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HOME RANGES AND MOVEMENTS OF BLACK BEARS IN A BOTTOMLAND HARDWOOD FOREST IN ARKANSAS

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Abstract: Between July 1979 and May 1982 movements of 23 radio-tagged black bears (*Ursus americanus*) were studied in a remnant bottomland hardwood forest in eastern Arkansas. Estimates of annual and seasonal home range varied substantially within age-sex groups. Mean annual home ranges of males were significantly larger than those of females in adult and subadult age classes. Within sex classes, mean annual home ranges of adult and subadults were similar. The size of annual home range was inversely related to habitat diversity and, in adult males, to weight. Typically, bears used significantly larger ranges in summer, when their diets were complex and breeding occurred, than in spring or fall-winter, when their diets were simple. Home ranges of 4 neighboring males overlapped considerably. Among 2 groups of females, home range overlap varied and may have been related to reproductive condition or kinship. Radio-tagged bears did not disperse from the study area nor far from their natal ranges, indicating that this remnant population is closed.

How black bears utilize space may be related to sex (Lindzey and Meslow 1977, LeCount 1980, Garshelis and Pelton 1981), age (Amstrup and Beecham 1976, Reynolds and Beecham 1980, Rogers 1987), reproductive condition (Alt et al. 1980), kinship (Lindzey 1976, Rogers 1987), social rank (Lindzey and Meslow 1977), and population density (Young and Ruff 1982). However, it appears that the abundance and distribution of foods are most important in determining the extent of movements and sizes of home ranges in black bears (Jonkel and Cowan 1971, Amstrup and Beecham 1976, Garshelis and Pelton 1981, Rogers 1987).

If home range is indicative of habitat diversity (i.e., quality), then comparative analyses of the sizes of black bear home ranges in different populations should be useful to evaluate habitats and develop management programs for the species. But this potential has not been realized for 2 reasons: first, sampling designs and methods for estimating home range have not been consistent among studies, and secondly, data from the broad ecological range of black bears, which extends from boreal forest in Alaska to subtropical wetland in Florida, are incomplete.

Most available information on movements of black bears comes either from northern and western regions of North America or from the Appalachian Mountains, which essentially is an arm of the northern forest. Noticeably lacking are data from wetland habitats in the Atlantic and Gulf coastal plains of the southeast. Taylor (1971) studied the movements of 3 black bears in a bottomland hardwood forest in Louisiana and Hamilton (1978) estimated the ranges of 2 bears in coastal North Carolina. In this paper, we present data on the movements and ranges of black bears in a remnant bottomland hardwood forest in the Lower Mississippi River valley.

STUDY AREA

The study was conducted on White River National Wildlife Refuge (Refuge), an elongated 46,000-ha area that extends for 87 km along the lower White River to within 10 km of its confluence with the Mississippi River (Fig. 1). Topography of the area is subtle with elevations

Fig. 1. Location of White River National Wildlife Refuge along the lower White River in eastern Arkansas.

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ranging from 41 to 49 m. Overflows of the White and Mississippi Rivers typically inundate 50-75% of the area for 2-4 months in late winter and early spring. Occasionally, flooding may affect 85% of the area and persist for 5-6 months into early summer.

Bottomland hardwood forest covers approximately 39,000 ha of the Refuge. Interspersed within the forest are 4,000-6,000 ha of oxbow lakes and bayous, bald cypress (*Taxodium distichum*) swamps, beaver (*Castor canadensis*) impoundments, and levied water storage areas.

Mean seasonal temperatures of the area range from 26 C in summer to 8 C in winter. Annual precipitation averages 128 cm; June through October is relatively dry. Accumulations of snow are uncommon.

METHODS

Fieldwork was concentrated in a 200-km^2 core study area in the southern half of the Refuge where access is good, and the forest attains its widest and most insular position in the lower White River basin. Bears were captured in Aldrich foot snares or barrel traps, immobilized, and weighed. Representatives of various age-sex classes in the population were equipped with motion-sensitive radio-transmitters affixed to collars (Telonics, Inc., Mesa, AZ). A lower premolar tooth was extracted for age determination (Willey 1974, Eagle and Pelton 1978). Radio-locations of instrumented bears were made by aerial (80%) and ground tracking and coded to 1-ha grid cells using the Universal Transverse Mercator coordinate system.

