GRIZZLY BEAR DENS AND DENNING ACTIVITY IN THE MISSION AND RATTLESNAKE MOUNTAINS, MONTANA

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Abstract: Forty-one grizzly bear (*Ursus arctos horribilis*) dens were found in the Mission and Rattlesnake Mountains, Montana, from 1976 through 1979. Ten of these dens were used by transmitter-equipped grizzly bears. Thirty-nine dens were excavated in open, side-hill park habitat and 2 were under forest canopy. Two dens occurred at 1250 m while 39 were between 2050 and 2500 m. Slope angle of sites averaged 30° for 15 measured dens. Dens occurred on all aspects except northwest. Movement to the den site in the fall was independent of low-elevation weather conditions and occurred between 10 October and 20 November. Two adult females moved to their dens prior to any snow and may have displayed a period of pre-hibernation lethargy prior to final den entry. Final den entry was closely associated with severe snowstorms at the den site that apparently sealed the den entrance with snow. Final den entry dates varied from 2 November until after 21 November. Dates of emergence varied from prior to 31 March to 26 April. Adult females accompanied by young remained at the den site after emergence for 7 to 12 days. All other grizzly bears left the den and moved to lower elevations immediately after emergence. One transmitter-equipped grizzly bear used its winter den during August as a bedding site. This is the first verification of summer use of a den by a grizzly bear. Two adult male black bears (*Ursus americanus*) were radio-instrumented to determine their denning habits. Both denned below 1800 m under forest canopy. Significant differences ($P < 0.001$) between den entrance height of excavated black bear and grizzly bear dens indicate that this measurement may be a useful indicator of species.

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The grizzly bear was declared a threatened species in its limited range in the lower 48 states in 1975 (U.S. Fish and Wildlife Service 1975). Grizzly bear den sites are an important and vulnerable component of grizzly bear habitat. Den sites are often limited in distribution and may be selected because of specific microclimatological factors, and bears within dens are vulnerable to intraspecific predation and sensitive to human disturbance (Murie 1944, 1961; Ustinov 1960; Sokov 1969; Novikov et al. 1969; Craighead and Craighead 1972*a*, *b*; Lentfer et al. 1972; Zunino and Herrero 1972; W. Troyer, biologist, U.S. Fish and Wildl. Serv., pers. commun. 1974; Pearson 1975; Harding 1976; Reynolds et al. 1976; R. Russell, biologist, Can. Wildl. Serv., pers. commun. 1978; H. Reynolds, biologist, Alaska Dep. Fish and Game, pers. commun. 1978; R. Knight, biologist, U.S. Natl. Park Serv., pers. commun. 1978; Vroom et al. 1980). This paper described den site characteristics and denning activity of grizzly bears in the Mission and Rattlesnake Mountains of northwest Montana emphasizing pre- and post-denning behavior and den site characteristics.

This paper is part of a comprehensive report on grizzly bear biology and habitat use on the Flathead Indian Reservation, Montana. The assistance of J. Claar of the Bureau of Indian Affairs, and G. Day, M. Haroldson, D. Carney, M. Madel, and L.C. Lee of the Border Grizzly Project at the University of Montana is appreciated. Funding was provided by U.S. Bureau of Indian Affairs, Confederated Salish and Kootenai Tribes, U.S. Fish and Wildlife Service, the University of Montana, and the Montana Department of Fish, Wildlife, and Parks. Special thanks go to C. Jonkel and J. Beecham for encouragement, discussion, and critical review of the manuscript.

STUDY AREA

The Mission Mountains form the eastern edge of the lower Flathead River Valley in Lake County in northwest Montana. The Mission Mountains, isolated by the forested Swan Valley to the east and the agricultural and residential lands of the Flathead Indian Reservation to the west, run north-south for 80 km and are a maximum of 16 km wide. The Mission Divide is the eastern boundary of the Flathead Indian Reservation, and the eastern slope of the range within the 29,500-ha Mission Mountain Wilderness. Vertical relief across the range from west to east is abrupt, varying from 850 m in elevation on the west slope to more than 3000 m on the Mission Divide and down to 1100 m in the Swan Valley in less than 14 km. Slopes rising more than 600 m in less than 1 km are common.

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Table 1. Timing of movement to den site and final den entry for transmitter-equipped grizzly bears in the Mission Mountains, Montana, 1976–1979.

