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MOUNTAIN GOAT HABITAT OF WYOMING'S BEARTOOTH PLATEAU: IMPLICATIONS FOR MANAGEMENT

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Abstract: From 1989 to 1991 characteristics of mountain goat (Oreamnos americanus) habitat were investigated on the Beartooth Plateau in northwestern Wyoming. Habitat information was gathered by observing non-radioed goats and by relocating 2 radio-collared goats. The potential bias of using observations versus radio telemetry are discussed. Habitat characteristics examined were cover type, slope, aspect, distance to cliff, elevation, and terrain. The data were analyzed using the use/availability technique. Just as in other areas, mountain goats on the Beartooth Plateau used cliffs and steep rocky slopes >75% as their primary habitat. They were usually within 402 m (1/4 mi) of cliffs and used the top half of slopes more than they were available. The goats did not exhibit a preference for aspect or elevation. Parturition areas, distribution, and movements are also discussed. Literature pertaining to mountain goat management and their sensitivity to human access and disturbance is reviewed. Finally, management recommendations are made for the major land uses: timber, minerals development, livestock operations, and recreation.

This study focused on habitat use and distribution of mountain goats on the Beartooth Plateau in northwestern Wyoming. Objectives were to: (1) supplement Hanna's (1989) information on goat distribution over the study area, (2) determine general mountain goat habitat selection patterns, (3) identify parturition (birthing) areas, (4) make a thorough literature review to compare results of this study to others, and (5) make management recommendations regarding livestock distribution, timber harvest, recreation, and petroleum exploration and development in relation to mountain goat habitat.

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STUDY AREA AND METHODS

The Beartooth Mountain range is located in southwestern Montana and northwestern Wyoming. The majority of the range is in Montana. Part of the range known as the Beartooth Plateau extends into Wyoming. The study area encompassed the Wyoming Beartooth Plateau south of Highway 212 and the eastern edge of the Line Creek Plateau in Montana (Fig. 1). The