Estimates of annual and seasonal home ranges were made by the minimum area method utilizing program TELEM (Koeln 1980). Home range polygons were subjectively adjusted to exclude areas considered unsuitable habitat (e.g., cultivated fields and maintenance areas). When a polygon was distinctly inflated due to a single outlying point that represented a temporary excursion or the first or last in a series of seasonal locations, the point was ignored to construct the polygon, and a 1 km-wide travel corridor between the polygon and the outlier was added to the home range estimate. The corridor method also was applied to define the area of travel between disjunct centers of activity.

Estimates of annual home range were based on locations between den emergence or capture in spring or early summer 1980 and den entry the following winter. For bears captured later in the summer (July-September), estimates were based on locations between the date of capture and 1 year later. To estimate seasonal home ranges, data were partitioned following major shifts in the

diets of black bears on the Refuge (Smith 1985). Spring was designated 1 March to 7 June, summer 8 June to 21 October, and fall-winter 22 October to 29 February.

Indices of forest and habitat diversity were calculated by Simpson's (1949) formula for 25-ha cells across the entire core study area. Forest diversity reflected the amount and evenness of 4 discrete community types in each cell. Components of habitat diversity included the 4 forest communities plus timbered impoundments and swamps, open water, and miscellaneous open areas (e.g., roads, levees, clear cuts, and spoils) that represented forest edge.

Comparisons of mean annual and seasonal home ranges for age-sex classes were made by nonparametric tests using the SAS (1982) RANK and GLM (General Linear Model) procedures. The *t*-test was used to compare mean weights of males in different parts of the study area. Mean values of habitat diversity and forest diversity in different parts of the study area were compared using the Mann-Whitney *U*-test.

RESULTS

Between July 1979 and May 1982, 2,104 locations of 28 radio-tagged black bears (12 males, 16 females) were made. Contact was maintained with 4 bears for 30-32 months, with 11 bears for 18-24 months, and with 11 bears for 11-17 months. Estimates of annual home range were not available for 5 bears monitored for ≤ 4 months nor 4 bears first radio-tagged in 1981 when collection of telemetry data was suspended between 12 September and 10 December. Outside that lapse, the mean interval between telemetry locations of active (i.e., not denned) individual bears was 5.2 days. The number of radio-locations from which annual home ranges were estimated varied from 30 to 67 ($\bar{x}$ = 49, N = 19 bears) because of variation in the length of the denning period among bears. The mean number of locations used to calculate seasonal ranges was 11 ± 3 (SD) for spring, 28 ± 6 for summer, and 18 ± 6 for fall-winter. Only 1 location per day per bear was used to estimate home range.

Annual Home Range

Much variation was observed in annual home range size within most age-sex classes of the population (Table 1). Annual home range size was strongly related to sex. Mean annual range of adult males (116 km^2) was significantly larger than that of adult females (12 km^2) (P < 0.02), and subadult males used larger annual ranges ($\bar{x}$ = 148 km^2) than subadult females ($\bar{x}$ = 9 km^2) (P < 0.03). With the possible exception of yearlings, for which we

Table 1. Estimates of annual home ranges of radio-tagged black bears on White River National Wildlife Refuge, Arkansas, 1980-1981.

Sex	Age (yrs)	Cohort	Sample size	Mean estimate (km^2)	Range
M	1	yearling	1	14	—
M	2-3	subadult	3	148	26-226
M	5-9	adult	6	116	39-266
F	2-3	subadult	3	9	8-10
F	4-12	adult	6	12	7-22

lacked data, annual home range size was not related to age. There was no significant difference between mean annual ranges of adults and subadults within either sex ($P > 0.05$).

