Third International Conference on Bears

Paper 41

Denning Ecology of Grizzly Bears in Northeastern Alaska

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INTRODUCTION

In arctic Alaska the grizzly bear, *Ursus arctos*, is at the northern limit of its range; the period of food availability during the summer season is short, reproductive potential is low, and populations may be more susceptible to the pressures of human development and sport hunting than they are in other regions.

As one aspect of a cooperative research program to determine the basic parameters of grizzly bear population size, structure and movement patterns in northeastern Alaska, denning was studied during April-November 1972, 1973 and 1974 (Reynolds 1974; Quimby 1974; Quimby & Snarski 1974; Curatolo & Moore, in press). The primary objectives of this segment of the study were to locate dens, delineate denning habitat and determine if the availability of den sites was a population limiting factor.

STUDY AREA

The study area is in the eastern Brooks Range along the southwestern border of the Arctic National Wildlife Range. It includes the Canning and Ivishak Rivers which flow north into the Arctic Ocean and the Junjik River and East Fork of the Chandalar River which flow south into the Yukon River and thence to the Bering Sea. The country is characterized by rugged mountains rising to 1700 m, cut through with river valleys up to 3 km wide at elevations from 300 to 900 m and interspersed with steep rolling hills in portions of the area. There are scattered stands of stunted white spruce *Picea glauca* on the south side of the divide but none on the north; otherwise the vegetation is similar: willows *Salix* spp., poplars *Populus* spp. and scattered *Shepherdia canadensis* in the river valleys; horsetails, *Equisetum* spp. and *Eriophorum*, in moist areas; and *Dryas* communities predominating in drier habitat.

PROCEDURES

Systematic aerial searches of small drainages for caves or material excavated from dug dens revealed 20 dens. Fourteen dens were located by tracking bears in the snow, some for long distances, during spring and autumn. The contrast of

excavated earth against vegetation or newly fallen snow resulted in the locating of eight dens from aircraft by biologists conducting other studies in our study area. Seven bears fitted with radio transmitters were found in dens. Three grizzly bear dens were located after interviews with native residents of Arctic Village.

RESULTS AND DISCUSSION

Den site Selection and Structure

Fifty-two dens were located including 29 active dens (23 dug and 6 in caves) for which the winter of use was known and 23 inactive dens (16 dug and 7 in caves) for which the year of use could not be determined.

Inclement weather, especially snowstorms during autumn, has been hypothesized as a major factor in stimulating denning activity (Craighead & Craighead 1965, 1972a; Jonkel & Cowan 1971). Observations during this study generally agree with this hypothesis.

In 1973, den construction was preceded by a major snowstorm and followed by a number of light snowfalls on successive days. The dates of den excavation were judged by the accumulation of snow on the material removed from the den and by the age of the tracks leading to the sites. Ten of the 14 active dens (71 percent) which were found during the fall were dug between 5 and 12 October. Intensive searches for dens were continued until 25 October but few fresh tracks were encountered after 12 October. However, four dens were located between 26 October and 7 November by other biologists in or adjacent to the study area; the dates of construction for these were unknown but at least one appeared to have been recently made. Similarly, in 1974, of eight bears whose summer movements were monitored, six denned between 3 and 9 October, a period characterized by cold temperatures and snowstorms, one denned on 29 September and one between 15 and 31 October.

Of the 52 dens, 47 (90 percent) were on southerly slopes, 4 (8 percent) were on northerly slopes and 1 (2 percent) was on an easterly slope. The den sites, excluding three coastal plain dens, had a mean elevation of 1040 m (S.D. = 240) above sea level and a mean elevation of 180 m (S.D. = 150) above the valley floor. Most dens were on slopes of 20 to 35 degrees.

A considerable difference in the exposure of the slope used for denning exists between geographic areas. Craighead & Craighnead (1972) found bears in Yellowstone National Park denning on north facing slopes at altitudes from 3100 to 2700 m. Lentfer *et al.* (1972) found the greatest proportion of bears on Kodiak Island denned on north facing slopes at 550 m and on the Alaska Peninsula on east facing slopes at 400 m. Our study showed bears in the Brooks Range had a definite preference for south facing slopes, possibly selecting sites which would melt the earliest and expose available forage. Bears in more southerly locations may be selecting sites which protect them from mid-winter thaws which would flood or dampen the den (Craighead & Craighead 1972a), a situation which rarely occurs in the Brooks Range.

A more probable explanation for the southern orientation of den sites is related to Brooks Range soil characteristics. These mountains lie within the zone of continuous permafrost (Péwé 1966). The soil on the north facing slopes may melt down only 30 to 60 cm from the surface while south slopes may melt to 2 m (Kline, pers. comm.). Permafrost soils of small particle size and high water content have a greater hardness than well-drained coarse soils (Péwé

1966), which would be easier to excavate. Bears appear to select terrain charaterized by steep slopes for drainage, south facing slopes for the maximum depth of thaw and rather coarse soil substrates. These characteristics would aid in den construction in autumn, but also make collapse of the den more likely after the spring thaw; and indeed all dug dens visited during the summer had collapsed.

