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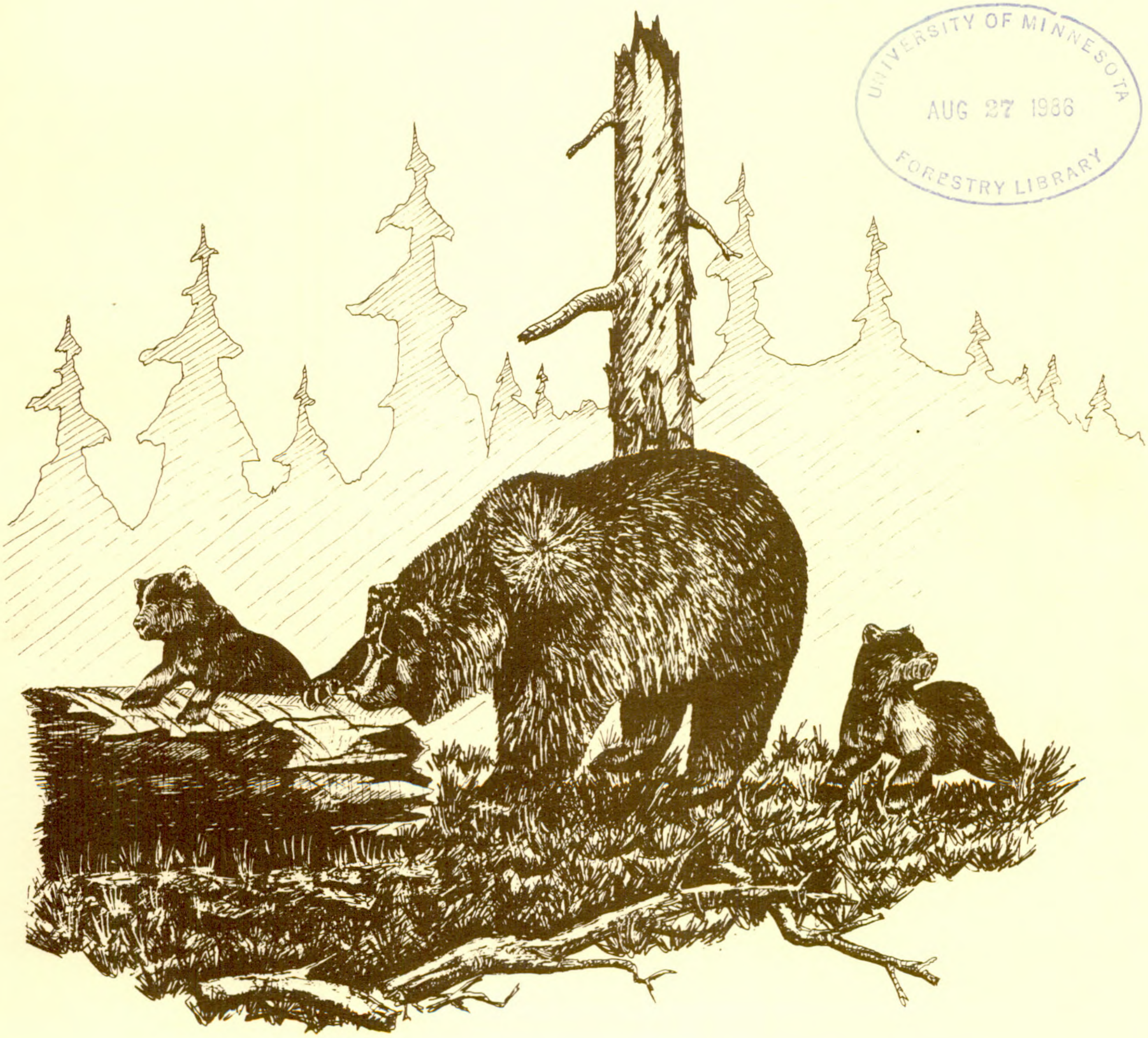

GRIZZLY BEAR HABITAT USE, FOOD HABITS, AND MOVEMENTS IN THE SELKIRK MOUNTAINS, NORTHERN IDAHO

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ABSTRACT: Grizzly bear (Ursus arctos horribilis) habitat in the Selkirk Mountains of northern Idaho was evaluated during 1983 and 1984. Habitat use, feeding habits, and movements of one adult female grizzly bear were investigated. Twenty habitat component classes were identified for analysis. Forb and shrub seral stages of a large, 18-year-old burn were used more than expected by chance ($P < 0.10$). Timbered components and recent cutting units were used less than expected. Food items were identified by scat analysis and direct observation of foraging grizzly bears. Eight previously undocumented food items were identified. Daily linear movements averaged 3.0 km, ranging from virtually no movement for a period of 3 weeks before denning to a long-distance trek of 45.7 km in an 18-hour period. Annual home ranges for 1983 and 1984 measured 195 km^2 and 609 km^2, respectively.

