

# HOME RANGE ACTIVITIES AND REPRODUCTION OF BLACK BEARS IN WEST-CENTRAL IDAHO<sup>1</sup>

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**Abstract:** Home range activities of 21 adult, 1 subadult, and 10 yearling black bears (*Ursus americanus*) in west-central Idaho were studied between March 1975 and December 1976. Adult males occupied significantly larger and less stable home ranges and ranged farther between radio-locations than adult females or yearlings. Habitat selection and movements were governed primarily by the distribution, availability, and phenology of key food plants. Home ranges overlapped extensively within and between sex-classes. Females separated from their yearling offspring about 1 June; however, occasional reassociations occurred shortly after the initial breakup. Dispersal appeared to occur primarily in the 2.5-year-old age group. The nondenning period extended from about the second week of April to about the last week of November. Time of entrance into and emergence from dens was highly variable among bears and between years. The minimum breeding age for females was 3.5 years; regular alternate-year breeding was not noted. Breeding began in late May, peaked in June, and extended through late July. Mean litter size was 1.9 cubs with a nearly even sex ratio. The reproductive rate was 0.782.

Studies from Maine (Spencer 1955), Florida (Harlow 1961), Virginia (Stickley 1961), Michigan (Erickson et al. 1964), Montana (Barnes and Bray 1967, Jonkel and Cowan 1971), California (Piekielek and Burton 1975), Washington (Poelker and Hartwell 1973, Lindzey 1976), and Minnesota (Rogers 1976) have shown that black bears exhibit great variation in habitat use, social behavior, population dynamics, and reproduction within and among regions. Because of this variation in black bear biology, data collection from other studies could not be used reliably to formulate a black bear management program in Idaho.

In 1973, the Idaho Department of Fish and Game and the Idaho Cooperative Wildlife Research Unit initiated a cooperative study of black bears to acquire management data. Part of the study, including movements and activities, was reported by Amstrup and Beecham (1976). Home range use, dispersal, and reproduction are reported here.

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## STUDY AREA

The study area, about 950 km<sup>2</sup>, is located in the Middle Fork of the Weiser River and Little Weiser River drainages in west-central Idaho. Elevations range between 975 and 2,470 m and slopes generally exceed 30 percent. The Columbia River basalt formation and the Idaho Batholith granitic formation are the two major geologic formations of the area. The climate is characterized by heavy precipitation in winter and spring, and hot, dry summers. Eighty percent of the mean annual precipitation of 86 cm falls during October through April at the upper elevations. The mean annual temperature is 4 C and ranges from -32 C to 43 C at Council, Idaho, 15 km northwest of the study area.

At the lowest elevations, ponderosa pine (*Pinus ponderosa*) grows in open and scattered stands with a predominantly grass understory. Hawthorn (*Crataegus columbiana*, *C. douglasii*) and chokecherry (*Prunus virginiana*) occur along intermittent streams and on some north slopes, and big sage (*Artemisia tridentata*) is common on many drier sites. Vegetation tends to become heavier with increasing altitude, and ponderosa pine remains dominant up to 1,525 m elevation. Between 1,525 and 1,700 m, Douglas-fir (*Pseudotsuga menziesii*) becomes the dominant tree species, with huckleberry (*Vaccinium globulare*) and buffaloberry (*Shepherdia canadensis*) as important understory shrubs. In wetter areas and at upper elevations of the

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Douglas-fir zone, grand fir (*Abies grandis*), subalpine fir (*Abies lasiocarpa*), and lodgepole pine (*Pinus contorta*) dominate the tree canopy. Grass meadows are common in the subalpine fir zone, generally above 1,830 m.

The area is used primarily for commercial timber production and cattle grazing. Recreational use is moderate.

## METHODS

Bears were captured with Aldrich foot snares in or adjacent to baited cubby sets. All bears were immobilized for handling with phencyclidine hydrochloride (Sernylan, Bio-ceutic Laboratories, Inc., St. Joseph, Missouri 64502), administered intramuscularly with a jab stick. Thirty-two bears were fitted with radiocollars during 1975 and 1976. About 75 percent of the radio fixes were taken from the ground and 25 percent from a fixed-wing aircraft. Individual bears were located on the average once every 4.5 days. Equipment and tracking procedures were comparable to those described by Seidensticker et al. (1970). All locations of bears were plotted on U.S. Geological Survey topographic maps (scale 1:62,500) gridded into 0.65-km<sup>2</sup> areas. Daily activity patterns were determined by periodically monitoring selected bears at hourly intervals for 24-hour periods. We used the minimum area method to estimate home range size (Mohr 1947). The *t*-test was used for most statistical comparisons.

