

Wolf, *Canis lupus*, Predation and Maternal Defensive Behavior in Mountain Goats, *Oreamnos americanus*

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Four attacks by single Wolves on Mountain Goats were observed at Caw Ridge, Alberta, during July and August 1995. One Wolf killed a yearling female and an adult female successfully defended her kid against an adult Wolf. In 206 agonistic encounters between kids and older Goats, mothers defended their kids only five times. These results do not support the hypothesis that maternal defense against conspecifics is common in Mountain Goats but demonstrate that females can defend kids against predators.

Key Words: Wolf, *Canis lupus*, Mountain Goat, *Oreamnos americanus*, predation, maternal defensive behavior, Alberta.

Wolves (*Canis lupus*) and Mountain Goats (*Oreamnos americanus*) both inhabit the Rocky Mountains in Alberta, Canada (Mech 1970; Rideout 1978). Wolves are known to prey upon Mountain Goats opportunistically but goats are usually a rare prey (Smith 1986; Huggard 1993; Festa-Bianchet et al. 1994; but see Fox and Streveler 1986). Huggard (1993) observed that Mountain Goats represented <2% of the biomass consumed by two Wolf packs in summer and 0.2% in winter in Banff National Park, Alberta. Peterson et al. (1984) reported that, although Mountain Goats were present in their study area on the Kenai Peninsula (Alaska), they were absent from the Wolf diet. Inaccessibility of goat range (Rideout 1978) and the potential risk presented by the very sharp horns of Mountain Goats (Geist 1967; Nelson and Mech 1985) could explain the scarcity of reports of Wolf predation on goats.

Offspring maternal defense against predators has been reported for several large ungulate species [Bighorn Sheep (*Ovis canadensis*): Hornocker 1969, Berger 1978; Buffalo (*Syncerus caffer*): Schaller 1972; Chamois (*Rupicapra pyrenaica*): Locati 1990; Moose (*Alces alces*): Stephenson and Van Ballenberghe 1995; Mule Deer (*Odocoileus hemionus*): Hamlin and Schweitzer 1979; Muskoxen (*Ovibos moschatus*): Gray 1987; Pronghorn (*Antilocapra americana*): Lipetz and Bekoff 1980; Thomson's Gazelle (*Gazella thomsonii*): Estes 1991; White-tailed Deer (*Odocoileus virginianus*): Smith 1987; Wildebeest (*Connochaetes taurinus*): Kruuk 1972; Zebra (*Equus burchelli*): Schaller 1972]. For Mountain Goats, Brandborg (1955) first suggested that maternal defensive behavior was important in defense against conspecifics, and could also be against predators. To our knowledge, however, there are no direct reports of maternal defense against predators by Mountain Goats. Geist (1971, 1974) stated that maternal protection of kids against conspecifics is common and necessary in Mountain

Goats because of frequent juvenile and adult aggression but no study has presented quantitative evidence of such behavior. Here we examine maternal defensive behavior of Mountain Goats against conspecifics and against predators and report a direct observation of predation of a Wolf on a goat.

Interspecific observations

During a study of Mountain Goats in west-central Alberta, Canada, we observed a female goat defend her 4-month-old kid against an adult Wolf. We also observed a Wolf kill a 15-month-old female. The events reported here occurred on Caw Ridge (54°04'N, 119°25'W), a gently rolling mountain complex in the front range of the Rocky Mountains.

On 30 August 1995, we observed a group of 40 goats (38 were marked) and 12 kids foraging in an open slope at about 2010 m altitude. They were approximately 100 m from timberline when, at 12:55, two adult Wolves (one gray and one completely black) ran out of the forest and chased the goats uphill for 300 m to the closest rocky cliff. The Wolves did not get closer than 40–50 m from the goats before they reached the cliff. At 13:02, the gray Wolf approached the goats at the bottom of the cliff and, after a few attempts, grabbed goat Number 166, a 3-month-old male kid of 23 kg marked 2 weeks before. As soon as the Wolf pulled the kid down the rocky ledge, the kid's mother (Number 23, a 7-year-old first marked as a kid) jumped down and charged the Wolf. She hit it twice on the rump and missed it on an other attempt. The Wolf released Number 166 and both mother and kid fled to the cliff to join the other goats. Three other adult goats then charged the Wolf and forced it to retreat. Number 23 apparently did not injure the Wolf which returned to join the other Wolf about 150 m away. The goats then disappeared to the other side of the escape terrain followed at about 200 m by the two Wolves that skirted round the cliff.

At 16:15, the group of goats came back to feed on the same slope they had used in the early afternoon. At 17:16, the same gray Wolf (as determined by its coloration) appeared alone at the top of the ridge and started pursuing the goats that ran toward a rocky cliff. As the Wolf approached the base of the cliff, the last three goats changed direction and started to run toward the forest. The Wolf caught up to the goats and grabbed the smallest one (a marked yearling female) by a hindleg but the goat escaped and kept running towards the forest. The Wolf recaptured the goat by the same hindleg while running downhill and they rolled together 15 m downslope. The goat got up again but was quickly caught at the throat and knocked down by the Wolf. The goat managed to stand and escape once again but was again recaptured, bitten at the throat, and died in <3 min. The Wolf then disappeared in the forest (<20 m away) for 5 min. It came back to the carcass at 17:36 and dragged it into the forest out of sight. At 17:44, the other goats started to bed in the cliff. Goat Number 75 (the mother of the yearling which had been killed) looked for several minutes at the site where the Wolf had disappeared and was the last goat to bed. She had not attempted to defend the yearling.