INTRODUCTION

Grizzly bears occur throughout the Selkirk Mountains of northern Idaho and northeastern Washington; however, data from the Selkirk Mountains Grizzly Bear Ecosystem (SMGBE) have been insufficient to allow the estimation of population parameters, habitat requirements, and accurate delineation of grizzly bear range (USDI 1982). Wright (1909) first documented the presence of this population in his historical account of hunting treks into the Selkirk range. Sutliff (1933) also chronicled a Selkirk grizzly bear hunt, noting a spring concentration of bears in the area. The most recent known kill occurred illegally near Priest River in 1983.

Scientific review of the Selkirk population was virtually absent until Layser's (1972, 1978) discussions of confirmed observations and sign. Zager (1981, 1983) conducted a habitat survey of the SMGBE to determine if grizzly bear habitat components and foods were present and capable of supporting a viable grizzly bear population.

Paper presented at the Grizzly Bear Habitat Symposium, Missoula, MT, April 30-May 2, 1985.

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To obtain additional information on the Selkirk grizzly bear population and its habitat, Idaho Department of Fish and Game, Washington Department of Game, USDA Forest Service, USDI Fish and Wildlife Service, Idaho Cooperative Wildlife Research Unit, University of Idaho, and British Columbia Fish and Wildlife Branch provided funding and materiel support for a 2-year research project. The objectives of the study were to determine seasonal grizzly bear habitat use, identify seasonal food habits, determine individual home ranges, and delineate population distribution.

STUDY AREA

The SMGBE includes the southern portion of the Selkirk range in Washington and Idaho, encompassing approximately 2 590 km^2 (fig. 1). The rugged, bedrock-exposed landscape is covered by a mosaic of dense coniferous forest, old burns, and cutting units. Elevations range from 518 m to just above 2 330 m. Precipitation ranges from 85 to 95 cm annually; snow depths average 1 to 6 m. Timber management dominates the area; virtually the entire SMGBE falls under Forest Service and Idaho Department of Lands administration.

METHODS

By combining over 220 habitat component complexes mapped by the Forest Service in 1983 and 1984, I identified 20 component classes for analysis:

	Habitat component	Description
A	Alder shrubfield	Dense shrubfield dominated by alder with Rocky Mountain maple. Canopy cover 80 + percent.
B	Mixed shrubfield burn	Open shrubfield dominated by mix of huckleberry, elderberry, fool's huckleberry, mountain-ash. Canopy cover 30 to 50 percent.
C	Mixed shrubfield snowchute	Dense shrubfield dominated by mix of species with cover to 100 percent. Maintained by violent, infrequent snow avalanches.

