BROWN BEAR MOVEMENTS AND HABITAT USE AT KARLUK LAKE, KODIAK ISLAND

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Abstract: Since 1967, brown bears (*Ursus arctos middendorffi*) have been radiotracked in studies devoted to movements and use of habitat. A total of 487 contacts were made with 29 animals. The bears tended to move to Karluk Lake streams in July to feed on salmon. In August, they spent more time in the midlands to feed on berries. Midlands appeared to be preferred for hiding and resting. Uplands were primarily used for cross-country travel and for denning in winter. Denning usually occurred in alder patches on northeast-facing slopes at elevations of 483 m to 670 m. Home ranges of 7 males averaged 24.4 km^2 as compared with 14.3 km^2 for single females during the summer and 10.6 km^2 for females with young during the fall. More data are needed on the period from den emergence to summer before all the habitat requirements at Karluk Lake can actually be identified.

The U.S. Fish and Wildlife Service has conducted population studies of brown bears at Karluk Lake on Kodiak National Wildlife Refuge since 1958. One objective of these long-term studies was to determine home range and movement patterns. The conventional method of recapturing tagged animals was supplemented by a radiotracking program in 1967. The purpose of this paper is to augment the preliminary findings reported by Berns and Hensel (1972).

We wish to express our appreciation to our former co-worker, R. Hensel, who initiated the radiotracking program and also reviewed the manuscript. We also thank T. Grubb, J. Gilbert, and the late R. Blott for assistance in capturing and in monitoring the movements of radio-instrumented bears.

STUDY AREA

Kodiak is a mountainous island with rugged peaks rising to 1,362 m. The coastline is long and intricate with prominent headlands, cliffs, and deep, narrow bays. Other features include 11 watersheds and 15 large lakes with numerous tributaries. Temperatures usually range between −18 C and 24 C, with an annual mean of about 5 C. The average annual precipitation is 152 cm, and lowlands are often without snow cover because of mild winter temperatures and frequent rainstorms.

Our investigations were conducted on the southern part of the island in the Karluk Lake drainage (Fig. 1). Karluk Lake is at an elevation of 111 m, is 19 km long and 0.8 km wide, and is fed by 9 lateral and 2 large terminal streams. During the summer and fall, red salmon (*Oncorhynchus nerka*) spawn in the feeder streams and along the lake shores. The dominant vegetation is alder (*Alnus* sp.), willow (*Salix* spp.), and grasses (Gramineae), with cottonwood (*Populus trichocarpa*) along valley bottoms.

METHODS

The radiocollars consisted of a transmitter unit and battery pack as described by Tester et al. (1964). Movements of radio-equipped bears were monitored from a Piper Supercub aircraft and, to a lesser extent, from the ground. A detailed description of equipment and monitoring techniques were given by Berns (1968). Berns and Hensel (1972) described a modification of the Boundary Exclusive Method (Stickel 1954) used to determine size of activity areas. The *activity area* is intensively used for the purpose of food gathering or winter denning. *Home range* is an area in which all living requirements are fulfilled or in which an animal normally spends all of its time.

Most of our data were collected during the falls of 1972-75. Some additional observations were made during the summers.

RESULTS AND DISCUSSION

Habitat Use

Of 487 radio contacts with instrumented bears during summer and fall (Table 1), males were located in lowlands 69 percent, in midlands 12 percent, and in uplands 19 percent of the time. Corresponding figures for females (with or without offspring) were 60 percent, 27 percent, and 13 percent.

It was apparent that bears made extensive use of lowlands because they were attracted by the large numbers of migrating salmon using the spawning streams. By mid-August, bears were found less frequently along salmon streams and were more often found hunting for berries in the midlands. From late September through October, bears returned to the lowlands to feed on salmon along lake shores and outlets of tributary streams. Immature bears, less proficient in