Vaginal smears and the appearance of mammary glands and vulvas were used to ascertain reproductive status of females. To provide a rough indicator of male reproductive status (as suggested by R. A. Mead, Department of Biology, University of Idaho), testes were measured (through the scrotal sac) to the nearest millimeter for length and width with size expressed as equivalent diameter (ED) where  $ED = \text{length} + \text{width} \div 2$ . Similar measurements have been used to indicate reproductive condition of polar bears (*Ursus maritimus*) (Erickson 1962). Maximum mean testis size for all males and data from vaginal smears were used to indicate the peak of the breeding season.

Bears were placed in 1 of 4 age-classes: cubs, 0-1 year old; yearlings, 1-2; subadults 2-4 for males and 2-3 for females; and adults, older than 4 for males and older than 3 for females. A first premolar or incisor tooth was extracted from all bears 2 years old or older and age was determined by cementum annuli (Stoneberg and Jonkel 1966).

In 1976, phenological development of 10 key food

plants was recorded by using the method of West and Wein (1971).

## RESULTS AND DISCUSSION

During 1975 and 1976, 1,517 radio-locations were obtained from 32 black bears (21 adults, 1 subadult, and 10 yearlings). Individual bears were radiotracked for periods ranging from 2 to 24 months.

### Movements

*Adult Movements.* — Adult male bears were the more mobile sex, having significantly greater mean distances between fixes than females for all months of the study with the exception of June and July in 1975 (Table 1).

Table 1. Mean distance, km (number of fixes) between radio-locations for adult black bears, west-central Idaho, 1975-76. *P* is the significance level of *t*-test, tested between sexes within years.

	1975			1976		
	Male	Female	<i>P</i>	Male	Female	<i>P</i>
May	-	-	-	5.8 (12)	1.8 (36)	<0.001
June	2.4 (18)	2.0 (20)	>0.5	4.8 (39)	1.9 (68)	<0.001
July	2.1 (62)	1.8 (52)	>0.2	4.2 (46)	1.9 (64)	<0.001
Aug.	2.6 (65)	1.5 (49)	<0.001	3.7 (29)	2.1 (42)	<0.01
Sept.	3.5 (69)	1.6 (59)	<0.001	4.2 (20)	1.8 (31)	<0.001
Oct.	2.7 (53)	1.4 (64)	<0.1	2.8 (12)	1.6 (36)	<0.2
Nov.	2.3 (38)	1.2 (32)	<0.05	-	-	-
Mean	2.6 (305)	1.5 (276)	<0.001	4.3 (158)	1.9 (277)	<0.001

*Mobility of Adults During the Breeding Season.* — The distance between radio fixes within sex-classes was relatively constant among months during both years of our study (Table 1). Thus, greater movements by adults during the breeding season apparently did not occur in west-central Idaho.

Lindzey (1976) reported greatest movements for adult male black bears during the breeding season. Barnes and Bray (1967) reported that adult male black bears moved from their usual areas to be with females during the breeding season. In agreement with the findings of Amstrup and Beecham (1976), Lindzey (1976), and Rogers (1976), our adult male ranges overlapped the ranges of several adult females; however, unlike the findings of Lindzey (1976), our males did not use their total ranges during the breeding season.

*Mobility of Females with Cubs.* — Cubs in our study were very energetic and, except for a short period immediately after emergence from the dens, their presence did not restrict the females' movements. Home

ranges were similar in 1975 and 1976 for 3 of 4 females that were accompanied by cubs in 1975 only. The fourth female occupied a larger home range the year she was with cubs. For female U-41, whom we followed from denning to denning in both years (with and without cubs), the mean distance between fixes for 3 seasonal periods was not significantly different between years (Table 2). Thus, our results do not support

**Table 2.** Mean distance (number of fixes) between radio-locations for a female black bear, U-41, with and without cubs, west-central Idaho. *P* is the significance level of *t*-test.

Period	With cubs	No cubs	<i>P</i>
	1975 (km)	1976 (km)	
May-July	2.4 (8)	1.7 (22)	>0.1
Aug.-Sept.	1.5 (19)	2.5 (7)	>0.2
Oct.-Nov.	1.5 (10)	3.5 (3)	>0.2

the conclusions of Barnes and Bray (1967) and Eveland (1973), who used the maximum distance between observations of marked bears to conclude that females with cubs were less mobile and used smaller areas than those without cubs.

### Home Range Size

*Adults.* — Adult males occupied significantly larger home ranges than adult females (Table 3). Among animals followed during both years, mean annual range for males was 60 km<sup>2</sup> (SE = ±29 km<sup>2</sup>) and mean total range for 2 years was 105 ± 39 km<sup>2</sup>; comparable figures for females were 12 ± 6 km<sup>2</sup> and 18 ± 5 km<sup>2</sup>, respectively. Stickley (1961), Erickson and Petrides (1964), Jonkel and Cowan (1971), Poelker and Hartwell (1973), Amstrup and Beecham (1976), and Lindzey (1976) reported similar results.