Variation in annual home range size was further related to habitat diversity and, in adult males, to weight. Our core study area was bisected diagonally by the White River. Indices of forest diversity and habitat diversity east of the river were significantly greater than they were west of it ($P < 0.001$). Annual home ranges of 4 adult males that ranged largely or totally east of the river were relatively small ($\bar{x} = 58$ km^2, range = 39-73 km^2) compared to those of 2 adult males (199 km^2 and 266 km^2) that concentrated their activities west of the river. One subadult male that lived east of the river had an annual home range of 26 km^2, whereas 2 that focused their activities west of the river had annual home ranges of 193 km^2 and 226 km^2. Based on telemetry data, males whose ranges lay largely east of the river seldom, if ever, crossed to the west, but those that spent most of their time west of the river frequently made excursions east of it. Mean annual range of 4 adult females that lived east of White River was 8 km^2 (range = 7-11 km^2) compared to annual ranges of 17 km^2 and 22 km^2 for 2 that lived west of the river. The latter 2 females made excursions east of the river to feed on acorns in fall 1980, but none of the 'eastern' females were known to cross the river to the west.

Among radio-tagged adult males ($N = 6$), there was a negative linear relationship ($r^2 = 0.73$) between weight and annual home range size; thus, those adult males that lived east of the river, where forest and habitat diversities were high, were heavier and utilized smaller annual ranges than those that lived west of the river, where forest and habitat diversities were relatively low. Using weights of all adult males captured, we found that those captured east of the river were significantly heavier ($\bar{x} = 113$ kg, $N = 13$) than those captured west of it ($\bar{x} = 92$ kg, $N = 6$) ($P < 0.01$).

Such interaction between home range size, body weight, and the location of home ranges was not as apparent among females. Weights of 2 radio-tagged adults that lived west of the river were 45 kg and 58 kg; weights of 8 radio-tagged adult females that lived east of the river ranged from 45 to 89 kg ($\bar{x} = 58$ kg). When all adult females in the capture sample were considered, mean weight of those captured east of White River (56 kg, $N = 10$) was marginally, but not significantly ($P > 0.2$) greater than that of females captured west of the river (49 kg, $N = 5$).

Seasonal Home Range

Sizes of seasonal home ranges also varied substantially within population cohorts (Table 2). Nonetheless, a general pattern of seasonal range use was apparent; relatively small areas were used in spring and fall-winter, whereas during summer, bears ranged over large areas, utilizing 66 to 89% of their annual home ranges.

Summer ranges of adult males ($\bar{x} = 97$ km^2, $N = 6$) were significantly larger than their spring ($\bar{x} = 15$ km^2, $N = 11$) or fall-winter ($\bar{x} = 27$ km^2, $N = 10$) ranges ($P < 0.03$). Mean sizes of seasonal ranges of 3 subadult males were similar to those of adult males (Table 2), but large variances within this group precluded statistical comparisons between seasons. Solitary adult females ranged over larger areas in summer ($\bar{x} = 10$ km^2, $N = 4$) than in spring ($\bar{x} = 3$ km^2, $N = 3$) or fall-winter ($\bar{x} = 4$ km^2, $N = 6$) ($P < 0.05$). In contrast, 3 subadult females used similarly sized areas in spring ($\bar{x} = 5.3$ km^2), summer ($\bar{x} = 5.9$ km^2), and fall-winter ($\bar{x} = 4.8$ km^2). The single yearling male for which we had seasonal data ranged over an area of 10 km^2 in the summer he separated from his mother, and then restricted his movements to an area of 2.3 km^2 in the fall-winter.

Patterns of seasonal range use by radio-tagged bears were related to the distribution and abundance of food and to reproductive behaviors. In spring and fall-winter, when bears used relatively small ranges, their diets were simple, dominated by herbage and oak acorns, respectively (Smith 1985). In summer, when bears ranged over relatively large areas, their diets were complex. Large summer ranges also coincided with the breeding season, which extends from mid-June to late August (Smith 1985). Spring ranges of females with newborn cubs were small (<1-2 km^2) compared to those of solitary adults (2-6 km^2) and females with yearlings (4-6 km^2) (Table 2). In fall-winter, females with cubs were quite mobile and ranged over significantly larger areas ($\bar{x} = 11$ km^2, $N = 3$) than solitary adults ($\bar{x} = 4$ km^2, $N = 6$) ($P < 0.01$).

Table 2. Estimates of seasonal home ranges (km²) of radio-tagged black bears on White River National Wildlife Refuge, Arkansas, 1979-1982.

