

## DIFFERENTIATING BLACK AND GRIZZLY BEAR FECES

DAVID HAMER, *Department of Biology, University of Calgary, Calgary, Alberta T2N 1N4*

STEPHEN HERRERO, *Faculty of Environmental Design and Department of Biology, University of Calgary, Calgary, Alberta T2N 1N4*

LYNN ROGERS, *North Central Forest Experiment Station, USDA Forest Service, 1992 Folwell Avenue, St. Paul, MN 55108*

In regions where grizzly bears (*Ursus arctos*) and black bears (*U. americanus*) occur sympatrically, biologists frequently have assumed they could differentiate the feces of these 2 species by measuring fecal diameter. Feces with diameters exceeding 5.0 cm have been attributed to the generally larger-bodied grizzly bear (Hamer 1974, Knight et al. 1977, Martinka 1972, Mealey 1975, Mundy 1963, Servheen and Lee 1979, Shaffer 1971). This practice apparently originated from Mundy (1963:15) who only stated: "It was found that grizzly scats tended to have a large calibre, around 50 millimeters or greater." Investigators have acknowledged the potential error of this method, noting that although this criterion would reduce the possibility of including black bear droppings in the samples, it also would exclude the feces of smaller grizzly bears (e.g., Mundy 1963). During a study of grizzly bear ecology in Banff National Park, Canada, we assessed fecal diameter as a criterion to differentiate black and grizzly bear feces.

Our Banff study area occupied 100 km<sup>2</sup> within a several hundred km<sup>2</sup> region of Banff National Park that, during our research program, appeared to be occupied exclusively by grizzly bears. The absence of black bears in this region was substantiated throughout 4 years of intensive field study that included the use of carcass bait stations during portions of 3 of the 4 years (Hamer et al. 1978, Vroom 1975). We do have 1 record of black bears in the study area, but this observation was attributed to a family group that had been trapped and relocated by park personnel. The family group was captured in an area of the park frequented by both black and grizzly bears and passed through the study area as

they moved from their release point back to the capture location. Because of the absence of resident black bears in the study area, we were confident that all fecal material we collected was from grizzly bears.

Feces were collected from May through October in 1976-78. For each measured feces, the diameter of the largest portion was recorded to the nearest 0.25 cm. Feces known to be from cubs (1-20 months of age) were excluded from the analysis ( $\bar{x}$  = 2.3 cm,  $N$  = 9); in addition, feces measuring <3.0 cm were assumed to be from cubs and also were excluded ( $N$  = 4). Fecal volume was measured by comparing a collected subsample (placed in a 400-ml collecting jar) to the remaining fecal volume and estimating the number of jars that the total volume would occupy.

The diameters of 104 feces were measured, giving a mean of 4.5 cm  $\pm$  0.85 (SD). Of the 104 feces, 60 (58%) measured <5.0 cm. Moreover, 43 additional feces were formless, and diameters could not be measured. Included in this category were feces composed largely or entirely of fruits (e.g., buffaloberry, *Shepherdia canadensis*) or succulent green plant material (e.g., horsetail, *Equisetum arvense*).

Our results indicate that a relatively small fraction of the total grizzly bear feces sample would have been included in our collection had we followed the 5.0 cm criterion. And if average fecal diameter increases with increasing weight of bears, then feces with diameters >5.0 cm could be from mainly the larger, perhaps adult male, members of the population. A misleading description of the food habits of the population might be forthcoming if grizzly bears, like certain other vertebrate species, display ecological partitioning of resources among polymorphic age-sex classes. Resource

partitioning in grizzly bears might be expected since male grizzly bears are substantially larger than females; Kingsley et al. (in press) report that the basal weight of mature male grizzly bears is about twice that of mature females. Our observations also suggested that fecal diameter was correlated to some degree with food item content; certain food items, according to their specific effects on fecal diameter, could be over- or under-represented in the subsample of feces  $>5.0$  cm in diameter.

Because data for black bears are not available from Banff National Park, we have not shown whether all feces with diameters  $>5.0$  cm are from grizzly bears, or whether some black bear feces also exceed this diameter. In Minnesota, fecal diameters were measured during a black bear study. Of 48 black bear feces judged to be from adult bears, 5 (10%) had diameters  $>5.0$  cm. Caution is required in interpreting these data. Differences in environmental productivity influence the average weights of bears of each species (Herrero 1978), and average fecal diameter probably increases with increasing weight of bears. Results for Banff National Park black bears would differ to some degree.

Other criteria to separate feces have been employed in regions where black and grizzly bears are sympatric. Mundy (1963) and Servheen and Lee (1979) used fecal volume as 1 criterion to differentiate the feces of black and grizzly bears. Feces with volumes  $>2.3$  liters were classified as grizzly bear. Shaffer (1971) classified as from grizzly bear those feces with diameter  $>5.4$  cm and volume  $>2.3$  liters. We estimated the volumes of 154 grizzly bear feces in Banff National Park and obtained a mean volume of  $0.9$  liters  $\pm 0.39$  (SD), indicating that the 2.3 liter criterion is invalid for the majority of grizzly bear feces in Banff National Park.

Shaffer (1971, Appendix A) also investigated the acidity (pH) of bear feces as a method of differentiation. No significant difference in the acidity of black vs. grizzly bear feces was established.

Lloyd and Fleck (1977) suggested that hairs ingested by bears during licking and groom-

ing might be subsampled from feces and used to identify the species. The authors encountered difficulty, however, in using hair characteristics to identify the species of bear (K. Lloyd, Univ. of British Columbia, pers. commun.), and in this study and a later one (K. Lloyd, M.S. Thesis, Univ. of British Columbia, in preparation), all fecal samples were lumped, and the food habits of both black and grizzly bears were treated as a single entity.

Field signs associated with feces (e.g., tracks, diggings), frequently assessed in conjunction with fecal diameter, were the only criterion used by Russell et al. (1978) to differentiate species. Because associated signs often are absent, this method may be unsatisfactory in many cases. But without direct observation of bears, no one has yet demonstrated another reliable or valid means of differentiating black and grizzly bear feces in regions of sympatry.

We thank Yolt Yzerman for field assistance. Ecological studies of the grizzly bear in Banff National Park were supported by Parks Canada, National Research Council of Canada grant No. A-6507 to S. Herrero, the University of Calgary, and the Canadian National Sportsmen's Fund.

#### LITERATURE CITED

- HAMER, J. D. W. 1974. Distribution, abundance, and management implications of the grizzly bear and mountain caribou in the Mountain Creek watershed of Glacier National Park, British Columbia. M.S. Thesis. Univ. of Calgary, Calgary, Alberta. 154pp.
- , S. HERRERO, AND R. T. OGILVIE. 1978. Ecological studies of the Banff National Park grizzly bear, Cuthead/Wigmore region, 1977. Parks Can., West. Reg., Calgary, Alberta. 50pp. (Mimeogr.)
- HERRERO, S. 1978. A comparison of some features of the evolution, ecology and behavior of the black and grizzly/brown bears. *Carnivore* 1:7-17.
- KINGSLEY, M. C. S., J. A. NACY, AND R. H. RUSSELL. 1980. Patterns of weight gain and loss for grizzly bears in northern Canada. Fifth Int. Conf. on Bear. Res. and Manage., Madison, WI. (In press.)
- KNIGHT, R., J. BASILE, K. GREER, S. JUDD, L. OLDENBURG, AND L. ROOP. 1977. Yellowstone grizzly bear investigations—annual report of