We documented two other Wolf attacks on goats in 1995. On 11 July, an adult Wolf attacked a group of 63 goats including 16 kids feeding in an open forest at 1920 m but was unsuccessful. On 20 August, a juvenile Wolf chased a group of 84 goats including 20 kids that were foraging at about 400 m from a steep rock face but the goats ran to the cliff and the Wolf never got closer than 30 m to them.

Another case of antipredator defense behavior was observed on 9 June 1994 in the same goat population. M. Festa-Bianchet and S.D.C. observed a Wolverine (*Gulo luscus*) near a group of 15 goats feeding below a ledge close to timberline. At this time, kids were only 1 to 2-weeks-old and therefore vulnerable to predators. Number 35, a 5-year-old female, ran towards the Wolverine and drove it away. This female did not have a kid.

Intraspecific observations

We sampled agonistic encounters involving kids between May and September 1995 and 1996. In 249.9 h of focal observation periods (Altmann 1974), we observed kids 3591 times within <4 m of goats other than their mothers or other kids. Kids were displaced by older goats in 206 (5.7%) of these encounters. Adult females, subadult females (1 and 2-year-old), and subadult males (1 and 2-year-old) were responsible for 63.9%, 30.3%, and 5.8% of these agonistic interactions, respectively. The mother intervened and defended her kid only five times (once against an adult female, once against a 2-year-old female, once against a yearling female which was the kid's sister, and twice against unclassified

individuals), suggesting that defense against conspecifics is rare.

Discussion

Our observations suggest that female Mountain Goats can protect their young against large predators but that goats may be vulnerable when far from escape terrain (Geist 1971; Rideout 1978; Smith 1983). Since 1989, 19 marked goats were known to have been killed by predators at Caw Ridge, including six taken by Wolves (Festa-Bianchet et al. 1994; Côté et al., unpublished data). Even if, in general, Mountain Goats appear not to be a common prey of Wolves (Smith 1986; Huggard 1993), Fox and Streveler (1986) reported that 62% of 124 Wolf scats collected in southeastern Alaska contained goat remains. Most goat populations in west-central Alberta are small (40–50 individuals [$\bar{x} = 44$] inhabiting defined home range with very little immigration and emigration) and have a very slow rate of increase (Smith 1988). It may only takes one pack that specializes on goat predation to cause an important increase in the yearly mortality of a goat population. If a Wolf pack killed ten goats during a winter, it could reduce population numbers by as much as 20–25%, as has been suggested for Cougar (*Felis concolor*) predation on Bighorn Sheep (Wehausen 1996; Ross et al., submitted). Therefore, it appears important to consider the possibility of individual Wolf packs specializing on goat predation when managing Mountain Goat populations.

The role of maternal defensive behaviour against conspecifics appeared much less important in our study population of Mountain Goats than suggested by Geist (1971, 1974). During 206 encounters, the female defended her young only five times. We observed just four cases where older goats used horn contact to displace a kid and each time the goat pushed the kid harmlessly instead of rushing it, suggesting little need for maternal defense. Furthermore, other researchers observed that kids were less commonly attacked by other goats than adult females and juveniles (Chadwick 1977; Dane 1977). In a winter study of goats at a baiting site, Masteller and Bailey (1988) observed that an orphan kid received much aggression, while kids with their mothers received few threats. Therefore, it appears that kids may be sheltered from many interactions by their mother (Singer 1977). This suggests that, even if kids are rarely defended against aggressors, they receive some protection just by being close to their dam (Chadwick 1977).

In our study, subadult males performed only 5.8% of the agonistic interactions received by kids. Similarly, Chadwick (1977) found that interactions with 2-year-old males accounted for only 13% of the kids' total number of social interactions. These results do not support Geist's (1974) hypothesis that

female Mountain Goats protect their kids against conspecifics and especially against subadult males. Therefore, there appears to be little selective pressure for maternal defense against conspecifics in goats (*see* Maestripieri 1992 for a review of maternal defense in mammals). No maternal defense against conspecifics was observed in studies of Bighorn Sheep (Geist 1971), Apeninne Chamois (Locati and Lovari 1990) and Muskoxen (Gray 1987). However, all our observations were conducted in summer when resources were abundant, and we might have reached different conclusions if it would have been possible to observe the goats during winter. When snow is deep, resources are scarce, rates of aggression increase (Petocz 1973), and kids feed in craters dug by their mothers (Chadwick 1977). They may at this time receive more protection from their dam.

Maternal defense in Mountain Goats seems to be used only in extreme situations such as defense against predators (Holroyd 1967; this study). Such behavior has been reported in several species of large ungulates (Packer 1983) and is likely to be selected even if it prevents offspring predation only a few times during the lifetime of a female.

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