Sex	Cohort	Spring			Summer			Fall-Winter		
		N	Mean	Range	N	Mean	Range	N	Mean	Range
M	subadult	3	25	3-62	3	103	25-145	5	26	13-40
M	adult	11	15	5-41	6	97	27-264	10	27	8-66
F	subadult	3	5	4-7	3	6	6	3	5	4-7
F	solitary adult	3	3	2-6	4	10	5-22	6	4	1-6
F	adult w/coy[a]	4	1	<1-2	—	—	—	3	11	8-15
F	adult w/yearlings	3	5	4-6	—	—	—	—	—	—

[a] cubs-of-the-year

Home Range Overlap

Based on population estimates for the study area (Smith 1985), a small proportion, possibly 25%, of the population was radio-tagged. Thus our estimates of home range overlap are conservative. Average overlap in the annual ranges of 3 neighboring adult males was 48% (range = 34-74%). Individual ranges of these adults further overlapped 31%, 79%, and 100% of the range of a radio-tagged subadult male. Observed home range overlap among adult males was greatest in summer ($\bar{x}$ = 45%) compared to spring ($\bar{x}$ = 10%) and fall-winter ($\bar{x}$ = 21%).

Annual home range overlap within 2 discrete groups of radio-tagged females, each consisting of an old adult, a young primiparous adult, and a subadult, ranged from 32 to 69% in 1 group and 38 to 57% in the other. Overlap in seasonal ranges was somewhat different between the 2 groups, however. In one, average overlap was similar in fall-winter (51%) and the following spring-early summer (43%), when the young adult had cubs, and the old adult was barren. In the other, average overlap in fall-winter also was 51%, but when both adults were accompanied by cubs the following spring-early summer, their ranges were exclusive and overlapped that of the subadult an average of 15%.

Dispersal

There was no evidence that bears dispersed from the Refuge nor far from their natal ranges. None of 2 yearling, 4 2-year-old, 2 3-year-old, or 2 4-year-old radio-tagged males dispersed from their known ranges. In addition, each of 2 males ear-tagged as 2-year-olds was recaptured approximately 5 km from his original capture site, 1 as a 3-year-old and 1 as a 4-year-old. Two females radio-instrumented as 2-year-olds maintained small stable ranges through their third year before their radio-trans-

mitters failed. Another female radio-tagged as a 2-year-old did not disperse during 2 years of monitoring and raised cubs in her known range at 5 years of age. Among males radio-tagged as yearlings, 1 used a small area adjacent to, but not overlapping his mother's range until his transmitter failed when he was 2.5 years old. Another resided in his natal range, but dissociated from his mother for 1 year following family break-up, and our study terminated.

DISCUSSION

Small sample sizes, large variances and inconsistencies in methodology among published home range studies preclude quantitative comparisons of our estimates of home range with those from other populations. No distinct relationships between home range size and either geography or habitat type are apparent, but some recurring themes are. Available data indicate that home range size in black bears varies tremendously within populations. Much of the observed variation can be explained by sex; males consistently range over larger areas than females (Taylor 1971, Lindzey and Meslow 1977, Alt et al. 1980, LeCount 1980, Garshelis and Pelton 1981, Novick and Stewart 1982, Young and Ruff 1982, this study). Age may further explain part of the observed variation in home ranges. Among females, subadults frequently utilize smaller ranges than adults (LeCount 1980, Quigley 1982, Rogers 1987), and independent yearlings of both sexes typically use relatively small areas (Amstrup and Beecham 1976, Reynolds and Beecham 1980, Rogers 1987, this study). After data are partitioned by sex and age, however, differences of 4 to 10 times in home range sizes of individual bears may remain.

Because body weight, i.e., condition, of adult males was significantly greater in the portion of our study area

with the highest diversity of forest and habitat types, we assumed that these indices of diversity were directly related to habitat quality. If so, given the relationship we observed between habitat diversity and home range size, we hypothesize that local variations in habitat quality may account for much of the unexplained variation in home range size within age-sex classes of a population. Black bears are mobile, opportunistic, largely herbivorous omnivores that exploit a variety of foods and closely track phenological development. The distribution and abundance of foods, particularly mast, largely affects their movements (Jonkel and Cowan 1971, Amstrup and Beecham 1976, Garshelis and Pelton 1981, Rogers 1987). It follows that the size of an individual's home range, i.e., the area it traverses annually to secure food and mates and to care for young (Burt 1943), is directly related to the diversity of vegetative cover, or habitats.