*Subadults.* — Trapping data from our study indicated the presence of both resident and dispersing subadults. Of 52 bears less than 4 years old, 23 (44 percent) were recaptured in 1 or more years subsequent to their initial capture. Fourteen of the 23 recaptures were known residents, whereas all of 29 (56 percent) captured in only 1 year were considered to be dispersing. Males comprised 56 percent of the resident group and 93 percent of the dispersing group.

One subadult male followed through 1975 used a home range of 16 km<sup>2</sup> (Table 3). This range was about the same size as the mean annual home range for adult females but was significantly smaller than that for adult males. Eveland (1973) reported that subadult males in Pennsylvania traveled farther between observations and presumably occupied the largest home ranges of all sex/age-classes. The difference between Eveland's findings and ours may be due to a difference in the social status of the bears on the 2 areas.

The size of subadult bears' home ranges depends upon whether they are residents or dispersers (seeking to establish a home range). The subadult we followed was known to be a resident because it had adopted the home range of its mother after she was killed (the subadult was a yearling at the time). Perhaps the subadults Eveland reported on were dispersing; if so, this fact would explain their large home range size.

*Yearlings.* — Yearlings remained with their mothers from the time they emerged from dens until about 1 June. Of 4 family units monitored, 2 were intact on 24 May but were separated by 3 June, 1 was intact on 27 May but was separated by 3 June, and the fourth was intact on 30 May but had separated by 4 June. After family breakup, there were occasional reassociations between the female and 1 or both yearlings and also between the yearlings. In 1 reassociation, the female

**Table 3.** Mean sizes (range of individual values) of annual and total home ranges of black bears, west-central Idaho, 1975-76.

1976 sex- and age-class	Sample size	Number of months bears were radio-tracked	Annual range		Total area used (km <sup>2</sup> )
			1975 (km <sup>2</sup> )	1976 (km <sup>2</sup> )	
Male					
Adult	4	14 (12-18)	60 (47-73)	61 (32-123)	105 (61-156)
Subadult	6	6 (2-8)	46 (26-84)	18 (14-25)	-
Yearling	1	10	16	-	-
Yearling	7	19 (13-24)	-	9 (5-13)	-
Female					
Adult	5	19 (12-24)	13 (5-25)	10 (5-16)	18 (12-26)
Yearling	6	9 (3-12)	9 (6-14)	16 (11-27)	-
Yearling	3	20 (17-24)	-	5 (4-7)	-

and yearling were sleeping under a tree during a rainstorm and the yearling was lying atop the female. This observation demonstrated that females do not always show antagonistic behavior toward separated yearlings, as reported by Barnes and Bray (1967). After family breakup, 9 of 10 instrumented yearlings remained in their mothers' home ranges and denned there the following fall. Mean distance between locations of females and yearlings from the time of family breakup until denning became greater as the season progressed (Table 4). The same relationship was re-

**Table 4.** Mean distance  $\pm$  SD between radio-locations of female and yearling black bears and between siblings after family breakup, west-central Idaho, 1976. Sample sizes are in parentheses.

Month	Females and yearlings (km)	Siblings (km)
June	2.0 $\pm$ 1.7 (41)	2.2 $\pm$ 2.1 (23)
July	2.5 $\pm$ 1.7 (41)	1.6 $\pm$ 1.1 (23)
August	1.7 $\pm$ 1.2 (25)	1.8 $\pm$ 1.3 (12)
September	4.0 $\pm$ 4.0 (24)	5.5 $\pm$ 6.8 (12)
October	4.5 $\pm$ 4.7 (31)	5.0 $\pm$ 7.4 (16)

corded for mean distance between locations of siblings, indicating that the family bond became progressively weaker over time. Even though both sexes of yearlings remained within their mothers' home ranges, there was a significant difference ( $P < 0.05$ ) between the mean areas used by males and females (Table 3). One yearling moved from the study area. He traveled approximately 20 km south where he used a 5-km<sup>2</sup> area until denning in November.

Our findings agree with those of Jonkel (1962), Barnes and Bray (1967), and Lindzey (1976), who all reported that family breakup generally occurred in early June. Jonkel (1962) and Barnes and Bray (1967) also reported that yearlings remain in the mother's home range.