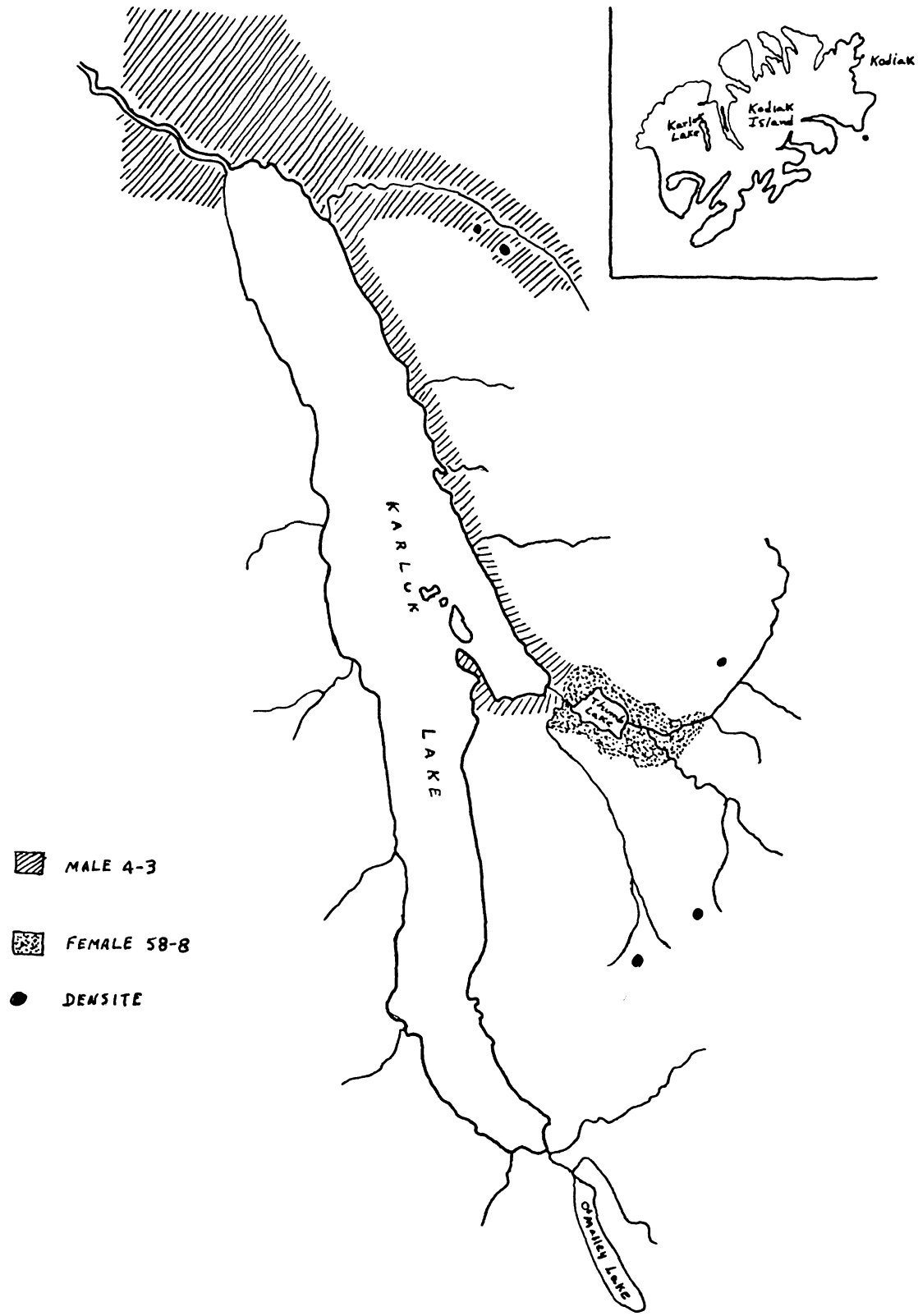

Fig. 1. Locations of 5 den sites and the ranges of 2 bears in the Karluk Lake drainage study area.

Table 1. Frequency of brown bears observed in different habitats, Karluk Lake, 1967-76.

	Total fixes	Lowland		Midland		Upland	
		Fixes	Percent	Fixes	Percent	Fixes	Percent
Females							
Summer	211	108	51	76	36	27	13
Fall	153	109	71	24	16	20	13
Total	364	217	60	100	27	47	13
Males							
Summer	45	35	77	6	13	4	10
Fall	78	50	64	9	11	19	24
Total	123	85	69	15	12	23	19

catching fish than mature animals, necessarily spent more time along the salmon streams than adult bears. This difference in skill may explain why midlands were used more frequently by adults, especially females with cubs, during the summer, when bear activity was greatest along the salmon streams. Alder patches at higher elevations were continually used by all bears as hiding and rest areas. Otherwise, the uplands received little use except for winter denning and, to a minor extent, cross-country travel. For example, of 36 contacts made with 4 bears in upland habitat during 1972-73, only 1 was of a bear moving toward another drainage. All other upland observations were of bears near denning sites.

Denning Activities

Some grizzlies have been known to travel 16-24 km during a 12-hour period and to range from 4 to more than 48 km from fall or summer foraging areas to den sites (Craighead and Craighead 1972). During our 1972-73 studies, in fall, a female brown bear traveled 7.2 km in a 24-hour period, but this movement was solely a feeding expedition. The longest single movement to a den site was made by a female with 1 yearling. After being instrumented, she stayed mostly in the upper midlands until 5 November 1972, when she moved 4 km to a denning site. On 10 November, after a light snow, the two bears were sighted digging a den in an alder patch at an elevation of 488 m.

In November 1972, a female, No. 13-72, with 1 cub moved 6.4 km from Karluk Lake in 5 days, where she eventually denned at an elevation of 580 m. On 19 November 1974, the female, alone at the time, was shot by a hunter while digging a den approximately 1.2 km east of her 1972 den site.

A subadult male, No. 1-3, was instrumented near the north end of Karluk Lake on 7 October 1973. He moved from the Karluk Lake area approximately 3.2 km to the Moraine Creek drainage on 20 October and denned in an alder patch at 580 m on 4 November.