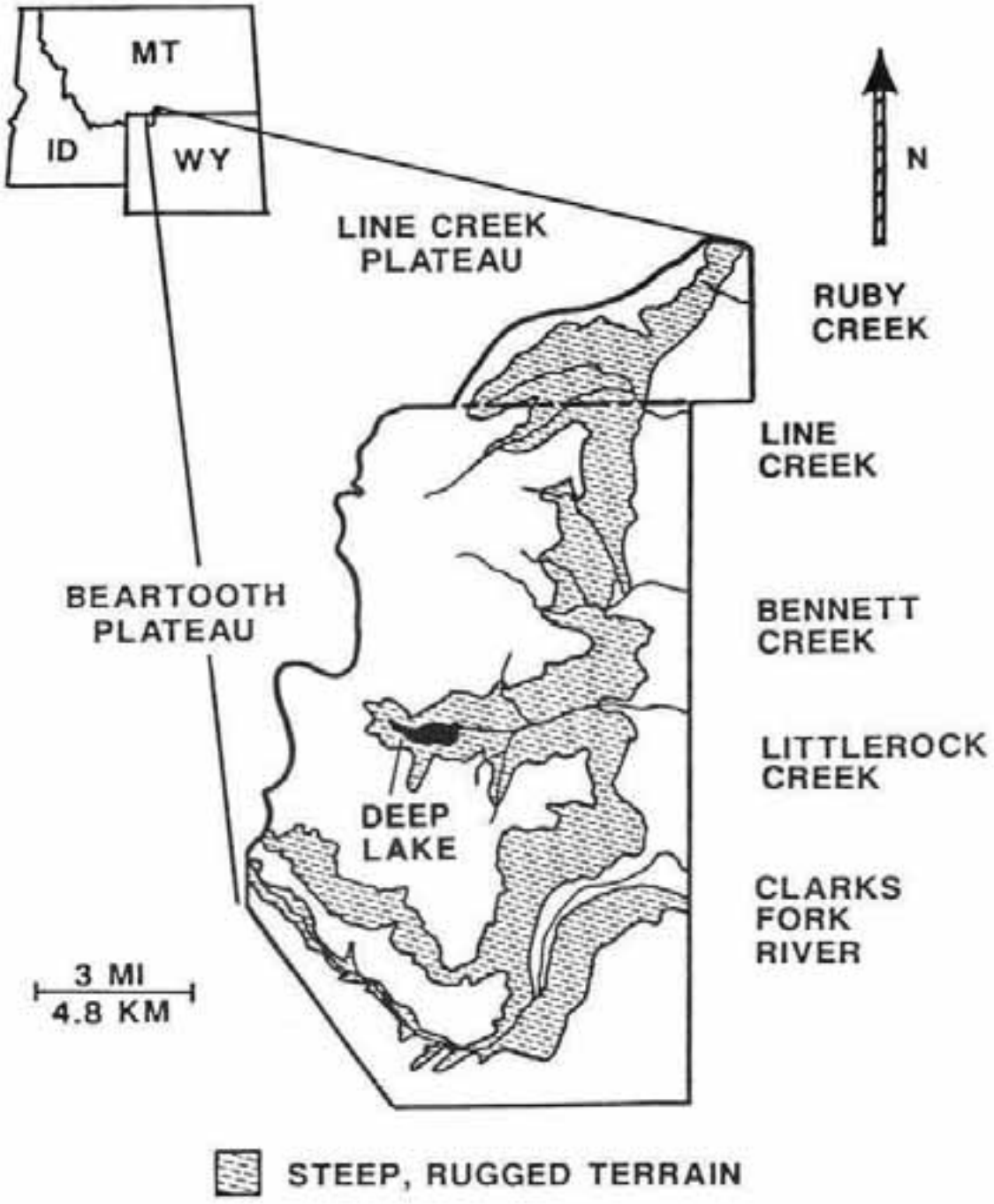

Fig. 1. Study area, Beartooth-Line Creek Plateau, Wyoming and Montana

southern boundary of the study area was the Clarks Fork of the Yellowstone River (hereafter referred to as the Clarks Fork). The western boundary was Thief Creek. There are four major drainages in the study area: the Clarks Fork River, and Little Rock, Bennett, and Line creeks. The study area is primarily used for sheep and cattle grazing and for dispersed recreation: hunting, fishing, backpacking, and horse-pack trips. It is open to lease for petroleum exploration and development.

The climate and vegetation on top of the Beartooth are alpine and are very similar to the Arctic (Billings 1988). Due to the wind, much of the study area, such as the lower part of the Clarks Fork Canyon, is often snow-free in winter. Vegetative composition is diverse ranging from alpine tundra near permanent snow fields on the top of the plateau to prickly pear (Opuntia spp.) and Yucca spp. at the bottom of Clarks Fork Canyon.

Two nannies were captured on Line Creek and radio collared in July 1989. They were stalked on the ground and darted with a Zoolu Arms Simmons rifle using a 3 cc Palmer Dart. In both cases 3.5 mg of Carfentanil were used and the antagonist was 25 mg of Xylazine. Seven more capture attempts were made in July 1989 and March 1990, all unsuccessful. Attracting goats to salt blocks was tried, but apparently these goats were not as attracted to salt as other populations. They were seen licking the salt (Jon Hanna, Wyo. Game and Fish Dep., pers. commun.), but not with any regularity or pattern. This may indicate there is adequate salt in their forage (Fox et al. 1989) or that it takes time for them to become habituated to artificial salt.

Goat number 3 was a 3-year-old and she had 1 kid of the year when she was collared. Number 0 was a 2-year-old and had no kids. They were relocated by air once or twice per month from August 1989 to September 1990 and once every several months thereafter by Western Air Research, Inc., a company specializing in wildlife telemetry flights. The flights were in a Maule M5-235C fixed-wing aircraft equipped with Yagi antennae on each wing strut, an on-board Loran navigation system, and a computer with which the pilot logs telemetry coordinates, date, weather, and other information.

In addition to the radioed goats, other goats were located during the course of the study. From August 1988 to August 1990, 29 trips were made to the study area, each trip varying from 1-5 days, and 329 goats were observed. Each group of goats seen was counted as 1 location, if they were together such that their location could be identified by 1 small dot or circle on a map. These goats were assumed statistically dependent. This was especially true with nannies with kids. Therefore, the 329 goats observed resulted in 120 locations. The same goat or group of goats was never counted twice in 1 day. If there was any doubt, the observation was not used.