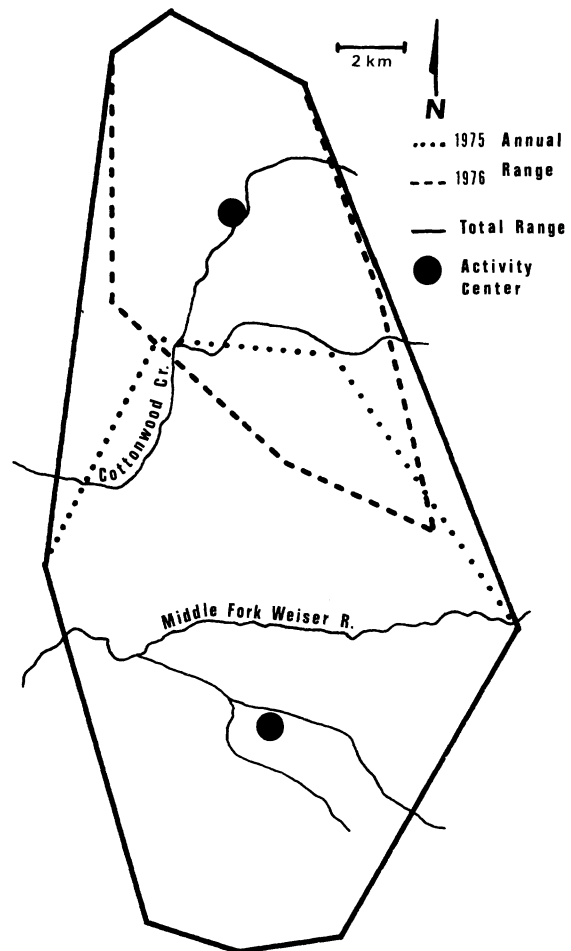
#### Home Range Stability

Adult females used about the same home ranges in 1975 and 1976; thus, the mean annual home range size of  $13 \pm 7$  km<sup>2</sup> for females tracked from 3 to 12 months ( $N=6$ ) did not differ significantly ( $P > 0.25$ ) from the mean total home range ( $18 \pm 5$  km<sup>2</sup>) for those tracked from 12 to 24 months ( $N=5$ ) (Table 3). In contrast, 3 of 4 adult males used different annual home ranges in 1975 and 1976; therefore, the mean total range of  $105 \pm 39$  km<sup>2</sup> for individual bears followed from 12 to 18 months ( $N=4$ ) differed significantly ( $P < 0.01$ ) from

the mean of  $31 \pm 26$  km<sup>2</sup> for those tracked from 2 to 8 months ( $N=6$ ).

Black bear home ranges that are relatively stable and habitual from year to year were suggested by Jonkel and Cowan (1971) and Amstrup and Beecham (1976). Our study confirms such a pattern of use for adult females but not for adult males. Sauer et al. (1969) speculated that 1 or 2 seasons may be inadequate to define accurately black bear home ranges. Our findings support their speculation, particularly for adult males.

Fig. 1 illustrates the typical pattern of home range



**Fig. 1.** Home range shift by adult male black bear U-11.

shift that the 3 males displayed. In all cases their centers of activity differed significantly between 1975 and 1976, and 50-80 percent of their locations in 1976 were outside the home ranges used in 1975. The intensive use of areas outside the 1975 range demonstrates the near-completeness of the home range shifts.

Because estrous females were present in the males' ranges in 1975, and food availability did not differ

between the ranges of 1975 and 1976, we feel that the shifting of males was not a response to these factors. Perhaps these shifts are caused by behavioral factors, but further study is needed to make this determination.

### Home Range Overlap

The black bears we studied did not appear to be territorial. They did not exclude bears from their ranges and several observations were made of bears feeding close to each other without displaying aggressive behavior. Thus, factors that help to explain high intraspecific tolerance may also help to explain home range overlap.

The extensive home range overlap for adult males and females is depicted in Figs. 2 and 3, respectively.

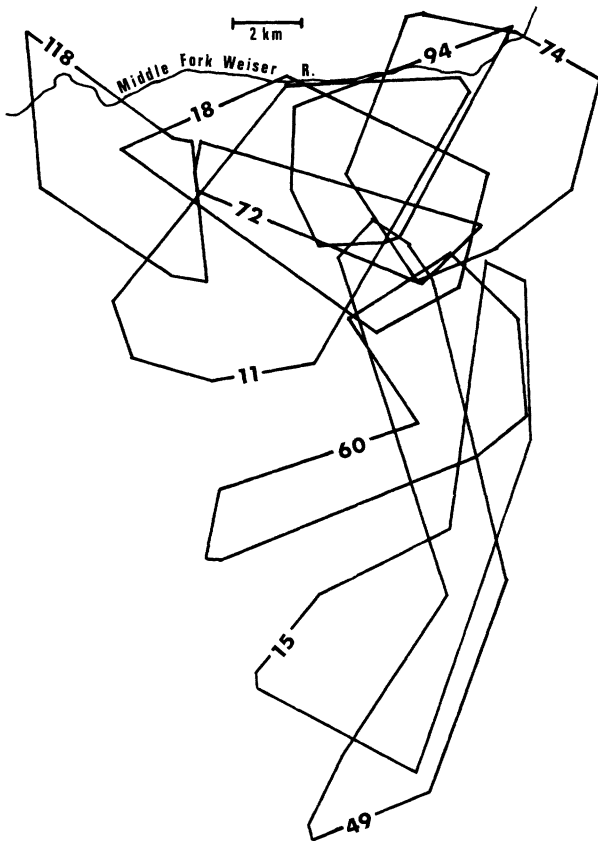


Fig. 2. Home range overlap for 9 adult male black bears. Polygons are the smallest area within which 75 percent of all their radio-locations occurred. Overlap of total ranges was more extensive.