Permafrost may also keep bears from digging dens earlier in the season. Craighead & Craighead (1972a) found bears constructed dens up to 2 months before finally entering the den for winter hibernation. Conversely, in this study, bears appeared to construct dens almost immediately before entering for hibernation. Since the maximum depth of thaw occurs in autumn it may be easiest to construct dens immediately before hibernation rather than months earlier when frozen soil may make excavation difficult or impossible.

The selection of moderate to steep slopes for den sites may also aid in construction of a heat trap where the chamber is higher than the entrance (Craighead & Craighead 1972a, 1972b) and for ease in getting rid of excavated material (Lentfer *et al.* 1972).

In this study area grizzly bears either dug dens or used natural rock caves for hibernation. In other parts of North America, reported brown and grizzly bear den sites have been dug (Murie 1963; Craighead & Craighead 1972a, 1972b;

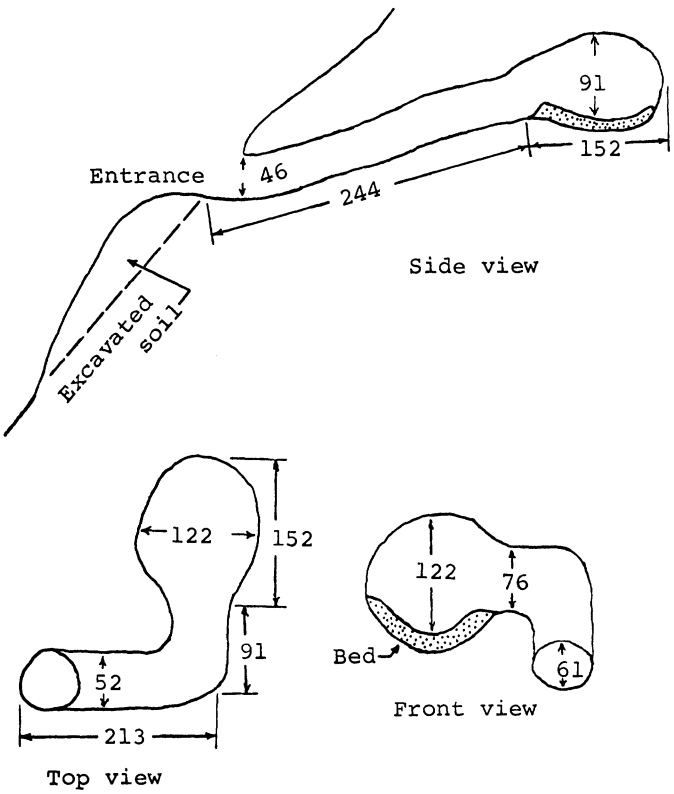


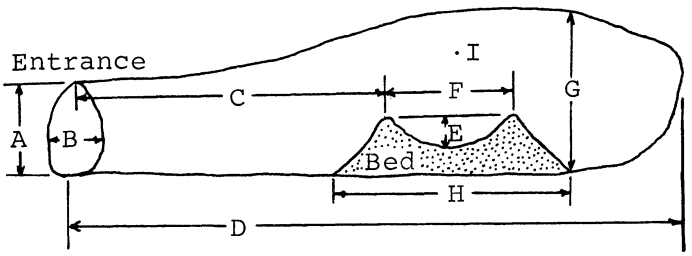
Fig. 1. Two dug grizzly bear dens, eastern Brooks Range, Alaska. (Dimensions in centimeters)

Lentfer *et al.* 1972), although Lentfer *et al.* (1972) noted receiving reports of utilization of caves on Kodiak Island and the Alaska Peninsula. Black bears, *Ursus americanus*, are more likely to dig dens under rocks, logs, trees or to utilize caves (Erickson *et al.* 1964; Jonkel & Cowan 1971; Craighead & Craighead 1972a). The European brown bear, *Ursus arctos arctos*, is reported to den in caves, hollow trees and dense vegetation (Couturier 1954).

Most dug dens collapsed before we were able to examine them; only one intact dug den and one which was partially collapsed were measured. On-the-ground observations showed that most dens closely followed the descriptions of Craighead & Craighead (1972a, 1972b) and Lentfer et al. (1972). The two that were found relatively intact were representative of the den structure shown in outline by collapsed dens (Fig. 1). Both dens were constructed with an upward leading tunnel between the entrance and the bed chamber, which provided an effective dead air space. Twigs, roots, grass, shrubs and moss were scraped into the chamber to form a nest-like bed.

Dimensions of cave dens are given in Fig. 2. All den sites had vegetation at or adjacent to the cave mouth; bears scraped and collected this vegetation, similar to that found in dug dens, into the den to construct beds. One of these beds, however, was constructed completely from the feces of porcupines, *Erethizon dorsatum*, which had previously occupied the cave.

