

DEN SELECTION BY BLACK BEARS IN THE GREAT SMOKY MOUNTAINS NATIONAL PARK

MICHAEL R. PELTON, Department of Forestry, Wildlife and Fisheries, and Graduate Program in Ecology, The University of Tennessee, Knoxville 37901

LARRY E. BEEMAN, Department of Forestry, Wildlife and Fisheries, and Graduate Program in Ecology, The University of Tennessee, Knoxville 37901¹

DANIEL C. EAGAR, Department of Forestry, Wildlife and Fisheries, The University of Tennessee, Knoxville 37901

Abstract: Dens of black bears (*Ursus americanus*) were located in the Great Smoky Mountains National Park using radiotelemetry. Bears preferred cavities located high in large trees; 7 dens were 6-17 m aboveground. Dens were associated with northern hardwood and cove hardwood forest types. All but 2 of the 12 dens located were at elevations above 1,000 m. The average dbh of 7 den trees was 97.1 cm. Inside dimensions of 7 tree dens averaged 218.4 × 59.6 × 62.0 cm. Tree dens are of definite survival value to bears, particularly females and cubs. Such dens offer protection from precipitation, cold temperatures, and human activities. Perpetuation of tree dens outside protected areas such as national parks is unlikely under current forest management practices.

Black bears are not hibernators in the classic sense, but they do enter a state of inactivity during winter months that is referred to by Hock (1961) as "carnivore lethargy." During winter dormancy, bears neither eat, drink, urinate, nor defecate (Folk et al. 1972). Parturition occurs during winter. Selection of winter dens that provide substantial protection from harsh weather and from harassment by man or by other animals has significant value for females with young. Den sites of black bears exhibit a high degree of variability, ranging from shallow depressions in forested areas (Smith 1946, Leopold 1959, Erickson et al. 1964, Part III) to man-made structures such as drainage culverts (Barnes and Bray 1967) or cabin subspace (Jonkel and Cowan 1971). Use of tree cavities as dens was reported for black bears by Switzenberg (1955), Jonkel and Cowan (1971), and Lindzey and Meslow (1976), and for Asiatic black bears (*Selenarctos thibetanus*) by Bromlei (1973). Only Lindzey and Meslow, and Switzenberg, reported bears denning in tree cavities above ground level. This paper presents preliminary findings regarding the selection of den sites by black bears in the Great Smoky Mountains National Park.

This research was supported by McIntire-Stennis Project No. 12 of the Department of Forestry and Agricultural Experiment Station and the Graduate Program in Ecology, The University of Tennessee, Knoxville, and the Great Smoky Mountains Natural History Association.

STUDY AREA

The Great Smoky Mountains National Park is a 2,072-km² mountainous area on the eastern Tennessee - western North Carolina border. The area has been

under the protection of the National Park Service since 1934. The park is characterized by steep narrow valleys, with elevations ranging from 230 to 2,025 m. Precipitation ranges from 130 cm at lower elevations to over 200 cm at higher elevations. Vegetation is diverse, in part reflecting the wide variety of microclimates created by the relief of the area (Whittaker 1956). Six broad forest types are recognized: cove hardwood, hemlock, northern hardwood, closed oak, open oak and pine stands, and spruce-fir (Shanks 1954).

METHODS

Black bears were trapped in the Great Smoky Mountains National Park during the summers of 1972, 1973, and 1974, and equipped with radiocollars. Their activities were monitored until movement and activity ceased in late fall and early winter. Specific den sites were located by homing on the radio signal. Dens were checked periodically to determine approximate dates of emergence. When dens were vacated in spring, the physical characteristics of the dens and vicinity were recorded.

RESULTS

Twelve dens were located; occupants included 6 adult females (> 3.5 years), 3 subadult males (2.5-3.5 years), and 1 subadult female. Two dens were located in the same winter for each of 2 of the adult females.