In 1975, the minimum home range overlap ranged from 54 to 100 percent for males and from 34 to 89 percent for females. Home range overlap between sexes was near 100 percent.

As a result of heavy hunting before 1975, the age structure of this population was weighted heavily to-

ward the younger age-classes. Eighty of 134 (64 percent) of our captured bears were less than 4 years of age. Because young bears tended to be less aggressive than older bears, the high degree of intraspecific tolerance we observed can probably be explained in part by the population's young age structure.

The other factor that may explain the extensive home range overlap and high intraspecific tolerance is the spatial and temporal distribution of food on the study area. Horn (1968) showed that it is not advantageous for animals to defend fixed areas where a patchy and temporally unpredictable food distribution occurs. Weins (1976) agreed with Horn and predicated that spatial or temporal patchiness of resources (e.g., food, breeding space, and nest or shelter sites) governs the

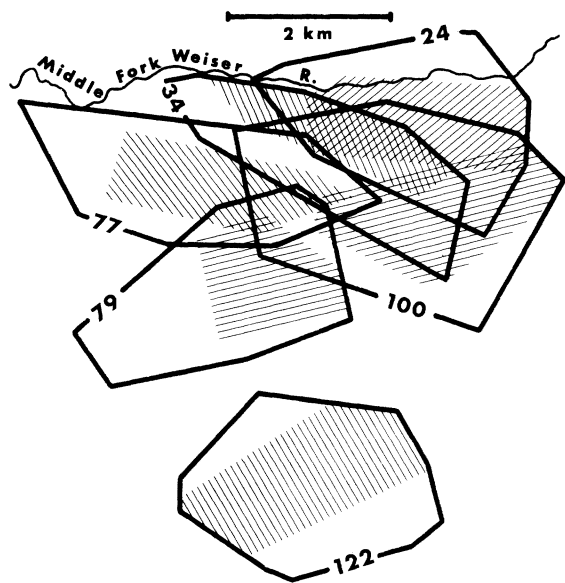


Fig. 3. Home range overlap for 6 adult female black bears. Hatch lines represent the smallest area within which 75 percent of all their radio-locations occurred.

pattern of social and space-related behavior of a population. Territoriality may be optimal where resources are plentiful and evenly distributed or accessible and predictable. However, as resource aggregation or unpredictability increases, the territory size required to meet individual needs must become larger. At some point, energy expenditure in defense of territory must place a limit on territory size, boundary defense must slacken, and spatial overlap will ensue. At that point, selection would favor home range as the optimal spacing mechanism.

Reported home range overlap within sex-classes of black bears has ranged from slight (Jonkel and Cowan 1971, Poelker and Hartwell 1973) to extensive (Lindzey 1976, this study). Jonkel and Cowan (1971)

interpreted limited overlap of ranges as an indication of territoriality. They felt the great diversity of topography, climate, and vegetation on their study area allowed bears to occupy small ranges. This diversity presumably provided uniformly distributed and continuously renewing food resources. In contrast, annual and seasonal variability in food production on our study area resulted in a patchy and unpredictable distribution that contributed to overlapping home ranges.

To see if bears were minimizing contact with members of the same sex by limiting most of their activity to some portion of their range, we delimited the smallest area that would encompass 75 percent of each bear's activities (Figs. 2, 3). The overlap in these areas became minimal for females but remained high for males. Females appeared to minimize contact with other females by concentrating their activities in a portion of their ranges. Lindzey (1976) found similar home range overlap within sex-classes and concluded that a dominance hierarchy produced spatial and temporal separation within the female cohort.

Although we cannot be certain that a dominance hierarchy did not induce the spacing pattern we observed, we speculate that it was caused by avoidance behavior. Females with cubs show a marked avoidance of other bears (Erickson 1965, Barnes and Bray 1967), although exceptions have been reported (Amstrup and Beecham 1976); perhaps avoidance behavior by females is carried over to years when they are without cubs. Since home ranges of females are stable, females should know where they are most likely to encounter neighboring females. They could then largely restrict their movements to that part of their range where contact with neighboring females would be minimal. If all females display such behavior, a pattern of spacing similar to the one we found would occur.

Other studies (Craighead 1971, Jonkel and Cowan 1971, Mundy and Flook 1973, Poelker and Hartwell 1973, Lindzey 1976) have shown that intraspecific tolerance is variable among black and grizzly bears (*Ursus arctos*). Food distribution, age structure, and social relationships are interrelating factors determining intraspecific tolerance.