There were days when few or no goats were located due to logistical problems and bad weather (fog, rain, hail, and snow, even in mid-summer). Most of the trips to locate goats were made in the spring, summer and fall, with an intensified effort made during spring and early summer 1990 to identify birthing areas. The entire study area was covered as much as

possible to determine goat distribution and gather habitat-use data throughout the study area.

Goats were located using 8 X 35 binoculars and a 15-60 power spotting scope. Locations were photographed and plotted on 7.5-minute USGS topographic quadrangle maps. Date, time, weather, activity, goat age-sex classification (if possible), and cover type were recorded. Cover-type classifications were divided into 3 categories: cliff-rock-talus, grass-forb-shrub, and forest-krummholz. Categories were limited to these simple types, because this was the limit of detail that could be determined from aerial photographs for the comparative random points.

Several topographic characteristics were determined later from maps. These were slope, aspect, terrain, elevation, and distance to cliff. From a combination of slope values listed in the literature and from goat observations, cliff was defined as a rocky substrate with a slope $\geq$ 100%. Slope categories were 0-24%, 25-49%, 50-74%, 75-99%, and $\geq$100%. Aspect was divided into 8 categories: north, northeast, east, southeast, etc. Terrain categories were flat/ridgetop, top half of slope, and bottom half of slope/valley. Elevation was divided into 7 categories of 305 m (1000 ft) each between 1220 m (4000 ft) and 3355 m (10,999 ft). Distances to cliff were 0-402 m (0-0.25 mi), 402-805 m (0.25-0.50 mi), and >805 m (>0.50 mi). The "use/availability" technique, including Bonferroni Z analysis, was used to analyze habitat and topographic data (Neu et al. 1974, Marcum and Loftsgaarden 1980, Byers et al. 1984). The P level was 0.05 for all tests.

Regarding bias, there were 2 choices: (1) either use the 2 radioed goats and assume they represented the population or (2) use primarily the observed goats and have the potential of under-counting habitats in which they are not easily visible, such as forested areas. The latter route was chosen for 2 reasons: first, assuming that 2 radioed goats represented the population was a very weak assumption, and the small sample size would have further complicated analysis. Second, the radio locations, either from the ground or the air, were not accurate enough to determine detailed habitat-topography use. The Loran locations from the air were as much as 800 m (0.5 mi) from the actual location, if the goat was observed. On the ground, there was too much signal bounce off rocks to identify locations without visual verification. Smith (1976) had the same difficulty. Radio locations were not used unless a visual observation was made, because vegetation, slope, and aspect can change drastically within a few meters (i.e., extreme patchiness of habitat-topography). As a result, the radio locations were almost as vulnerable to observability bias as the general ground locations. In summary, the larger sample size associated with observed goats, even with the possibility of underestimating goats' use of forested habitats, was considered better than using the small sample size and potentially erroneous data from the radio-telemetered goats. If radioed goats were located visually from the ground or air, however, those locations were added to the data pool.

Johnson (1980) concluded that organisms select habitats in a hierarchical manner; what a researcher determines as available can greatly affect the outcome of use/availability analysis. He suggested that the order of selection varies from geographical range down to food items

available at a feeding site. He contended that animals select habitat components only after they select a home range within a geographical range, because a home range contains all the habitat components an animal needs to survive and reproduce. Only then can a researcher look at the relative importance of habitat components. Unfortunately, home ranges of unmarked goats could not be determined and sample sizes were insufficient for radioed goats. Therefore, the availability of habitat variables over the entire study area were examined to at least determine general selection patterns on a study area-wide basis. The null hypothesis was:

> H_o: Mountain goats on the Beartooth Plateau utilize habitat characteristics in proportion to their availability (i.e., "no difference" in use) on the study area.

Since goats on the Beartooth live on a plateau incised by canyons rather than the more typical mountain-valley goat habitat, patterns of goat use of habitats in the Beartooth were compared to goat use of habitats in other areas. If patterns of use were similar, the available literature could be used to make management recommendations.

RESULTS AND DISCUSSION

Habitat Analysis

Chi-square.--Elevation was the only characteristic for which the null hypothesis was not rejected (Table 1). The null hypothesis of "no difference" between goat locations and random points was rejected for the other habitat attributes.