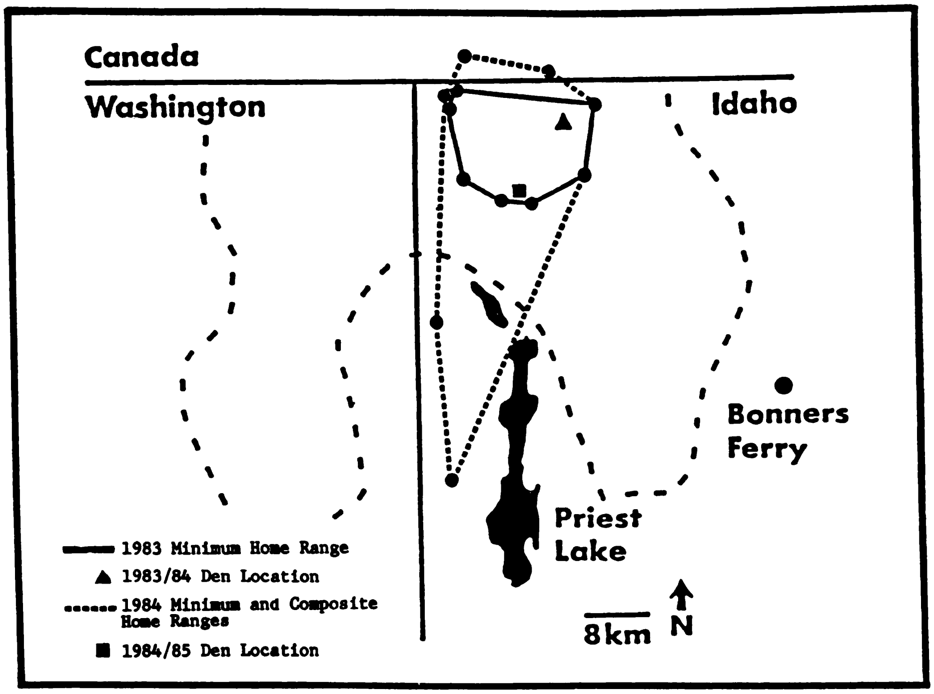

Figure 1.--1983 and 1984 minimum home ranges for grizzly bear U867. The 1983 range (195 m^2) included period from June 4 capture to November 5 den entry. The 1984 range (609 km^2) included period from April 22 den emergence to November 5 den entry.

Habitat component		Description
D	Drainage forbfield	Small, succulent forbfield at base of rock outcrops, cirque headwalls, and moraines. Maintained by snowmelt and rain drainage off of rock.
E	Timbered mixed shrubfield	Shrub-dominated understory with tree canopy of 30 to 60 percent.
EE	Forbfield burn	Early seral forb stage following natural fire.
F	Forbfield cutting unit	Early seral forb stage following timber harvest.
FF	Open-timbered grass	Grass-dominated understory with tree canopy 30 to 60 percent.
G	Grass sidehill park	Open, grass-dominated park; often along ridges or on upper slopes.
H	Mixed shrubfield	Shrubfield with <30 percent tree canopy codominated by mix of shrubs.
K	Rock	Nonvegetated rock, slabrock, talus, scree, boulders, cliffs, outcrops.
M	Marsh	Sedge-dominated with slow-moving or standing water.
NC	New cutting unit	Recent timber harvest site with little or no vegetation regeneration.
R	Riparian stream-bottom	Lush growth along streams; includes open and timbered sites.
U	Mixed shrubfield	Mixed species seral shrub cutting unit stage following timber harvest.
V	Huckleberry shrubfield	Shrubfield dominated by canopy of >40 percent huckleberry, <30 percent tree cover.
W	Wet meadow	Grass- and sedge-codominated meadow.
X	Beargrass sidehill park	Open, beargrass-dominated park; often along ridgetops or on upper slopes.
Z	Dry meadow	Open, grass-dominated meadow; often created by physical disturbance.
O	Closed timber	Tree-dominated site with canopy >60 percent.

Table 1.--Interpretation of habitat component use versus availability results for grizzly bear U867[1]

Habitat component	Habitat use[2]			
	Spring	Summer	Fall	Total
Alder shrubfield	<	<	=	=
Mixed shrubfield burn	=	>	=	>
Mixed shrubfield snowchute	=	=	=	=
Drainage forbfield	=	=	=	=
Timbered mixed shrubfield	=	<	<	<
Forbfield burn	=	>	<	>
Forbfield cutting unit	<	=	=	=
Open-timbered grass	<	<	<	<
Grass sidehill park	=	=	<	=
Mixed shrubfield	=	=	=	=
Rock	=	=	=	=
Marsh	=	=	=	=
New cutting unit	<	<	<	<
Riparian streambottom	<	=	=	=
Mixed shrubfield cutting unit	=	=	=	=
Huckleberry shrubfield	=	=	<	=
Wet meadow	=	=	=	=
Beargrass sidehill park	<	=	=	=
Dry meadow	<	=	=	=
Closed timber	<	<	=	<

[1] N (use) = 272 radio locations.
N (availability) = 307 random locations.
[2] Habitat use symbols:
< Use significantly less than availability ($P < 0.10$).
> Use significantly greater than availability ($P < 0.10$).
= No significant difference detected between use and availability ($P > 0.10$).

Studies in the SMGBE (Zager 1981; Demers 1983; Robinson and Riley 1984) and Montana (Jonkel 1982; Christensen and Madel 1982) provided general descriptions of each habitat component class (Almack 1985).