#### Annual Home Range Use

The seasonal and daily use of annual home ranges was influenced primarily by food availability and distribution. Spencer (1955), Stickly (1961), Hatler (1966), Jonkel and Cowan (1971), and Amstrup and Beecham (1976) reported that bear home range use was influenced by distribution, quantity, and quality of food

resources. Black bear activity on our study area moved up and down the elevation gradient (Table 5) in response to key foods (Fig. 4). Food habits, phenology

Table 5. Mean elevation  $\pm$  SD of black bear radio-locations, west-central Idaho, 1975-76.

Month	1975 (m)	1976 (m)
May	-	1,432 $\pm$ 186
June	1,676 $\pm$ 169	1,493 $\pm$ 182
July	1,706 $\pm$ 224	1,584 $\pm$ 248
August	1,615 $\pm$ 200	1,463 $\pm$ 181
September	1,432 $\pm$ 247	1,341 $\pm$ 163
October	1,432 $\pm$ 280	1,371 $\pm$ 178

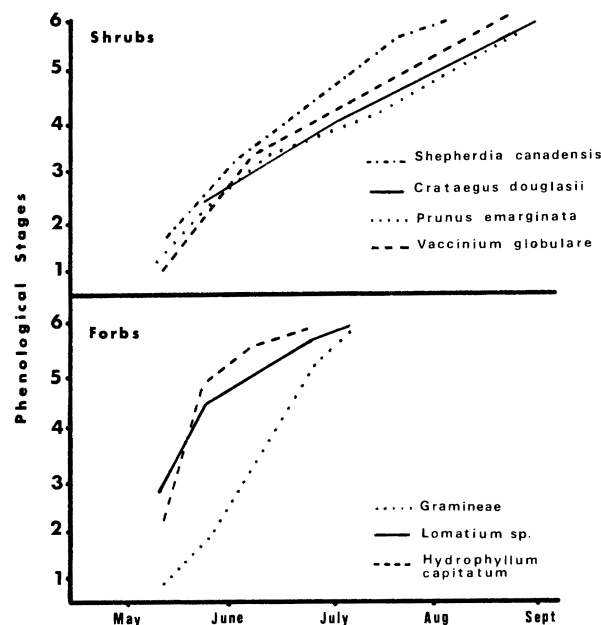


Fig. 4. Phenological changes in 7 key food plants, 1976. Respective phenological stages for shrubs and forbs are: 1 = flower, vegetative growth; 2 = fruit set, flower buds; 3 = fruit swelling, flower; 4 = fruit turning color, fruit set; 5 = fruit ripe, fruit swelling; and 6 = fruit dry or dropping, plant curing (based on method of West and Wein 1971).

of food plants, and elevational usage together revealed that from April to mid-July, bears followed the "green-up" as snowmelt progressed upslope, and fed on grasses and forbs that were in early phenological states. By mid-July, snowmelt was complete, grasses and forbs at the lower elevations had begun to cure, and bear activity tended to occur at the higher elevations. Huckleberries and buffaloberries began to ripen at middle elevations by mid-July, and by late July bears were concentrating most of their activity at those elevations in response to the ripe berries. In August, huckleberries and buffaloberries began to diminish. By

mid-August, bears were feeding on newly ripened bittercherries (*Prunus emarginata*), chokecherries, and hawthorn berries at lower elevations (Beecham, unpublished data). Bears remained at these lower elevations and generally concentrated their activity around those foods until denning.

Day-to-day use of home ranges appeared to be primarily influenced by the patchy distribution of food. Bears did not use established trails but tended to move from 1 area of their range to another and then back again, following nearly the same route (Fig. 5).

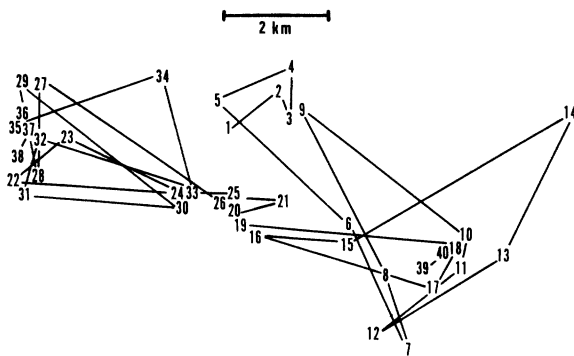


Fig. 5. Movements of subadult male U-72, 1976, which typify home range use of black bears in west-central Idaho. Numbers represent sequential radiolocations. Location clusters correspond to seasonal food distribution.

When animals are rewarded with temporary sites of food concentration, the heterogeneity of resource distribution may be reflected in a pattern of home range use consistent with Herrnstein's principle of reinforcement (Wilson 1975). Herrnstein (1971) found that domestic pigeons (*Columba livia*) learned to peck at disks in direct proportion to the percentage of times each disk reinforced the pigeon with food.

