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Received: 28 May 2001.

Accepted: 29 March 2002.

Associate Editor: Immell.

PROBABLE GRIZZLY BEAR PREDATION ON AN AMERICAN BLACK BEAR IN YELLOWSTONE NATIONAL PARK

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Ursus 13:372–374 (2002)

Key words: American black bear, grizzly bear, interspecific killing, predation, *Ursus americanus*, *Ursus arctos*, Yellowstone National Park

Both grizzly bears (*Ursus arctos*) and American black bears (*U. americanus*) live in Yellowstone National Park (YNP), which is located primarily in Wyoming, USA. In areas where grizzly bears and black bears are sympatric, temporal isolation and behavioral differences likely reduce direct competition between the species (Aune 1994). In the Greater Yellowstone Ecosystem (GYE), grizzly bears are generally most active during nocturnal and crepuscular times (Schleyer 1983, Holm et al. 1999), whereas black bears are mostly diurnal (Barnes and Bray 1967, Holm et al. 1999). Grizzly bears evolved to exploit non-forested habitats, whereas black bears are primarily forest adapted (Herrero 1978). Grizzlies are also generally larger than black bears and much more aggressive in defending themselves and their offspring from conspecifics and other predators (Herrero 1978), whereas black bears typically escape predators by running into forest cover or

climbing trees (Herrero 1985).

Due to their larger body size, grizzly bears have a competitive advantage over black bears in large non-forested areas (Herrero 1977). Although displacement of black bears by grizzly bears from high quality habitat has been documented (Shaffer 1971, Kendall 1984, Aune 1994), interspecific killing of black bears by grizzly bears has only occasionally been reported (Arnold 1930, Jonkel and Cowan 1971, Murie 1981, Ross et al. 1988, Mattson et al. 1992).

We documented probable grizzly bear predation on an adult male black bear in Hayden Valley, in central YNP. Hayden Valley is a large (>8,500 ha) non-forested valley surrounded by the forested Central Plateau. Flora in the valley is dominated by sagebrush (*Artemisia* spp.) and a variety of forbs, grasses, and sedges (Meagher 1973). Numerous graminoid-dominated wetlands are present in the valley. Lodgepole pine (*Pinus contorta*) forest types that occur on infertile rhyolite soils dominate the forested plateau surrounding Hayden Valley (Despain 1990). Spruce (*Picea engelmannii*)–fir (*Abies lasiocarpa*) stands are interspersed throughout the lodgepole pine zone in areas of more favorable moisture regimes such as pond margins, north slopes, and drainages (Graham 1978). Grizzly bears are active in both the forested and non-forested areas of Hayden Valley throughout the non-denning season (Gunther et al. 1995). Black bears are mostly observed within and near the edges of the forested portions of the valley and rarely far from forest cover in the non-forested areas (Gunther et al. 1995).

On 2 August 1998 we received a report of a dead black bear on the northeast side of the Yellowstone River in Hayden Valley, across from the Grizzly Overlook interpretive sign along the Grand Loop road. We investigated

the report and found a dead adult male black bear in tall sedges on the bank of the river, 174 meters from the road. Field inspection of the carcass revealed that the dead black bear had canine puncture wounds to the head and nose as well as a crushed skull and left eye orbital. The penis, baculum bone, and testicles were bitten off and found next to the carcass. There were canine marks on the scrotum, and the left hind quarter was partially consumed. The carcass had not been buried. Two fresh scats containing vegetation were observed next to the carcass and near (<3 meters) the partially consumed hind quarter. The predator that scavenged and likely killed the black bear probably defecated these scats while feeding on the carcass. We collected the black bear carcass for necropsy to determine cause of death and to obtain evidence as to the species of predator that killed it. We collected the scats found next to the dead black bear for DNA analysis to confirm the species of the predator.

Laboratory necropsy indicated the dead black bear had been in fair to good physiologic condition given the time of year (kidney fat index measured 24%), and no evidence of disease was observed. The carcass (minus the eaten tissue) weighed 77.6 kg. Based on body size and condition, we estimated that the black bear probably weighed approximately 91 kg prior to being partially consumed. The hide and musculature of the left side of the head were torn away, exposing a portion of the skull. The left zygomatic arch was shattered and bone fragments were missing. A puncture wound had penetrated the skull ventral and posterior to the orbital process. Numerous puncture wounds were observed in the hide surrounding the head, but no damage was noted to the neck. Although several ribs on the left side of the thoracic cavity were broken, the lack of hematoma and tissue damage to that region indicated that the damage occurred post-mortem. Much of the tissue surrounding the left hind quarter and a portion of the large intestine had been eaten. The cause of death was determined to be trauma to the head.