Using these classes as a framework, I obtained baseline habitat use data for the SMGBE from daily radio monitoring and direct observation of an adult, female grizzly bear (U867). I followed the sampling design and analyses presented by Marcum and Loftsgaarden (1980). This method identifies the number of radio and random locations found in each habitat component class within the composite home range. Proportions of seasonal habitat use (radio locations) and availability (random locations) are then compared by analysis of chi-square ($P < 0.05$) and modified Bonferroni z ($P < 0.10$) statistics. Spring availability proportions may be slightly inflated, due to variable snow cover of components at higher elevations.

Distances from all 272 radio locations and 307 random locations measured to the nearest different habitat component, water, road, and trail provided further habitat use information. I grouped distance measurements into three classes: close (< 100 m), mid (100-500 m), and far (> 500 m).

Scat analysis and direct observation of foraging grizzly bears provided data for a partial list of grizzly bear food items. Differentiation of scats by bear species followed the methods of Hamer and Herrero (1980), excluding diameter and amorphous volume as positive identifiers. I classified a scat as "grizzly bear" only when I saw the scat dropped or found the scat at a visual observation site or close-distance radio location, where other direct evidence of grizzly bear activity was apparent.

I determined the length of daily movements for the radio-collared female by measuring linear distances on a map (Mech 1983). Delineation of her 1983 and 1984 home ranges followed the procedures described by Mohr (1947). Area polygons formed by 272 independent radio locations depicted minimum annual and composite home ranges (Russell and others 1979).

RESULTS AND DISCUSSION

Habitat Use

I rejected the null hypothesis that U867 used habitat components in proportion to their availability. Both total and seasonal comparisons showed significant differences between component use and availability ($P < 0.05$) (table 1).

Overall, U867 used mixed shrubfield burn and forbfield burn habitat components significantly more than expected (P < 0.10). She used timbered mixed shrubfield, open-timbered grass, new cutting unit, and closed timber components less than expected (P < 0.10).

Studies have indicated that grizzly bear spring range is often limited by prevailing snow cover and minimal plant productivity during early phenological stages (Jonkel 1982; Craighead and Mitchell 1983). Therefore, I anticipated use of important spring components, such as wet meadows, marshes, and snowchutes, to be greater than their availability. However, U867 used no component more than expected during spring. No significant differences (P > 0.10) were indicated between use and availability proportions for mixed shrubfield burn, mixed shrubfield snowchute, drainage forbfield, forbfield burn, grass sidehill park, mixed shrubfield, rock, marsh, mixed shrubfield cutting unit, huckleberry (Vaccinium spp.) shrubfield, and wet meadow habitat components. She used alder (Alnus sp.) shrubfield, forbfield cutting unit, open-timbered grass, new cutting unit, riparian streambottom, beargrass (Xerophyllum tenax) sidehill park, dry meadow, and closed timber components less than expected (P < 0.10).

Summer results closely paralleled field observations. Mixed shrubfield burn and forbfield burn habitat components showed greater use than expected during summer (P < 0.10). U867 often used burn components to the near exclusion of other classes, feeding nearly 50 hours on huckleberry and elderberry (Sambucus racemosa). She used alder shrubfield, timbered mixed shrubfield, open-timbered grass, new cutting unit, and closed timber components less than expected (P < 0.10).

U867 used no fall component more than expected (P > 0.10). She used timbered mixed shrubfield, forbfield burn, open-timbered grass, grass sidehill park, new cutting unit, and huckleberry shrubfield components less than expected (P < 0.10).

Field observations indicated a shift from summer to fall component use. She fed on grass and forb roots in clearcuts and selection cuts during October each year; however, cutting units did not show more fall use than expected (P > 0.10). During this same period, daily activity decreased to a predenning lethargy phase. This inactive period may have overshadowed apparent heavy use of cutting units in early fall.

Sixty-three percent of the total radio locations fell within 100 m of the nearest habitat component. Similar results were noted for seasonal measurements. Of the total number of radio locations, 68 percent occurred nearest to timber and shrubfield components. U867 may have selected these sites for the security cover provided by the dense vegetation (Zager 1980; Jonkel 1982).

U867 remained near water more than expected by chance (P < 0.05), with 27 percent of her total radio locations within 100 m of water and 79 percent within 500 m (table 2). Seasonal analyses failed to show significant differences between the use and availability of water distance classes (P > 0.10).

The distribution of water did not appear to limit her use of any area. Perhaps this analysis indicates a preference for moist site foods, or the abundance of moist sites, rather than a direct water requirement.