Table 1. Summary of Chi-Square analyses between goat locations (used) and random points (available) for 6 attributes of mountain goat habitat in northwestern Wyoming

Attributes	Chi-Square	DF	P	Reject H_o
Cover type	64.679	2	0.000	yes
Aspect	20.158	7	0.005	yes
Distance to cliff	83.418	2	0.000	yes
Terrain	35.001	2	0.000	yes
Elevation	10.852	6	0.193	no
Slope	88.357	4	0.000	yes

Use/availability analysis.--Of the 3 cover types, only cliff-rock was used by goats more than its availability (Table 2). Grass-forb-shrub was used less than its availability probably because large expanses of the study area are grass-forb-shrub. Goats use and require this type, both on

alpine and grassland ranges, for forage (Fox 1983). However, its use is limited by distance from steep terrain. These results probably reflect the use of the entire study area instead of home ranges for the availability analysis. One cannot necessarily conclude that a component is of little value, just because it is used less than it is available (Johnson 1980).

Table 2. Use and availability of 3 cover types by mountain goats in northwestern Wyoming

Cover type	Proportion available (P_i)	Proportion used for P_i	Confidence interval	Selection[a]
Cliff-rock	0.125	0.625	$0.519 \leq P_1 \leq 0.731$	+
Grass-shrub	0.475	0.233	$0.141 \leq P_2 \leq 0.326$	-
Forest-krummholz	0.400	0.142	$0.065 \leq P_3 \leq 0.218$	-

[a]The + sign means that the proportion used is greater than the proportion available, the - sign means proportion used is less than available, and 0 refers to no difference.

Forest-krummholz was also used less than available, probably due to observation bias (Foster 1982). Goats probably use forest-krummholz as travel corridors between cliffs and for forage in the understory (Brandborg 1955, Chadwick 1973). However, in interior populations, research has shown they do not use forested areas nearly as much as cliff-rock-talus (Chadwick 1973, Thompson 1980).

Three categories of slope were used less than available: 0-24%, 25-49%, and 50-74% (Table 3). Goats used 75-99% and ≥100% slope categories more than available in their habitat. Goats were located on cliffs or within 402 m (0.25 mi) of cliffs much more than they were available (Table 4). Goats used distances to cliff 402-805 m (0.25-0.50 mi) and >805 m (0.50 mi) less than they were available. They used flat-ridge top and bottom half of slopes less than available, and used the top half of slopes more than available (Table 5).

Even though mountain goats on the Beartooth Plateau appeared to use various aspects in a manner other than random (Table 1), they did not show a preference for any one aspect (Table 6). This may be due to the physical nature of the study area. Drainages which form the cliffs flow in several directions. The Clarks Fork of the Yellowstone River, for example, enters the study area flowing southeast, makes a horseshoe bend, and then flows northeast. Little Rock Creek flows almost due east, but it has steep side canyons which flow north. Every canyon has steep cliffs on opposing sides, and goats seemed to utilize almost every available cliff regardless of aspect.

Table 3. Use and availability of 5 slope categories by mountain goats in northwestern Wyoming

Slope	Proportion available (P_i)	Proportion used for P_i	Confidence interval	Selection[a]
0 - 24%	0.467	0.142	$0.060 \leq P_1 \leq 0.224$	-
25 - 49%	0.250	0.092	$0.024 \leq P_2 \leq 0.160$	-
50 - 74%	0.192	0.100	$0.029 \leq P_3 \leq 0.170$	-
75 - 99%	0.058	0.167	$0.079 \leq P_4 \leq 0.254$	+
≥ 100%	0.033	0.500	$0.382 \leq P_5 \leq 0.618$	+

Table 4. Use and availability of 3 distances to cliff by mountain goats in northwestern Wyoming

Distance to cliff m (mi)	Proportion available (P_i)	Proportion used for P_i	Confidence interval	Selection[a]
0 - 402 (0 - 0.25)	0.383	0.933	$0.879 \leq P_1 \leq 0.988$	+
402 - 805 (0.25 - 0.50)	0.225	0.058	$0.007 \leq P_2 \leq 0.110$	-
> 805 (> 0.50)	0.392	0.008	$-0.012 \leq P_3 \leq 0.028$	-

[a]The + sign means that the proportion used is greater than the proportion available, the - sign means proportion used is less than available, and 0 refers to no difference.