The large number of puncture wounds inflicted to the bear's head made it difficult to locate a matching pair of canine puncture marks. However, one set of marks believed to be caused by the lower canines was observed near the right mandible. The center-to-center distance of these canine puncture marks was 59 mm, typical of average size, adult male grizzly bears in the GYE. In grizzly bears, lower canine widths range from 35 to 66 mm (\bar{x} = 53 mm, SD = 6 mm, n = 35). Based on measurements taken from reference skulls, a lower canine width of 59 mm is too large to have been inflicted by even a large black bear, wolf (*Canis lupus*), or mountain lion (*Felis concolor*) from the GYE. The distance between lower canines range from 37 to 55 mm (\bar{x} = 45 mm, SD = 4 mm, n = 31) in black bears, 35 to 48 mm (\bar{x} = 40 mm, SD = 3

mm, n = 33) in wolves, and 29 to 41 mm (\bar{x} = 35 mm, SD = 4 mm, n = 56) in mountain lions. Predation by wolves can be further ruled out because in 1998, wolves had only recently been reintroduced to YNP and no wolves had yet established territories in Hayden Valley (Smith et al. 1999). Predation by a mountain lion is not likely either. In YNP, mountain lions typically inhabit Douglas-fir (*Pseudotsuga menziesii*) and spruce-fir forest types containing numerous rocky canyons and outcrops (T. Ruth, Hornocker Wildlife Institute, Gardiner, Montana, USA, personal communication, 2001). The kill site was located in a large, non-forested valley bottom without these features, not typical of mountain lion habitat in YNP. Based on canine widths alone, we cannot completely rule out predation by a black bear because it is possible that an exceptionally large, old adult male black bear in YNP might have a 59-mm lower canine width. However, the identification of the predatory bear as a grizzly based on canine widths was also supported through laboratory analysis of DNA extracted from the bear scats collected at the kill site. DNA extraction and species identification using mitochondrial DNA fragment analyses (Murphy et al. 2000) unambiguously identified the scats collected next to the dead black bear as being from a grizzly bear.

The availability of trees as a means of escape through climbing or hiding was an important selective force in the evolution of black bears (Herrero 1977, 1978, 1985). In this incident, no tracks were left in the lush grass to enable us to determine the events that led to the black bear being killed. Therefore, we do not know if the black bear was stalked, ambushed, or chased to the kill site. There were no ungulate carcasses nearby that would have attracted multiple large carnivores to the area. To reach the potential security of a climbable tree to escape from the kill site, the black bear had 3 options. The nearest climbable tree was a dead snag 72 meters west of the kill site, on a small island (0.21 ha) in the Yellowstone River. The black bear would have had to swim and run through the river for 68 meters and run 4 meters on land to reach the snag. The nearest climbable, live trees were in a small (1.2 ha) stand, 129 meters to the southwest, and on the shore opposite from where the black bear was killed. To reach these trees the black bear would have had to swim and run through the river for approximately 118 meters and run 11 meters on land. The nearest climbable trees that could be reached without swimming were approximately 900 meters northeast and uphill from the kill site. These trees were also the nearest contiguous forest large enough to potentially have provided escape or hiding cover.

In areas where grizzly bears and black bears are sympatric, differences in morphology, behavior, food preferences, and habitat selection (Herrero 1978) generally allow

each species to exploit different subniches and coexist within common geographic areas (Aune 1994). Holm et al. (1999) reported overlap in home ranges of black and grizzly bears in the GYE. In that study, black bears included more forested habitats within their home ranges, whereas grizzly bears selected more nonforested habitats (Holm et al. 1999). Gunther et al. (1995) reported overlap in areas of activity of grizzly and black bears throughout most of YNP, but reported that black bears were seldom observed far from forest cover in large non-forested areas such as Pelican (Gunther 1991) and Hayden Valleys. Black bears may underutilize large non-forested areas due to habitat and food preferences (Aune 1994) or to avoid potentially aggressive interactions with grizzly bears, wolves, and coyotes (*C. latrans*; Herrero 1985). Our observation of interspecific killing gives insight into (1) potential selective pressures that may influence the distribution of black bears, and (2) subniche separation between black bears and grizzly bears in YNP.

ACKNOWLEDGMENTS

We thank G. Holm and an anonymous reviewer, as well as Editor R. Harris for comments that improved this manuscript. D. Smith and K. Murphy provided additional carnivore reference skulls. D. Ireland, T. Ruth, and T. Schock assisted with measurements of canine widths from reference skulls.

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Received: 30 July 2001.

Accepted: 21 February 2002.

Associate Editor: Harris.