Bear No.	Sex	Age (years)	Year	Reproductive status	Movement to den site		Den entry		Den elevation (m)	Den aspect
					Date	Weather[a]	Date	Weather[b]		
230	F	14	1977	Solitary	15 Nov	Snow	17–22 Nov	Snow	2080	SW
		15	1978	Solitary	13–16 Oct	No snow	18–20 Nov	Snow	2100	SW
		16	1979	w/2 cubs	6 Nov	Rain	17–21 Nov	Snow	2100	SW
305	F	7	1978	w/1 cub	10 Oct	No snow	2–14 Nov	Snow	2380	NE
		8	1979	w/1 yrlg.	After 1 Nov	Rain	Before 21 Nov	Snow	2350	SW
224	F	0.5	1977	Solitary	15 Nov	Snow	17–22 Nov	Snow	1250	W
		1	1978	Solitary	2–13 Nov	No snow	14 Nov	Snow	1250	W
		2	1979	Solitary	19–20 Nov	Snow	After 21 Nov		2050	W
191	F	2	1978	w/sibling	3–13 Nov	No snow	18–20 Nov	Snow	2280	SE
200	F	9	1976	Solitary	17 Nov	Snow	20 Nov	Snow	2316	SW

[a] Weather at low-elevation areas immediately before and during movement to higher-elevation den sites.
[b] Weather at den site immediately before and during final entry.

The Rattlesnake Mountains lie 10 km south of the Mission Range. The north and west slopes of the Rattlesnake range are within the Flathead Indian Reservation, and remaining lands are within the 24,540-ha Rattlesnake Wilderness Area. The extreme southwestern range of the grizzly bear in northwest Montana occurs in the Rattlesnake Mountains (Servheen, unpubl. data).

Precipitation within the Mission and Rattlesnake ranges varies with elevation. Areas below 1000 m receive approximately 70 cm of yearly precipitation; areas above 2000 m generally receive in excess of 150 cm, mostly as snow. Prevailing winter winds are generally from the northwest.

METHODS

Grizzly bears were captured on the west slope of the Mission and Rattlesnake ranges from fall 1976 through fall 1979. Bears were fitted with radio collars, and located by ground and air searches.

Dens were located for all bears that carried functioning transmitters. Denning habitat was identified by noting features of the denning habitat used by transmitter-equipped bears. Typical den site habitat was then intensively surveyed by helicopter and ground searches to locate additional dens. Dens were visited and characterized by size, elevation, aspect, slope, den type, and vegetation type (Pfister et al. 1977).

Denning activity was noted by following transmitter-equipped animals, observing newly excavated dens in the fall, and following tracks in the snow. Times of movement to the den, final entry, and emergence from the den were correlated to weather and snow conditions.

RESULTS AND DISCUSSION

During the autumn periods of 1976, 1977, 1978, and 1979, 5 transmitter-equipped bears were tracked to 10 den sites, 2 of which were visited and measured. Helicopter surveys located 27 additional den sites, 9 of which were visited and measured. Four other dens were located from the ground. The total number of dens located was 37 in the Mission Mountains and 4 in the Rattlesnake Mountains.

Time of Denning

Movement to the den site generally occurred during the 1st 2 weeks of November except for adult females Nos. 230 and 305 in 1978 (Table 1). Both of these bears moved to den sites more than 2 weeks prior to any low-elevation snowfall. When captured on 29 September 1978, No. 305 was in excellent condition with a heavy fat layer. She may have moved to the den early because she had enough fat reserves for denning by early October and had no need to continue feeding in low-elevation fall range. No. 230's 1978 fall range overlapped that of No. 305 where fall foods were abundant. It seems probable that No. 230 had also built up sufficient fat reserves by mid-October.

Craighead and Craighead (1972*a*) described a condition of prehibernation lethargy characterized

Table 2. Timing of emergence from den, and movement away from the den after emergence, for grizzly bears in the Mission Mountains, Montana, 1978–1979.

Bear No.	Sex	Age (years)	Year	Reproductive status	Emergence date	Weather	Movement from den site	Den elevation (m)	Den aspect
230	F	15	1978	Solitary	Before 31 Mar	Cold	Immediate	2080	SW
		16	1979	w/3 cubs	25–26 Apr	Sunny	2–7 May	2100	SW
305	F	8	1979	w/yearling	24–25 Apr	Sunny	2–7 May	2380	NE
224	F	1	1978	Solitary	1–3 Apr	Sunny	4 Apr	1250	W
		2	1979	Solitary	12–15 Mar	Cold		1250	W
191	F	3	1979	w/sibling	5–14 Apr	Sunny		2280	SE

by reduced movements and alertness prior to den entry. They ascribed the early movement of one grizzly bear to its den to an early onset of such lethargy. We did not observe any prehibernation lethargy, although Nos. 230 and 305 both stayed at the den site with little or no detectable movement for 3–4 weeks prior to final den entry. This lack of movement may have been indicative of a lethargic state.