No significant differences (P > 0.10) were noted between distances measured to roads from radio and random locations. Sixty-four percent of the total radio locations occurred in the > 500-m distance class. Seasonal results varied for each road distance class (table 2). These data result from the distribution of the road system in the SMGBE. At least one road penetrates each major drainage in U867's composite home range; however, seasonal activity centered in areas of low road density.

Total and summer analyses of distance to nearest trail data indicated greater than expected use of the < 100-m and 100- to 500-m classes (P < 0.10) (table 2). The > 500-m distance class was used less than expected for these two periods (P < 0.10). Spring and fall results failed to show significant differences between the use and availability of trail distance classes (P > 0.10). Few maintained trails occurred within U867's composite home range, hence the large number of radio locations in the > 500-m distance class. Many of the trails documented for this analysis are actually overgrown fire access roads showing continued use as game trails.

Food Habits

The food habits of U867 were similar to those of grizzly bears in other ecosystems; however, I recorded eight food items undocumented in other study areas:

Species	Structures observed[1]
Direct observation food items	
Camponotus sp. ants	E
Carex spp.	Fl, Lvs
Equisetum arvense	Fl, St
Formica sp. ants	E
Graminoid spp.	Fl, Lvs, R
Gymnocarpium dryopteris	Lvs
Heracleum lanatum	St
Luzula hitchcockii[2]	Fl, Lvs, R, St
Sambucus racemosa	Fr
Streptopus amplexifolius[2]	Lvs, St
Taraxacum officinale	Lvs, St
Trifolium repens	Fl, Lvs, St
Trillium ovatum[2]	Fl, St
Vaccinium spp.	Fr, Lvs, St

Table 2.--Interpretation of seasonal distance class use versus availability for grizzly bear U867[1]

Distance to nearest:	Distance class use[2] Close < 100 m	Mid 100-500 m	Far > 500 m
Water			
Spring	=	=	=
Summer	=	=	=
Fall	=	=	<
Class total	>	=	=
Road			
Spring	=	<	=
Summer	=	=	=
Fall	=	>	=
Class total	=	=	=
Trail			
Spring	=	=	=
Summer	>	>	<
Fall	=	=	=
Class total	>	>	<

[1]N (use) = 272 radio locations.
Spring = 62 radio locations.
Summer = 132 radio locations.
Fall = 78 radio locations.
N (availability) = 307 random locations.

[2]Distance class symbols:
< Use significantly less than availability (P < 0.10).
> Use significantly greater than availability (P < 0.10).
= No significant difference detected between use and availability (P > 0.10).

Species	Structures observed[1]
Dig food items	
Angelica arguta[2]	R
Claytonia lanceolata	R
Clintonia uniflora[2]	R
Erythronium grandiflorum	Fl, R, St
Graminoid spp.	R
Lomatium sp.	R
Mitella breweri[2]	R
Osmorhiza spp.	R, St
Sambucus racemosa	R
Spermophilus columbianus	E
Tiarella trifoliata[2]	R, St
Viola glabella[2]	Lvs, R, St

The analysis of 234 scats and direct observation of foraging grizzly bears provided food lists for the SMGBE (table 3).

[1]E = entire organism
Fl = flower
Fr = fruit
Lvs = leaves
R = root
St = stem.

[2]Food item not noted in literature.

During spring, U867 fed on sedges (*Carex* spp.), horsetail (*Equisetum* spp.), clover (*Trifolium* spp.), grasses, and roots of western spring beauty (*Claytonia lanceolata*), glacier lily (*Erythronium grandiflorum*), and biscuit-root (*Lomatium* spp.). She used wet meadows, marshes, and moist cirque basins extensively during this season.

She fed in mixed shrubfields of a large burn during summer. Huckleberry and elderberry fruits, horsetail, licorice-root (*Ligusticum* spp.), and ants (*Camponotus* sp., *Formica* sp.) were common food items. Shrub fruits dominated her summer diet, although at times she fed almost exclusively on forbs and grasses.

During fall in 1983, U867 dug in old (greater than 2 years) clearcuts and selection cuts for roots of grasses, Brewer's mitella (*Mitella breweri*), and coolwort foamflower (*Tiarella trifoliata*). However, in 1984, she excavated cutting units exclusively for roots of first-season growth elderberry and desiccated sweet-cicely (*Osmorhiza* spp.). She also clawed and rolled logs for ants and earthworms (Class Oligochaeta).