In our study area, foods utilized by black bears in spring and fall-winter occurred in concentrations; herbage at elevated sites least affected by flooding and acorns in homogenous oak stands, effectively limiting the area needed to satisfy a bears' nutritional needs. In contrast, bears apparently ranged over large areas during summer to exploit the diverse but widely dispersed sources of food available at that time.

Because bears relied almost exclusively on 1 food type in spring and 1 in fall-winter, they were vulnerable to annual vagaries in the abundance and distribution of these foods. This was evident in 1981 when a mast failure of overcup oak (*Quercus lyrata*), by far the most consistent and widely distributed hard mast-producing species in the area, occurred. Despite the lack of telemetry data between mid-September and early December that year, we were able to document that 1 adult male and 3 adult females with cubs made long excursions outside their known ranges to ridges where red oak (*Q. nuttalli* and *Q. phellos*) acorns and sweet pecans (*Carya illinoensis*) were available. In addition, 1 yearling and 3 adult males temporarily disappeared from the core study area, presumably on long excursions outside their known ranges to alternate sources of mast. Similar effects of mast availability on fall movements of black bears have been observed across the species' range (Jonkel and Cowan 1971, Reynolds and Beecham 1980, Garshelis and Pelton 1981, Novick and Stewart 1982, Rogers 1987). Because survival of cubs and yearlings and the productivity of females are closely tied to the abundance of fall foods (Rogers 1987), and movement into unfamiliar range increases the vulnerability of bears to human-related hazards (Garshelis and Pelton 1981), management strategies for black bears should emphasize maintenance of

forest diversity to provide alternate sources of fall mast critical to bears when staple mast-producing species fail.

Among subadult and adult bears in our sample, only subadult females did not exhibit significant increases in range size during summer. It is likely, therefore, that breeding behavior contributed to the relatively large sizes of summer ranges in adult males and females and in subadult males. Lindzey and Meslow (1977) and Rogers (1987) found that adult males actively ranged over large areas in summer, apparently to monitor estrous in adult females. Alt et al. (1980) reported that movements of adult males and breeding females peaked during summer. Although subadult males typically are not successful breeders (Erickson and Nellor 1964, Rogers 1977, Barber and Lindzey 1986), they may range over large areas in summer due to social pressure from breeding adult males (Rogers 1987), which may explain the large summer ranges of subadult males in our study.

The size and overlap of summer breeding ranges in adult and subadult ranges indicated that males did not defend resources or mates in our study area. Similarly, extensive home range overlap and a lack of territoriality in male black bears have been observed across the species' range (Amstrup and Beecham 1976, Lindzey and Meslow 1977, LeCount 1980, Reynolds and Beecham 1980, Garshelis and Pelton 1981, Young and Ruff 1982, Rogers 1987). Among females, adults may tolerate their daughters to the point of altruism, but compete with unrelated females for range (Rogers 1987). The variation we observed in home range overlap between females likely was related to kinship. It is probable that the 2 adults whose ranges overlapped extensively were related because they were captured at the same trap site on consecutive days and used the same tree den in alternate years.

Dispersal by male black bears is common and typically occurs at 2 years of age. Among 10 radio-tagged males in Minnesota, none dispersed as yearlings, 6 dispersed as 2-year-olds, and 4 dispersed as 3-year-olds. Jonkel and Cowan (1971) and Beecham (1983) reported dispersal by yearling as well as 2-year-old males. Lindzey and Meslow (1977) found that males expanded their ranges as 2-year-olds but did not disperse until 4 years of age. Dispersal behavior in black bears should increase fitness by reducing inbreeding and competition among kin (Rogers 1977, Beecham 1983). Subadult males in our study area apparently did not disperse far, if at all, from their natal ranges. If not, they likely will compete with their brothers and fathers for mates, which may be their sisters or mothers. Dispersal corridors between the White River basin and black bear populations in northern Lou-

isiana and western Arkansas are incomplete, and genetic exchange between them is doubtful. Given these circumstances, the long-term fitness of the White River population, which may be the only native black bear population in the Lower Mississippi River Valley, is a special concern.