Dates of final den entry were centered around the 3rd week in November (Table 1). Grizzly bears were usually active in the vicinity of the den prior to entry as evidenced by tracks in the snow. Final den entry was correlated with a severe snowstorm in all cases. The deposition of a thick snow cover which covered the den entrance was probably the major influence on final den entry.

Our data suggested that movement to the den by grizzly bears in northwest Montana was determined by: (1) onset of winter weather, or (2) high body fat levels. Grizzly bears which develop sufficient fat levels for successful denning in early autumn may move to den sites prior to severe weather and become lethargic. Grizzly bears which are unable to procure enough food resources to develop a heavy fat layer early may continue to feed until severe winter weather forces them to enter the den later in the autumn.

Time of Emergence From the Den

Information on emergence times and conditions are summarized in Table 2. These data indicate that adult females with young are the last to emerge from the den, and are the only bears to remain in the vicinity of the den for several days after emergence. This is contrary to what Pearson (1975) observed in the Yukon, where subadults and solitary females also stayed near den sites after emergence. The emergence times we observed are in general agreement with those reported from Yellowstone Park (Craighead and Craighead 1972*a*) and Banff National Park, Alberta (Vroom et al. 1980).

Den Site Characteristics

Den Types. — All dens in the Mission and Rattlesnake Mountains were excavated. Typically they were dug straight into slopes with a short tunnel and a chamber that was not much longer or more developed than the tunnel. Several angled to the side after the initial tunnel due to the presence of a large rock or rock slab (Fig. 1). Our aerial survey was biased toward discovery of excavated dens because these dens were located on open slopes and had obvious mineral soil tailings below the entrance. We possibly missed natural caves. However, no transmitter-equipped

Table 3. Angle of slope of grizzly bear dens and use of natural cavities in North America.

Study	Area	Sample size	Angle of slope (degrees) Range	Mean	Use of natural cavities
Vroom et al. 1977	Banff National Park, Alberta	47	22–40	33	0 of 47
Russell, pers. commun. 1978	Jasper National Park, Alberta	10	15–40	27	1 of 10
Pearson 1975	Southwest Yukon	10	30–40	35	0 of 15
Reynolds et al. 1976	Brooks Range, Alaska	52	20–35	Not reported	13 of 52
Knight, pers. commun. 1978	Yellowstone National Park area	15	11–37	22	2 of 16
This study	Mission and Rattlesnake Mountains	15	21–35	30	0 of 41

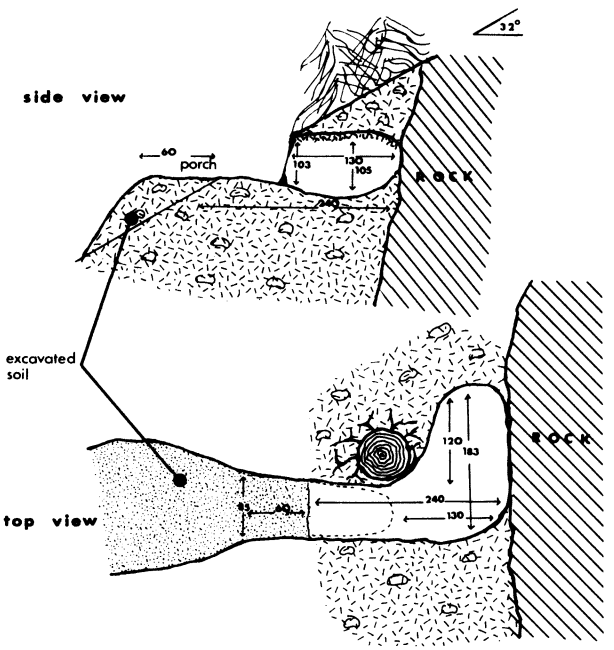

Fig. 1. Den with angle due to a rock wall encountered during excavation. Measurements in cm.

bears used caves, indicating a probable low level of use, as has been noted in other areas (Table 3).