Another subadult male, No. 4-3, was instrumented on 9 October 1973 near Camp Island. This bear moved to the Moraine Creek valley and visited the den of No. 1-3 on 12 November. The next day, he was sighted about 0.4 km away at an elevation of 518 m, preparing a den. He was seen on 16 November lying 14 m from his den, and he emerged from the den between 30 April and 6 May 1974.

The foregoing observations suggest that distances from major feeding areas to denning sites were not great. Grizzlies observed by Craighead and Craighead (1972) dug dens as early as 3 and 8 September but did not actually den until November. Brown bears apparently differ from grizzlies by remaining near or inside their dens for the duration of the winter. Den construction usually began late in October, often within alder patches on slopes of 487-670 m in elevation. Five of 6 dens of instrumented bears were on slopes facing northeast and 1 was on an east-facing slope (Fig. 1.).

Site selection and den construction by brown bears have been described by Lentfer et al. (1972). Couturier (1954) reported that the European brown bear often used natural shelters. Jonkel and Cowan (1971) stated that the bases of hollow trees were often used by black bears (*Ursus americanus*) for dens in the spruce-fir forest of Montana. There have been some reports of denning in natural rock caves, but none were found in the Karluk Lake area. All observed dens on the Alaska Peninsula and on Kodiak Island were excavated by bears.

Movements

Single bears of either sex moved greater distances than females with young, despite an abundant food supply in summer and fall. Home ranges of 7 males averaged 24.4 km^2, those of 6 single females averaged 14.3 km^2, and those of 17 maternal females averaged 10.6 km^2 (Table 2).

Table 2. Home range size for male, single female, and maternal female brown bears at Karluk Lake as determined from radiotracking 30 individuals, 1967-76.

Class of bears	Sample size	Home range size (km^2)	
		Average	Range
Males	7	24.4	2.6-49.2
Single females	6	14.3	9.0-19.9
Maternal females	17	10.6	0.5-36.2
Total	30	14.6	0.5-49.2

Areas used only 3 or 4 days were not considered a bear's activity area. Such casual movement could be described as wandering. Two examples of wandering included a single female, No. 58-8, who traveled 14.5 km into the adjacent Uyak drainage, and a male, No. 4-3, who moved 19 km from the north end to the south end of Karluk Lake. Both animals returned to their original areas within a few days.

Bears in the Karluk studies seldom traveled over 16 km, but a yearling male tagged in 1960 at Karluk Lake was killed in May 1967, 40 km from the tagging site. A trapper also found the collar of an adult male bear 45 km from his capture site. The yearling may have dispersed after family breakup and the adult male, tagged in the spring, may have traveled 45 km during the breeding season in search of females.

Established brown and black bears often return to their familiar home ranges if moved. Mundy and Flook (1973) reported that 2 transplanted bears returned 72 km in 7 days by the most probable direct route. Bader (1974) reported that an adult female black bear moved at least 160 km and crossed several major bodies of water to return to her capture site in less than a month. An adult male brown bear transplanted to Montague Island from Cordova returned 76 km in 28 days (Reynolds 1973). The bear had to swim a minimum of 11 km through strong tidal current to return to the capture site. A grizzly sow transported 113 km from her home site returned in 3 days (Pearson 1972).

Berns and Hensel (1972) observed that some brown bears used two activity areas and others used only one. For example, female No. 58-8 was instrumented 4 times in 5 years and was monitored 27 times by radio and sighted 13 times for a total of 40 contacts. All except 1 contact were in the Thumb-Karluk drainage. As a subadult, she once wandered a distance of 14.5 km but there after confined her movements to a home range of 10.6 km^2.

A subadult male, No. 4-3, emerged from his den between 30 April and 6 May 1974. Although his radio transmitter no longer functioned, the color-coded collar was retained until 25 August. Between 22 June and 16 July, the bear made 25 visits for salmon to the weir at Karluk Lake outlet. He was sighted on 25 July at Canyon Creek, 19 km away, near the south end of Karluk Lake. On 25 August, he was again observed at the outlet, where weir attendants saw him fighting with another bear. Later the same day, they saw him without his collar, catching fish near the weir. During the year, 62 contacts were made with this bear near Karluk Lake. Except for one 4-km movement to a winter den, his range was calculated to be 40.6 km^2 in a rather narrow band along the lake. No. 4-3 was killed by a hunter on 27 October 1974, within 1.6 km of the Karluk Lake outlet.

Although movements of bears Nos. 58-8 and 4-3 might be misleading because they continually frequented the Karluk drainage, both apparently spent a large part of their lives within a relatively small area. The use of relatively restricted areas by Kodiak brown bears may be attributed to an abundance of salmon and berries and nearby denning sites all in close proximity. The annual requirements of brown bears can perhaps be met within a comparatively small range at Karluk Lake. However, additional data are needed, particularly on the period after den emergence, to effect a better understanding of the ecological factors that support this unique assemblage of brown bears.

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