LITERATURE CITED

ALT, G.L., G.J. MATULA, F.W. ALT, AND J.S. LINDZEY. 1980. Dynamics of home range and movements of adult black bears in northeastern Pennsylvania. Int. Conf. Bear Res. and Manage. 4:131-136.

AMSTRUP, S.C., AND J. BEECHAM. 1976. Activity patterns of radio-collared black bears in Idaho. J. Wildl. Manage. 40:340-348.

BARBER, K.R., AND F.G. LINDZEY. 1986. Breeding behavior of black bears. Int. Conf. Bear Res. and Manage. 6:129-136.

BEECHAM, J. 1983. Population characteristics of black bears in west central Idaho. J. Wildl. Manage. 47:405-412.

BURT, W.H. 1943. Territoriality and home range concepts as applied to mammals. J. Mammal. 24:346-352.

EAGLE, T.C., AND M.R. PELTON. 1978. A tooth sectioning and simplified staining technique for aging black bears in the southeast. Proc. East. Black Bear Workshop 4:92-98.

ERICKSON, A.W., AND J.E. NELLOR. 1964. Breeding biology of the black bear. Pages 5-45 in The black bear in Michigan. Mich. Agric. Exp. Stn. Res. Bull. 4.

GARSHELIS, D.L., AND M.R. PELTON. 1981. Movements of black bears in the Great Smoky Mountains National Park. J. Wildl. Manage. 45:912-925.

HAMILTON, R.J. 1978. Ecology of black bear in southeastern North Carolina. M.S. Thesis, Univ. Ga., Athens. 241pp.

JONKEL, C.J., AND I.M. COWAN. 1971. The black bear in the spruce-fir forest. Wildl. Monogr. 27. 57pp.

KOELN, G.T. 1980. TELEM: a computer system for analyzing radio-telemetry data. Dep. Fish. and Wildl. Sci. Va. Polytechnic Inst. and State Univ., Blacksburg.

LECOUNT, A.L. 1980. Some aspects of black bear ecology in the Arizona chaparral. Int. Conf. Bear Res. and Manage. 4:175-179.

LINDZEY, F.G. 1976. Black bear population ecology. Ph.D. Thesis, Oreg. State Univ., Corvallis. 105pp.

_____, AND E.C. MESLOW. 1977. Home range and habitat use by black bears in southwestern Washington. J. Wildl. Manage. 41:413-425.

NOVICK, H.J., AND G.R. STEWART. 1982. Home range and habitat preference of black bears in the San Bernardino Mountains of southern California. Calif. Fish and Game 67:21-35.

QUIGLEY, H.Q. 1982. Activity patterns, movement ecology, and habitat utilization of black bears in the Great Smoky Mountains National Park. M.S. Thesis, Univ. Tenn., Knoxville. 140pp.

REYNOLDS, D.G., AND J.J. BEECHAM. 1980. Home range activities and reproduction of black bears in west-central Idaho. Int. Conf. Bear Res. and Manage. 4:181-190.

ROGERS, L.L. 1977. Social relationships, movements, and population dynamics of black bears in northeastern Minnesota. Ph.D. Thesis, Univ. Minn., Minneapolis. 194pp.

_____. 1987. Effects of food supply and kinship on social behavior, movements, and population growth of black bears in northeastern Minnesota. Wildl. Monogr. 97. 72pp.

SAS. 1982. SAS user's guide: statistics. Stat. Anal. System Inst., Inc., Cary, N.C. 921pp.

SIMPSON, E.H. 1949. Measurement of diversity. Nature 163:688.

SMITH, T.R. 1985. Ecology of black bears in a bottomland hardwood forest in eastern Arkansas. Ph.D. Thesis, Univ. Tenn., Knoxville. 209pp.

TAYLOR, D.F. 1971. A radio-telemetry study of the black bear (Euarctos americanus) with notes on its history and status in Louisiana. M.S. Thesis, La. State Univ., Baton Rouge. 87pp.

WILLEY, C.H. 1974. Aging black bears from first premolar tooth sections. J. Wildl. Manage. 38:97-100.

YOUNG, B.F., AND R.L. RUFF. 1982. Population dynamics and movements of black bears in east central Alberta. J. Wildl. Manage. 46:845-860.