The mean elevation of den sites was 1,194 m, with all but 2 of the dens located above 1,000 m. Den elevations were related to the inaccessibility of these elevational areas during pre-park logging; most logging in more accessible areas eliminated large trees. Dens were associated with northern hardwood and cove hardwood forest types. Five of 12 den trees were located on slopes with a southern exposure. Bears entered dens

¹Present address: Division of Forestry, Fisheries and Wildlife, Tennessee Valley Authority, Norris, Tennessee 37828.

between 5 December and 21 December. Dates of spring emergence were less accurately determined but appeared to occur during late March.

All dens were associated in some way with large, mature trees. Seven dens were located high in trees, with their entrances at heights of 6.1-17.4 m (\bar{x} = 13.3) above the ground. Two dens were inside the bases of trees, with their entrances located high above the ground; 2 were in cavities beneath the root networks of large trees or stumps; and 1 was at the sheltered base of a red maple (*Acer rubrum*). Of the 7 tree cavities for which we have specific data, 3 were in eastern hemlocks (*Tsuga canadensis*), 2 in red maples, and 2 in northern red oaks (*Quercus rubra*). The average dbh (diameter at breast height) of 7 of the trees with den cavities was 97.1 cm (range, 84.0-122.3 cm). Entrances of tree cavities averaged 37.7x55.4 cm, and inside dimensions of cavities averaged 218.4x59.6x62.0 cm (height x width x length).

The entrances of dens of all 6 adult females were located high in trees (2 cavities were at ground level). Dens of the 2 subadult males were the only ground dens occupied throughout the period of winter dormancy.

DISCUSSION

Data from the present study substantiate earlier reports that pregnant females and juveniles may be more selective in their choice of den sites than adult males (Cahalane 1947, Erickson et al. 1964). Lindzey and Meslow (1976) found that adult female black bears enter dens earlier than other members of the population. They are followed by the subadults of both sexes; adult males were the last segment of the population to den. Earlier denning by adult females probably enabled them to select more protected sites than other segments of the population. The smaller size of females allows them to utilize dens with entrances too small for many adult male bears and thus reinforces the selective advantage of small body size. Dimensions of interior cavities are enlarged by the scraping activities of bears on cavity walls; the punky wood is then used as bedding material. Our observations of black bears in the wild and of those held in enclosure indicate that adults spend more time in trees than was previously assumed, particularly while feeding on serviceberries (*Amelanchier* spp.), wild cherries (*Prunus serotina*), and acorns (*Quercus* spp.). The ability of bears initially to locate tree dens is likely enhanced by their arboreal activities.

By taking advantage of tree cavities aboveground, black bears avoid 3 major environmental factors that

affect the rate of heat loss or energy consumption in winter: cold air drainage along the surface of the mountain slopes (above ground cavities), cold winds above ground level (insulation provided by trees), and moisture (dry interior of cavity). In the better protected and insulated tree dens, females likely expend less stored energy for body maintenance and thus conserve this energy for fetal development and lactation. In addition, tree dens high aboveground (entrances and/or cavities) afford a high degree of protection to bears from harassment by man and by other animals. Bears are easily and routinely routed from ground-level dens, but in only 1 instance did a bear leave a tree den in our numerous visits to these sites. Tree dens made it possible for bears to spend the winter in 1 location and thus avoid any hazards that might be precipitated by their movements.

A significant fact emerging from this study is the apparent importance of large, mature trees in providing den sites for black bears in the Great Smoky Mountains National Park. Bromlei (1973: 94-102), discussing the closely related Asiatic black bear, reported that hollow trees are preferred denning locations, and that it is considered abnormal for this species to den elsewhere. He further reported that hollow trees suitable for winter sleep are limited in number in most Russian forests and are almost completely lacking in secondary pyrogenic forests. The present study provides strong evidence of the extensive use and importance of hollow trees for the North American black bear.

Black bears in the park exhibit a strong affinity for relatively small home ranges in spring and summer. After dramatic departures in the fall (up to 25 km), most bears return to their former home ranges to den (Pelton, unpublished data). To what degree the propensity of bears to den on spring-summer range is due to familiarity with prime den sites there, or to other factors, is unclear at present. Also unclear is the incidence of year-to-year reuse of tree dens by the same or different bears. We hypothesize that the frequency of reuse may be high due to the relative scarcity of tree dens compared with other potential den sites.

