to 1976 as indicated by dividing the number of days they had changed locations by the total daily locations determined each month and expressed as a percentage.

Bear no.	Sex	Age (years)	Month									
			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	
8	M	8	100	100	100	0	13	30	100	100	100	
7	F	3	68 ^a	83	75	80	0	4 ^c	35	87	92	
45	F	6	-	-	26	10 ^c	0	16	66	-	-	
33	F	22	94	44	10	7 ^b	0	12 ^c	70	100	-	
19	F	6	-	75	14	0	80	46	-	-	-	
49	M	2	-	-	-	92	-	-	-	-	-	
31	M	3	-	-	-	100	100	-	-	-	-	

^aBear was wounded by a hunter and remained in one location from 17 October to 24 October 1974.

^bMovement resulted from excessive rainfall.

^cMovement resulted from human disturbance.

North Carolina has a split hunting season for bears. In 1974-75 and 1975-76, the seasons were mid-October through mid-November and mid-December through 1 January. The 1976-77 seasons were 1-20 November and 13 December-1 January. Bladen County had a known kill of 44 bears (27 males, 16 females, and 1 unknown) for this 3-year period. The percentage of adults, particularly females, in the total harvest decreased from October through December. These data suggest a trend toward decreased activity, especially among adult females, during autumn. The common hunting practice is to search for bear sign along dirt roads and around bait piles and then select the largest track on which to release dogs. This procedure may result in a disproportionately high harvest of adults during early autumn. Adults and subadults probably exhibited similar movement patterns during the early season, but subadults, particularly males, apparently remained more active and were more vulnerable to harvest late in the hunting season.

DISCUSSION

Adaptation of the black bear to a diversity of habitats throughout the United States and Canada is due partially to its ability to become dormant during winter, a period of harsh weather and minimal food supply. In the northern reaches of the bear's range, its annual activity cycle consists of preparing for winter dormancy, denning for periods up to 6 months (Erickson 1965, Hatler 1967, Jonkel and Cowan 1971), and recuperating from dormancy. Moving southward, the period of dormancy decreases usually to less than 3 months as winter weather becomes more moderate and the duration of available food increases. Duffy (1971) suggested that native bears in Louisiana remained active during winter, whereas those transplanted from Minnesota denned for extended periods.

Most studies concerning factors that elicit denning have been conducted in regions with severe winters. Winter weather conditions, particularly snowfall, were reported to have induced denning of bears in Ontario (Northcott and Elsey 1971) and Montana (Jonkel and Cowan 1971). Decreased food availability and physical condition are also important factors (Erickson 1965, Carpenter 1973). Lindzey and Meslow (1976) studied black bears during the dormant period in southwestern Washington, an area of mild winters. They concluded that the proximal stimulus for bears to enter dens was provided by the cumulative effects of low temperatures

and above-average precipitation but that good physical condition was an ultimate prerequisite to denning. Carpenter (1973) reported that bears low in stored body fat often remained active throughout the winter.

Bears in our study area were not subjected to extreme weather conditions prior to denning. Although food availability decreased markedly as autumn progressed, most bears in our area apparently were able to build adequate fat reserves before entering dens. There was evidence, however, that subadult males may not den at all. This failure to den may have been related to low fat reserves in this age-class, as subadults harvested in late autumn generally had less fat than older bears.

Adult females and subadult bears of both sexes usually den earlier than adult males (Erickson et al. 1964, Lindzey and Meslow 1976). Jonkel and Cowan (1971) found adult males emerging from dens before subadults, but Lindzey and Meslow (1976) reported that adult males and 2-year-olds of both sexes emerged at approximately the same time, followed by adult females. In our study, females denned earlier and remained inactive later than males.

Black bears use a variety of den sites throughout their range (e.g., Erickson et al. 1964:100). Females and yearlings have been found to select sites offering better protection from weather than do adult males (Cahalane 1947, Erickson et al. 1964). Protected sites may not always be selected, however, as several authorities reported finding females with cubs in open nests, or depressions in thickets, or under the boughs of coniferous trees when the ground was covered with snow (Morse 1937, Smith 1946, Cahalane 1947). As mentioned, 4 bears radio-monitored during our study selected den sites in Carolina bays. These densely vegetated bays appeared to provide adequate protection, except after extended periods of rainfall. The bear that selected a hollow tree was the only one known to den outside a bay. Suitable trees for denning were scarce on the study area as most of the large trees we examined were hollow to the ground and contained swamp water during winter. Eight such trees (7 bald cypress, 1 blackgum) bore signs of having been climbed by bears, an indication that they were examined and found to be unsuitable for denning.

Attempts to observe bears in bay den sites resulted in bears leaving before visual contact was made. The experiences of Poelker and Hartwell (1973:74) and Lindzey and Meslow (1976:411) in southwestern Washington indicated that bears, except most females with newborn cubs, left their dens as humans approached. However, accounts of bears observed in

dens are common in the literature (Morse 1937, Schoonmaker 1938, Matson 1954, Duffy 1971, Jonkel and Cowan 1971).

Fecal plugs such as the one found during our study have been reported commonly (Morse 1937, Smith 1946, Matson 1954, Svihla and Bowman 1954), but a quantitative analysis of the contents has not been previously reported. Smith (1946) described the accumulated residue in the lower colon as a heterogeneous collection of material picked up at random, after the suspension of active feeding in fall, together with a residue of secretions. Conversely, it appears that bear No. 7, a 3-year-old female, "selected" the leaves of greenbrier and fetterbush that comprised 99.9 percent volume of the fecal plug we found in March 1975. Greenbrier leaves were not considered a major food item, especially during winter, but were most prevalent in scats collected in May; leaves of fetterbush did not occur in any of the 732 scats collected during our study (unpublished data).

All of our radiotelemetric, track count, scat collection, and harvest data indicated that activities decreased progressively in autumn as bears prepared for winter

dormancy, and gradually increased in spring after bears emerged from dens. These trends have been reported in a number of other studies (Jonkel and Cowan 1971, Hardy 1974, Amstrup and Beecham 1976, Lindzey and Meslow 1976).

MANAGEMENT RECOMMENDATIONS

Black bears in the North Carolina Coastal Plain require a diversity of habitat types. One of the most important habitat components is that which provides the necessary protection during winter dormancy, a particularly critical period when females are rearing cubs. Large, relatively impenetrable Carolina bays on our study area served this purpose; however, we feel that bears would have used tree activities almost exclusively, if available, because of the added protection from weather, high water, man, and hunting dogs. Most of the large trees were removed by extensive logging in the past. Now, vast acreages of bay habitat are being converted to farmland. If black bears are to be maintained in viable numbers and hunted as game animals in eastern North Carolina, their existing habitat must be preserved.

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