We believe that as bears moved among food patches they probably experienced varying degrees of success in obtaining food. When they reached their home range boundary, or an area where food was scarce, they retraced the route along which they had recently experienced their highest foraging success. We considered this to be an efficient foraging pattern for exploitation of patchily distributed food resources.

Bear activity shifted within home ranges to take advantage of locally abundant food, but there was very little movement to sites of abundant food outside home ranges. In 4 years of radiotracking, 2 instances were recorded where residents (both females) made foraging trips outside their home ranges. These females moved distances of 11 km and 19 km, respectively, from the centers of their home ranges, in fall, traveling from the upper elevations of a drainage where food was scarce to

lower elevations where berries were still available. One trip lasted about 3 weeks; the duration of the other was unknown.

### Daily Activity Patterns

Black bears have been reported as both nocturnal (Erickson 1965) and diurnal (Amstrup and Beecham 1976). Bears in this study were diurnal throughout their active season. Daily activity peaks occurred at 1000 and 2100 hours. Black bears were inactive most often between 0100 and 0400 hours.

### Reproduction

**Breeding Season.** — The use of vaginal smears to determine stages of the estrous cycle in black bears has not, to our knowledge, been reported in the literature. We feel that our interpretation of the smears was reliable because of their close similarity to smears from other carnivores (Liche and Wodzicki 1939, Hansson 1947, Farris 1950, Asdell 1964). Since we were unable to verify the smears by analyzing the reproductive tracts, there is a possibility of error. However, we feel certain that the vaginal smears were a more reliable criterion for determining the breeding season than the usual technique of rating the vulval swelling.

Cell types and their relative abundance in vaginal smears from 14 females showed 10 bears in estrus in June, 3 in the first half of July, and 1 in the last half of July. Two observations of consort pairs, 1 of which involved copulation, occurred in July.

Greatest male reproductive activity as measured by mean monthly testis size occurred in June (Fig. 6).

The breeding season began in late May and extended through July, with the peak occurring in June. This breeding season was similar to those reported by Erickson and Nellor (1964), Poelker and Hartwell (1973), and Lindzey (1976).

**Breeding Age and Productivity.** — Between 1973 and 1977, we determined the age at first successful breeding for 9 females to be 3.5 years ( $N=3$ ), 4.5 years ( $N=5$ ), and 5.5 years ( $N=1$ ). Our data showed that black bears in west-central Idaho had a much lower minimum breeding age than the 5.5- to 6.5-year minimum reported for Montana (Jonkel and Cowan 1971), but not as low as that reported for North Carolina where 80 percent bred first at 3.5 years of age (Collins 1973).

The mean size of 16 litters was 1.9 cubs:1 single and 15 sets of twins. The sex ratio of 27 cubs did not differ significantly from 50:50 ( $X^2=0.92$   $P<0.3$ ).

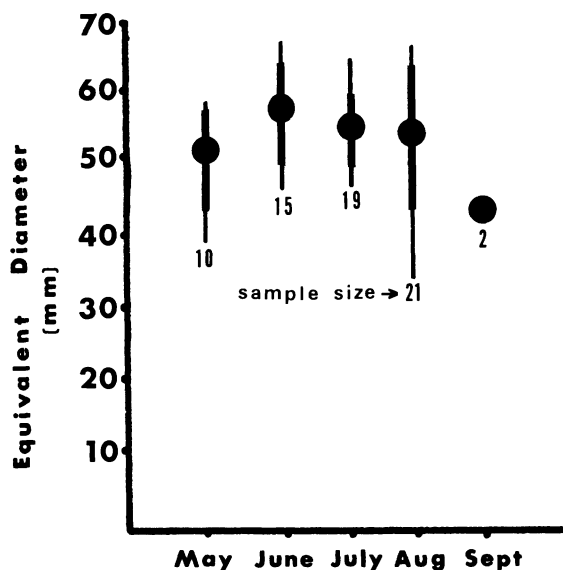


Fig. 6. Size of testes of black bears 3 years of age and older.

• =  $\bar{X}$ ,  $\blacksquare$  = SD,  $\text{—}$  = Range.

Mean litter size (1.9), mean litter frequency (31 percent for 3 years), and low minimum breeding age indicated that black bears in west-central Idaho were more productive than those in other parts of the western United States and Alaska (Hatler 1966, Jonkel and Cowan 1971, Poelker and Hartwell 1973, Piekielek and Burton 1975, Lindzey 1976). However, they did not approach the productivity reported for bears in the eastern United States (Spencer 1955, Harlow 1961, Sticklely 1961, Erickson and Nellor 1964, Hamilton 1972, Collins 1973). We calculated a reproductive rate of 0.782 (after Craighead et al. 1974) from 5 reproductive cycles representing 4 females.

Alternate-year cub production by females was not consistent. Between 1973 and 1976, a minimum of 5 females over 5 years of age did not produce litters for at least 2 consecutive years.