There appears to be a high rate of natural attrition among trees suitable for black bear denning. Of the 7 trees providing cavities high off the ground in the Smokies, 3 have broken off at the den cavity or have blown down since 1973. One of the ground dens has been rendered useless by the further falling of the tree that formed the den. We feel that lightning and wind play an important role in both den formation and destruction. Large trees are more vulnerable to wind

damage and are also weakened at the locations of cavities. A survey of 68 random sites in our study area revealed an incidence of wind and lightning damage of 20.6 percent and 8.8 percent, respectively. The population dynamics of so-called cull or overmature trees is essentially unresearched. Cavity formation, longevity, and destruction as well as factors affecting cavity size and use are fertile areas for further research.

Forest management practices outside the confines of protected areas like the park have eliminated potential den trees either by cutting cull trees during forest stand improvement or by cutting trees before they reach the minimum size necessary for large cavities to form. Known den trees in the Great Smoky Mountains National park were located in areas unaffected by logging before creation of the park in 1934. However, outside the park much of the remaining black bear habitat in the southern Appalachians is on national forest lands where intensive forest management has resulted in elimination

of den trees and potential den trees. Most remaining den trees are in areas previously inaccessible to logging; even on these sites timber stand improvement has eliminated some cull trees. The advent of new techniques for harvesting trees on previously inaccessible terrain (e.g., balloon, helicopter, or cable logging) will hasten the further elimination of den trees on national forest lands. Unless current forest management policies are revised, some form of wilderness designation may be the only feasible alternative to ensure the perpetuation of black bear tree dens.

Although black bears are quite versatile in selection of dens, available tree cavities appear to be extensively used and provide the most suitable sites for black bears in the southern Appalachians. We feel that more attention should be given to preserving prime den sites as an important component of black bear management. These sites may be particularly important in maintaining viable black bear populations in marginal habitat.

LITERATURE CITED

- BARNES, V. G., JR., AND O. E. BRAY. 1967. Population characteristics and activities of black bears in Yellowstone National Park. Final Rep. Colorado Coop. Wildl. Res. Unit, Colorado State Univ., Fort Collins. 199pp.
- BROMLEI, F. G. 1973. Bears of the south far-eastern USSR. Publ. for U.S. Dept. of Interior, Washington, D.C., by Indian National Scientific Documentations Centre, New Delhi. 138pp.
- CAHALANE, V. H. 1947. Mammals of North America. MacMillan Co., New York. 682pp.
- ERICKSON, A. W., J. NELLOR, AND G. A. PETRIDES. 1964. The black bear in Michigan. Michigan State Univ. Agric. Exp. Stn. Res. Bull. 4. 102pp.
- FOLK, G. E., JR., M. A. FOLK, AND J. J. MINOR. 1972. Physiological condition of three species of bears in winter dens. Pages 107-124 *in* S. Herrero, ed. Bears — their biology and management. IUCN Publ. New Ser. 23.
- HOCK, R. J. 1961. Seasonal variations of physiologic functions of arctic ground squirrels and black bears. Bull. Harvard Univ. Mus. Comp. Zool. 124:155-171.
- JONKEL, C. J., AND I. MCT. COWAN. 1971. The black bear in the spruce-fir forest. Wildl. Monogr. 27. 57pp.
- LEOPOLD, A. S. 1959. Wildlife in Mexico — the game birds and mammals. University of California Press, Berkeley. 568pp.
- LINDZEY, F. G., AND E. C. MESLOW. 1976. Winter dormancy in black bears in southwestern Washington. J. Wildl. Manage. 40(3):408-415.
- SHANKS, R. E. 1954. Reference list of native plants of the Great Smoky Mountains. Botany Dept., Univ. of Tennessee, Knoxville. 14pp. (Mimeogr.)
- SMITH, B. E. 1946. Bear facts. J. Mammal. 27(1):31-37.
- SWITZENBERG, D. F. 1955. Black bear denning in tree. J. Mammal. 36(3):459.
- WHITTAKER, R. H. 1956. Vegetation of the Great Smoky Mountains. Ecol. Monogr. 26:1-80.