Elevations of Dens. — All dens except 2 of an orphan cub were in high-elevation areas between 2050 m and 2500 m (Table 4). This elevational range was comparable with the ranges reported in other studies (R. Russell, biologist, Can. Wildl. Serv., pers. commun. 1978; Vroom et al. 1980). Similar stratification of geology and vegetation in northwest Montana and southern Alberta probably accounts for the similarities in elevation range. Dens in the Mission and Rattlesnake Mountains are lower in elevation than dens in Yellowstone National Park (Craighead and Craighead 1972*a*) and higher than dens in southwest Alaska (Lentfer et al. 1972) or the Yukon (Pearson 1975).

Slopes of Sites. — Slopes of den sites were between 28° and 35° for 14 of 15 dens measured (Table 4). One den was at 21° on a lower slope site and was collapsed. The range of 28° to 35° seems consistent with data from other areas (Table 3). This choice of slope angles allows snow to accumulate but not enter the chamber by slumping or sliding down inside (Harding 1976). Vroom et al. (1980) have speculated that since most dens were dug perpendicularly into slopes, those excavated into slopes of less than 25° would have a very thin covering of soil over the tunnel and chamber, increasing the possibility of roof collapse and reducing thermal effectiveness.

Aspect of Sites. — We found grizzly bear dens on aspects between 45° and 277° (Table 4). We believe that these exposures were chosen because of consistent snow depth at all aspects above 2000 m in the Mission Mountains. Craighead and Craighead (1972*a*), Reynolds (biologist, Alaska Dep. Fish and Game, pers. commun. 1978), and Vroom et al. (1980) have noted the importance of snow depth in the selection of a den site because it is important to the comfort and survival of the hibernating bear. In some regions snow depth may be dependent on aspect and prevailing winds. In other areas, such as the Mission Mountains, snow depth above a certain

Table 4. Characteristics of 15 grizzly bear dens in the Mission and Rattlesnake Mountains.

Elevation (m)	Slope (degrees)	Aspect (degrees)	Entrance width/ height (cm)	Total length (cm)	Chamber width/ height (cm)	Tailings length[a] (cm)
2050	28	277	53/64	241	102/119	610
2060	28	262	38/79	142	58/58	127
2060	28	265	56/56	264	140/68	584
2068	21	216	46/53			460
2072	35	200	91/97	396	132/160	526
2080	30	220	69/76	211	274/107	671
2080	32	62	86/104	244	185/107	777
2080	32	62	66/99	155	76/99	366
2080	32	50	86/74	122	102/112	356
2080	32	60	81/76	114	86/94	396
2080	30	60	81/38			366
2080	29	210				422
2173	35	78	71/79	213	142/137	475
2316	33	220	61/66	163	147/79	427
2500	32	250	69/74	129	129/94	447

[a] Tailings length is distance from edge of porch (see Fig. 1) to downslope end of mineral soil excavated from den.

elevation is not critically affected by aspect and wind vectors, and therefore is not a selective factor in den location.

Bed Construction

Of 15 dens visited, 8 contained beargrass (*Xerophyllum tenax*) bedding material in the chamber. Beargrass was the predominant vegetation around most dens. Beds varied from a few scattered leaves to well-developed, nest-shaped structures, low in the center and surrounded by higher sides. One bed was deep and well developed, containing several cubic meters of beargrass. Material on the bottom layer of this bed was old and decomposed, while the upper layer was fresh with a few green beargrass leaves on top. Other workers have reported conifer boughs, twigs, grass, and moss used as bedding materials (Craighead and Craighead 1972a; Pearson 1975; Reynolds et al. 1976; R. Knight, biologist, U.S. Natl. Park Serv., pers. commun. 1980). Beargrass use has not been previously recorded.

Four dens did not contain any bedding material and the floor was merely dug to a smooth bottom of soil and gravel. Use of bedding materials in dens by grizzly bears appears to vary, with consistent use in some areas (Craighead and Craighead 1972a) and inconsistent use in others (Pearson 1975). Thus, actual use of a den cannot be inferred from the presence of bedding material.

Distribution of Dens

Dens occurred either singly, in dispersed groupings with dens approximately 200 to 500 m apart, or in compact groups of 2 or more within an area of less than 1 ha. Of 41 dens, 10 occurred in 3 compact groups of 5, 3, and 2 dens. The latter 2 were excavated and used by a transmitter-equipped grizzly bear in 2 consecutive years. Den grouping may occur because of: (1) restricted availability of suitable den habitat (Pearson 1975); or (2) learning of, and return to suitable sites through experience, as speculated by Craighead and Craighead (1972a).