Between 1973 and 1976, bears had low and high years of cub production as evidenced by the range of 18-54 percent in litter frequencies. However, because of inconsistencies in minimum breeding age and lack of a regular alternate-year breeding cycle, our data indicate that black bears in west-central Idaho have not established a synchronous breeding pattern as described by Free and McCaffrey (1972).

The relative effects of nutrition versus social behavior and spacing on population processes such as

minimum breeding age, breeding success, growth, and survival, have been widely studied, and the opinions as to which factor is most influential remain divided (Watson and Moss 1970). Both nutrition and social behavior may influence populations concurrently, and the latter may be mediated through the former (Watson and Moss 1971).

Because effects of nutrition, social behavior, and spacing are complex, it is difficult to assess their relative effects on reproductive success and minimum breeding age in wild, free-ranging populations. However, there is evidence that regional differences in black bear minimum breeding age and reproductive rate may be primarily due to diet and nutrition (Spencer 1955, Harlow 1961, Erickson and Nellor 1964, Barnes and Bray 1967, Jonkel and Cowan 1971, Hamilton 1972, Collins 1973, Piekielek and Burton 1975, Rogers 1976, this study).

Rogers (1976) reported that captive black bears on a rich diet, even though dominated by larger bears, developed more rapidly than wild ones and commonly bred at 2.5 years of age. In contrast, wild black bears seldom breed at that age. The few reported cases of early breeding have come from the eastern United States (Hamilton 1972, Collins 1973), where nutrient-rich mast is a major food item. Rogers (1976) also reported that reproductive success was positively correlated with the fall weight of female black bears in Minnesota and, like Jonkel and Cowan (1971), he noted increased reproductive success after years of abundant food and decreased success after years of poor food. In general, accumulated data indicate an apparent latitudinal gradation in black bear minimum breeding age and reproductive rate that may be related to nutrition. In the eastern United States, where a mast diet is common, bears have a lower minimum breeding age, higher reproductive rate, and larger mean adult body weight (Spencer 1955, Harlow 1961, Erickson and Nellor 1964, Hamilton 1972, Collins 1973) than in the western United States (Barnes and Bray 1967, Jonkel and Cowan 1971, Piekielek and Burton 1975, this study (where a less rich diet of grasses, forbs, and berries is most common).

Behavioral differences between populations with differing densities and/or age structures may also influence reproductive rate and minimum breeding age. However, in the studies reported, nutrition appeared to account for most of the variability in these population processes.

*Denning Activity.* — Time of entrance into and emergence from dens was highly variable among bears

between years. The nondenning season for black bears on our study area extended from about the second week of April to about the last week of November. In 1975, all instrumented bears denned between 27 October and 25 November (Table 6). In 1976, denning began on 15 October and was completed by 16 November.

but that denning occurred promptly when feeding was terminated.

In both years, the dates of denning of adult males and females differed. Males denned first in 1975 ( $Z=1.34$ ,  $P>0.20$ , Wilcoxon Rank-Sum Test), but females were the first to den in 1976 ( $Z=-1.46$ ,

Table 6. Denning dates for black bears in west-central Idaho, 1975-76.

1976 sex- and age-class	Sample size		Denning dates			
			1975		1976	
	1975	1976	Mean	Range	Mean	Range
Male						
Adult	7	2	9 Nov.	27 Oct.-25 Nov.	5 Nov.	2 Nov.-7 Nov.
Subadult	1	-	22 Nov.	-	-	-
Yearling	-	5	-	-	3 Nov.	22 Oct.-16 Nov.
Female						
Adult	7	7	17 Nov.	6 Nov.-24 Nov.	26 Oct.	15 Oct.-8 Nov.
Yearling	-	2	-	-	27 Oct.	20 Oct.-2 Nov.

The average date of denning in 1976 (30 October) was 15 days earlier than in 1975 (14 November). Because phenological development of food plants was about 2 weeks earlier in 1976 than in 1975, the availability of food in fall differed between the years. In 1975, some bears foraged actively even after several inches of snow had accumulated. In contrast, in 1976 all instrumented bears denned earlier than in 1975, even though daily temperatures were unusually mild and no appreciable amount of snow had fallen. Therefore, the earlier denning in 1976 may have been a response to the lack of food. Erickson and Youatt (1961) reported that prolonged feeding delayed denning of captive bears

$P>0.15$ ). Females denned on the average 8 days later than males in 1975 but 10 days earlier than males in 1976. Because of small sample sizes and high variability of denning dates, it may have been coincidence that females denned later than males in 1975 and earlier than males in 1976. However, it is more probable that their reproductive condition (all were pregnant) in 1976 caused them to den earlier than the males. Lindzey (1976) reported that pregnant females denned before males but he did not mention nonpregnant females.

Mean denning dates of male and female yearlings were about the same, respectively, as for adults (Table 6).

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