Table 3.--Grizzly bear food items identified by scat analysis (N = 34 scats)

Species	Constancy	Structures observed[1]
	Percent	
Shrubs	10.6	
Lonicera sp.	5.9	Lvs, R
Oplopanax horridum	5.9	Fr, S
Sambucus racemosa	5.9	Lvs, R, St
Vaccinium membranaceum	41.2	Fr, Lvs, S, St
Vaccinium scoparium	8.8	Lvs, S
Vaccinium spp.	20.6	Lvs, S, St
Forbs/ferns	60.0	
Equisetum spp.	55.9	St
Ligusticum canbyi	17.6	Lvs
Ligusticum sp.	23.5	Lvs
Lomatium sp.	11.8	Lvs
Osmorhiza chilensis	5.9	Lvs, R, St
Osmorhiza sp.	17.6	Lvs, St
Streptopus amplexifolius	5.9	Fr, S
Trifolium sp.	8.8	Fl, Lvs, St
Unknown fern sp.	2.9	Lvs
Unknown seed	5.9	S
Grass/grasslikes	16.2	
Carex sp.	38.2	Fl, Lvs
Graminoid spp.	85.3	Fl, Lvs, R, St
Luzula hitchcockii	11.8	Lvs, R (?)
Animal	15.2	
Camponotus sp. ant	11.8	E
Formica sp. ant	17.6	E
Odocoileus sp.	5.9	B, H, Hf
Spermophilus columbianus	11.8	B, C, H, T
Ursus americanus	2.9	H
Ursus arctos	20.6	H
Unknown sp. beetle	5.9	E, L, W
Unknown sp. bone	5.9	
Unknown sp. hair	8.8	
Unknown sp. insect wing	2.9	
Unknown sp. worm	2.9	

[1]B = bone
C = claw
E = entire organism
Fl = flower
Fr = fruit
H = hair
Hf = hoof
L = leg
Lvs = leaves
R = root
S = seed
St = stem
T = teeth
W = wing.

Dens

In 1983, U867 denned in a northeast-facing, natural rock cave at 1 902 m. The cave measured 9.4 m deep and opened at the base of a rock outcrop that protruded into a timbered mixed shrubfield. The entrance measured 86 cm wide and about 80 cm high.

She used white rhododendron (*Rhododendron albiflorum*) and fool's huckleberry (*Menziesia ferruginea*) stems to form a nest located about 5.4 m from the entrance and measuring 1.6 m in diameter. The nest site had apparently been used before, as evidenced by 30 cm of decayed shrub stems and beargrass leaves that lay under the most recent nest material.

I found two scats behind the nest. Both scats were moldy and densely compacted; each contained grizzly bear guard hairs and smooth woodrush (*Luzula hitchcockii*) leaves.

A rock shelf, 1.1 m wide, extended for about 7.6 m in front of the den. A natural mat of soil and smooth woodrush covered the shelf and extended down slope into a timbered mixed shrubfield of white rhododendron, fool's huckleberry, and huckleberry. U867 had chewed off many of these shrubs, leaving only 10 to 15 cm of the stems remaining above ground. I found chewed shrubs up to 21 m from the den. Five daybeds were located on this shelf, and several trees showed deep claw marks to a height of about 2.5 m.

In 1984, U867 also denned in a natural, rock cave. The den lay between two active snowchutes at 1 890 m on the northeast-facing headwall of an east-facing cirque basin. The cave opened at the base of a rock outcrop in a mixed shrubfield/rock habitat component complex. The entrance was very exposed and measured 133 cm high and 90 cm wide.

The nest measured 137 cm in diameter and was located at the rear of the cave. Chewed stems of mountain-ash (*Sorbus* spp.) and huckleberry, along with leaves of smooth woodrush and sedge, served as nest material. Most of this material had been scraped from the nest and swept out of the den. I found only three shrubs near the den that showed any evidence of chewed stems.

I found three small scats just inside the cave. They were not densely compacted, as were the 1983-1984 den scats. All three scats contained unidentified vegetal debris.

Den entry both years occurred on November 5. Den emergence was on April 22, 1984, and during the week of May 10, 1985.