Age and Reuse of Dens

Recently used dens could be identified by the lack of vegetative growth on the tailings, recent digging or shaping of the chamber floor, hair caught on rocks or roots around the tunnel entrance, and fresh green bedding. Occasionally

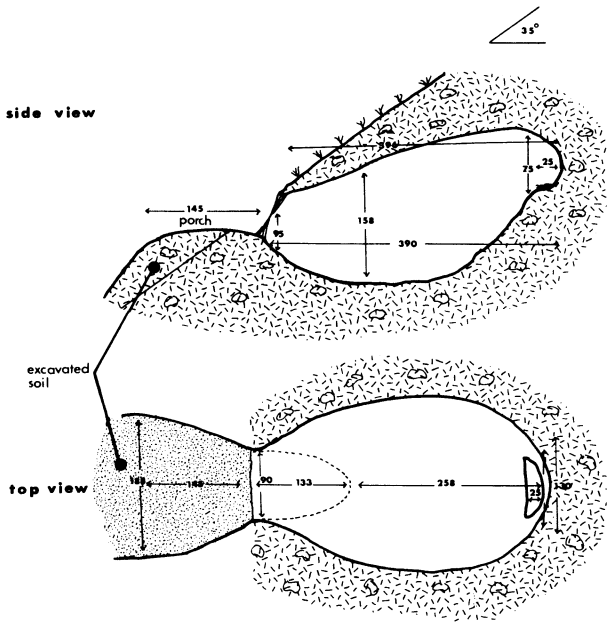

Fig. 2. Den with remnant rear shelf covered with old beargrass. This den was apparently remodeled. Measurements in cm.

dens had burrows of small mammals inside the chamber or around the entrance. Such burrows sometimes occurred 3–4 months after a transmitter-equipped bear left a den.

We know of 2 dens that were reused. Stratified layers of older and newer bedding indicated reuse at one den, while reexcavation of another was indicated by a remnant shelf covered with beargrass bedding in the rear of the den (Fig. 2). Den reuse is uncommon in most areas due to roof instability and collapse (Reynolds et al. 1976, Vroom et al. 1980). Dens in the Mission Mountains are stable; only 2 of 41 had collapsed, but reuse is still unusual.

Grizzly bears are sensitive to human disturbance at the den site and may abandon a den (Craighead and Craighead 1972a, Reynolds et al. 1976). To test the possibility that den reuse was influenced by our entering dens for measurements, we did not visit 2 dens used by transmitter-equipped bears. Neither bear reused its den the next year, indicating that choice of a new den site each year is not necessarily related to human disturbance by den entry.

Summer Den Use

Use of a winter den as a summer retreat by the same bear was verified in one case. When we

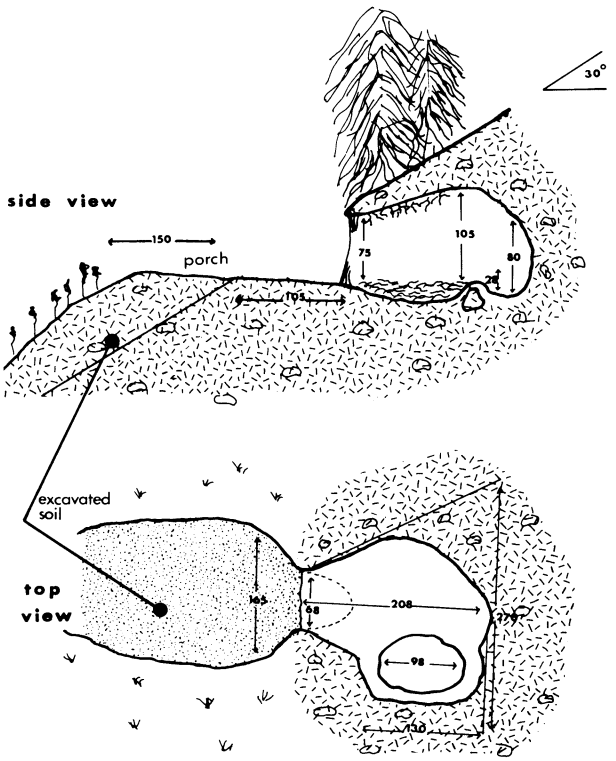

Fig. 3. Den with 2 beds: a beargrass bed close to the entrance, and a bed of soil in the rear of the chamber. This den was used as a summer bedding site by Grizzly No. 230. Measurements in cm.