Craighead & Craighead (1972a, 1972b) discuss the warm micro-environment which develops in the den when snow covers the entrance and creates an effective insulating layer of snow and dead air. In the Brooks Range snowfall is very light, and temperatures may reach –50°C for weeks at a time; maintenance



	A	B	C	D	E	F	G	H	I*
Mean	125	189	232	506	27	107	88	189	149
Range	52-216	55-293	0-625	289-899	15-46	70-168	55-122	131-217	25-70
Standard deviation	64	155	177	235	12	37	21	58	55
No. in sample	11	11	11	11	8	6	10	10	11

*I—width of cave above center of bed

Fig. 2. Composite side view sketch and dimensions (in centimeters) of 11 grizzly bear rock cave dens and hibernation beds, eastern Brooks Range, Alaska.

of a warm microclimate within the den would seem to be important for sustaining fat reserves and the animal's well being. The construction of beds up to 30 cm thick with walls extending as high as 47 cm serves as an insulative barrier to the cold; other adaptations to conserve body heat include construction of the bed above the level of the entrance and, in the case of some dug dens, pushing vegetation into the entrance from the inside, effectively reducing the size of the mouth of the den. However, in some cave dens, beds were close to and at the same height as the entrance, allowing air to circulate freely; these had only a bed of vegetation to conserve body heat.

Movement

Den sites were located within or closely adjacent to the area used by grizzlies during spring, summer and autumn. Of the eight bears whose home ranges were determined in 1974 by radio telemetry or visual observation none migrated outside their summer or autumn range to den (Curatolo & Reynolds, in prep.). When eight bears whose home ranges were not known were tracked to dens during the fall of 1973, the straightline distances traveled before den sites were reached were 3.2, 3.2, 4.8, 6.5, 8.1, 9.7, 12.9 and 54.8 km. Another bear was tracked from its summer and early autumn range 51.6 km to its denning area but its den was not found. Thus, two of these nine bears moved a considerable distance to reach denning areas, possibly beyond their summer ranges.

Two types of home ranges have been reported in other areas: one in which a single area was used throughout the year for foraging and denning, and one in which the summer and early autumn foraging area was connected by a migratory corridor to an early spring and late autumn area that contained the den (Berns & Hensel 1972; Craighead & Craighead 1972a).

Our study showed that seven of eight bears had known home ranges of the single area type and that seven of nine bears with unknown home ranges were tracked to dens which appeared to still be within their home ranges due to the short distances traveled. Thus it appears that most grizzlies in our study area did not have different seasonal ranges connected by a migratory corridor, but used a single, well-defined area throughout the year.

Den Related Activities

No re-use of dug dens was found in this study, although rock cave dens may have been used more than once. Both Lentfer *et al.* (1972) and Craighead & Craighead (1972a) cited one instance of possible den re-use, but there is little doubt that most bears construct new dens each year since seepage and erosion tend to collapse dug dens in the spring and summer (Lentfer *et al.* 1972). Although individual dens may not be used more than once, there is some evidence that bears may use the same general area for more than 1 year (Craighead & Craighead 1972a).

In 1973, bears abandoned five den sites after they were tracked to them by helicopter. One bear abandoned two of these sites after it had been disturbed on 7 October and again on 8 October. Bears appeared to be most prone to abandon dens when disturbed during or shortly after den construction. However, dens could be located without causing abandonment by approaching them carefully and spending little time in the area. No dens were abandoned in 1974.

Two cases of possible den-related mortality were recorded. The remains of a 2-year-old bear were found in a small and poorly constructed cave den. The other case involved the report of a large bear feeding on the carcass of another bear. Inspection of the site showed that the bear, probably a male, had discover-

ed an occupied den and had either killed the occupants (a sow and at least one yearling) or had discovered them dead within the den. Pearson (1972) cites an instance in which a male killed a female at a den. Lentfer *et al.* (1972) found no instances of den mortality; neither had Craighead & Craighead (1972a), but they believe that old bears may die in the den.

Denning Habitat Availability

If the availability of denning habitat was a population limiting factor it would have its greatest effect on the low foothills and coastal plains where permafrost is closest to the surface. Although bears whose home ranges were primarily in the mountains foraged in this area during certain times of the year, few bears established home ranges entirely in the region; this was probably due more to the lateness of thaw, slow disappearance of snow and low food resources than to availability of denning sites. Well-drained sites near stream banks may be important for denning for the few bears that winter in this area.

In the mountains and foothills, denning took place over wide areas on both the north and south slopes of the Brooks Range. There did not seem to be specific areas of denning where habitat was limited although south facing slopes were preferred and some caves may be re-used in successive years. Thus it appears at this time that denning habitat is not a limiting factor on the grizzly bear population in northeastern Alaska.

ACKNOWLEDGEMENTS

This cooperative study was supported by Alaska Arctic Gas Study Company through Renewable Resources Consulting Services, Ltd. and by Alaska Federal Aid in Wildlife Restoration Project W-17-6-4.9R. Field facilities were provided by Alaska International Air, Inc. and laboratory facilities by the Naval Arctic Research Laboratory, Barrow, Alaska.

We extend thanks to Gregory D. Moore, Patricia C. Reynolds, David Snarski, Steve Lindsey, Lee Peet and Bob MacAfee for companionship and assistance in the field.

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