Daybeds

I located 10 grizzly bear daybeds in the SMGBE; eight of these belonged to U867. Daybed No. 1 lay under a lone, mature subalpine fir (*Abies lasiocarpa*) within a grass sidehill park. I located two scats within 1 m of the bed. Both scats measured approximately 8 cm in diameter and

3 L in volume. Each scat contained over 90 percent grass and a trace of licorice-root leaves.

U867 located Daybed No. 2 next to an uprooted stump, associated with ground squirrel (Spermophilus columbianus) digs in a mixed shrubfield burn. This bed measured about 82 cm in diameter and 76 cm deep and contained four alternated layers of loose soil and grass leaves. Radio telemetry indicated that she used this site several times, perhaps adding a fresh layer of soil and grass for each occupancy.

Daybeds No. 3 to 7 lay on the shelf in front of her 1983-1984 cave den. Each bed measured about 90 cm in diameter. Twigs of white rhododendron and fool's huckleberry lined two of the beds; the others lay directly on a mat of smooth woodrush. I cannot document when she used these daybeds.

Craighead and Craighead (1972a, 1972b) and Craighead (1979) noted grizzly bear use of daybeds at the den site immediately prior to denning. Servheen (1981) observed similar use of den site daybeds. He also postulated that grizzly bears may use dens and associated daybeds during the summer to escape daytime heat, which may be the case here. During this July examination, ambient temperatures differed from 6.7 °C in the cave, to 20.0 °C on the shelf outside.

U867 used two daybeds immediately before denning in 1984. After feeding in a clearcut about 100 m down slope, she located Daybed No. 8 on the edge of a small alder shrubfield. She remained in this south-facing bed during a severe overnight snowstorm. The unlined bed lay between two naturally exposed roots on the uphill side of a large Engelmann spruce (Picea engelmannii). A scat packed with sweet-cicely and elderberry roots lay about 5 m from the bed.

She remained at Daybed No. 9 for 15 days, until moving to her den. This bed lay on a natural mat of sedges against the uphill side of a large mountain hemlock (Tsuga mertensiana). Snow measured about 1 m at the bed site. No scats or evidence of feeding were noted near the bed.

Daybed No. 10 lay about 0.5 m from the entrance to her 1984-1985 cave den. Measuring 50 cm in diameter and formed on a natural mat of smooth woodrush, the bed covered the top of a flat boulder. I found no scats near this daybed, but I noted extensive digs for glacier lily within 10 m of the site.

Movements

The mean daily linear movement for U867 measured 3.0 km. Daily movements ranged from 0 to 45.7 km, including periods of virtually no movement before denning and one long trek of 45.7 km to a feeding site. Seasonally, her daily movements averaged 2.8 km for spring, 3.7 km for summer, and 2.4 km for fall, with no significant differences noted ($P > 0.05$). Almack (1985) described several individual movements in detail.

Radio location analysis showed no significant differences in seasonal use of aspects ($P > 0.05$). She remained between 1 400 and 1 700 m elevation, except during May, when she was located at 850 m for about 7 days.

Home Range

Annual home ranges for U867 during 1983 and 1984 measured 195 and 609 km^2, respectively (fig. 1). Her composite home range duplicated the 1984 annual range.

The composite range measured larger than those calculated for most females in other study areas. Both Servheen (1981) and Jonkel (1982) reported female home ranges in northwestern Montana varying from 15 to 136 km^2. Aune and Stivers (1982) reported female ranges from 31 to 450 km^2 on the Rocky Mountain Front in north-central Montana. In Canada, Russell and others (1979) reported several large female home ranges from Jasper National Park; the largest of these measured 532 km^2. One of the largest female home ranges, documented in Yellowstone National Park by Knight and Blanchard (1983), measured approximately 900 km^2.

Russell and others (1979) postulated that a young female (4 to 9 years old) may explore a larger home range to optimize her chances for breeding and to locate a "core range" suitable for rearing cubs. This idea provides a plausible explanation for the size of U867's 1984 home range.

All of her long-distance movements (> 15 km), with the exception of fall movements to den sites and summer movements resulting from human disturbance, occurred from late May to late June, during the breeding season. She also used a much smaller area during summer and fall in 1984.

This smaller "core" area contained approximately 65 percent of her radio locations and measured about 45 km^2. Mostly located within a large burn, this area contained a rich food supply, consisting of productive forbfields, huckleberry and elderberry shrubfields, and an abundance of ground squirrels, marmots (Marmota caligata), and ants. She emerged from her 1984-1985 den about May 13 with two cubs.

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