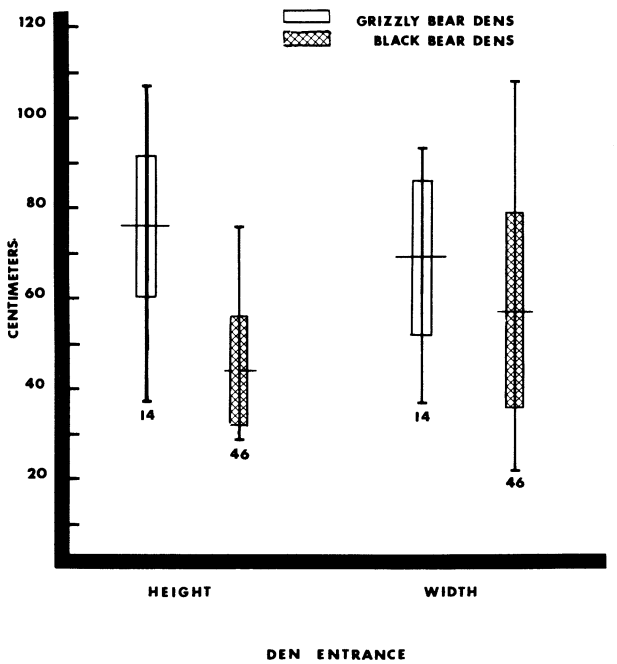

Fig. 4. Entrance height and width of excavated grizzly bear dens in the Mission and Rattlesnake mountains, Montana, and of excavated black bear dens in Idaho. Difference between heights was highly significant ($P < 0.001$), but differences between widths were not ($P > 0.05$). Means ± 1 standard deviation, ranges, and sample sizes are presented.

visited a den in August the rear of the chamber had been excavated and the bedding removed (Fig. 3). The dirt floor was compacted as if by a sleeping bear and the den smelled strongly of bear as if recently occupied. As we emerged from the chamber a grizzly bear approached to within 10 m of the den and gave a low growl. Radio-tracking the next day revealed No. 230 within 1 km of this den she had used the previous winter.

Summer use of winter dens has not previously been reported for grizzly bears or black bears, but J. Beecham (biologist, Idaho Fish and Game Dep., pers. commun. 1980) has evidence that Idaho black bears sometimes visit dens in summer. Inside the grizzly den where we observed summer use, the air temperature was 5 C cooler than that of the outside air, and it was dry and free of mosquitoes. The den provided complete visual cover in the semi-open subalpine habitat where it occurred. The disadvantage of summer den use was possible surprise and predation by a larger bear. Pearson (1975) documented such intraspecific predation when a male grizzly bear encountered a female in her den in the autumn.

Differentiation Between Black Bear and Grizzly Bear Dens

The identification of grizzly bear dens is important in areas where black bears and grizzly bears are sympatric. In this study, all dens above 1800 m elevation were identified as grizzly bear dens. This identification was based on: (1) reports that black bears are absent at these elevations in areas of sympatry with grizzlies, due to possible competitive exclusion (Vroom et al. 1980); (2) our observations that all transmitter-equipped grizzly bears used dens above 1800 m (except for 1 orphaned cub) and that 2 transmitter-equipped black bears in the study area denned below 1800 m in forested habitat; and (3) published literature describing black bear den sites in areas below 1800 m in northwest Montana (Jonkel and Cowan 1971). However, Beecham et al. (1983) found that black bears in

west-central Idaho, where grizzly bears do not occur, utilized den sites that were similar in elevation and site characteristics to those described for grizzly bears in this study. This information casts some doubt on the validity of the den identification methods used here; the question cannot be resolved without conclusive data concerning exclusion of black bears from high elevations where the 2 species are sympatric.

To quantify differences between black and grizzly bear dens, the height and width of the den entrance was compared between Mission– Rattlesnake dens and black bear dens in Idaho (Beecham et al. 1983) (Fig. 4). Differences between means were significant for height (t test, $P < 0.001$), but not width (t test, $P > 0.05$). This suggests that entrance height may be a reliable index of species, and lends support to the identification of the dens reported in this paper as grizzly dens.

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