The same is true for elevation. Line Creek carves the plateau at 3050 m (10,000 ft); the Clarks Fork carves a lower terrace at 1769 m (5800 ft). Therefore, the lack of a clear pattern suggested by the Chi-square analysis may be due to the propensity for goats to select cliffs wherever they occur. Other studies indicate a variety of aspect and elevational preferences (National Council of the Paper Industry for Air and Stream Improvement 1989), probably due to the unique topographic characteristics of each study area.

In summary, the 4 characteristics which seem to be "preferred" by goats in the use/availability analysis all pertain to steep, rocky slopes and cliffs. The characteristics are slopes ≥75%, top half of slope, cliff-rock-talus cover type, and 0-402 m (0-0.25 mi) distance from cliff. The use of cliffs by mountain goats on the Beartooth Plateau in Wyoming is

Table 5. Use and availability of 3 terrain categories by mountain goats in northwestern Wyoming

Terrain	Proportion available (P_i)	Proportion used for P_i	Confidence interval	Selection[a]
Flat/ridge top	0.308	0.175	$0.092 \leq P_1 \leq 0.258$	-
Top half of slope	0.225	0.600	$0.493 \leq P_2 \leq 0.707$	+
Bottom half of slope & valley	0.467	0.225	$0.134 \leq P_3 \leq 0.316$	-

Table 6. Use and availability of 8 aspect categories by mountain goats in northwestern Wyoming

Aspect	Proportion available (P_i)	Proportion used for P_i	Confidence interval	Selection[a]
North	0.042	0.117	$0.036 \leq P_1 \leq 0.197$	0
Northeast	0.067	0.100	$0.025 \leq P_2 \leq 0.175$	0
East	0.217	0.117	$0.036 \leq P_3 \leq 0.197$	-
Southeast	0.242	0.300	$0.185 \leq P_4 \leq 0.415$	0
South	0.125	0.192	$0.093 \leq P_5 \leq 0.290$	0
Southwest	0.183	0.067	$0.004 \leq P_5 \leq 0.129$	-
West	0.075	0.033	$-0.012 \leq P_6 \leq 0.078$	0
Northwest	0.050	0.075	$0.009 \leq P_7 \leq 0.141$	0

[a]The + sign means that the proportion used is greater than the proportion available, the - sign means proportion used is less than available, and 0 refers to no difference.

very similar to goat habitat selection in almost all other ranges that have been studied (National Council of the Paper Industry for Air and Stream Improvement 1989).

It is safe to conclude that, just as mountain goats in other ranges, goats in the Beartooth require cliffs and steep rocky terrain associated with alpine and subalpine vegetation. This is a general, macro, study-area wide conclusion, and there is still much to be learned about how

mountain goats use micro areas within their home ranges on the Beartooth.

Distribution and Movements

Mountain goats were distributed in almost all available cliff habitats in the study area, with the exception of the southeast, south, and southwest slopes of Clarks Fork Canyon. Although the majority of observations were in the spring and summer, drastic changes in areas of goat use were not observed seasonally. Many of the aerial locations of goats were not used in the statistical analysis, especially in winter, due to the potential telemetry error mentioned previously. Therefore, sample sizes were too small to analyze the data seasonally. However, general observations on flights revealed that goats used some areas yearlong. Goats that wintered with radioed goat number 3 spent both winters at high elevations on Line Creek and "Middle" Line Creek, in the same places they used in the summer. Goat number 0 initially made a significant move from her capture site on Line Creek to Deep Lake, which may have been a response to capture stress. She spent the first winter, 1989-1990, in what was commonly thought to be summer range only, on the south side of Deep Lake. Although some goats do seem to shift to higher elevations in the summer, many remain low or travel occasionally to lower elevations, as number 3 did in early August when she moved to the base of Bennett Creek.

Some mountain goats that have been studied on other ranges make changes in areas of use, elevation, and/or aspect on a seasonal basis (Smith 1976, Nichols 1985). Other populations show little change between seasons (Chadwick 1973), and within populations both extremes can be exhibited. Nichols (1985) reported movements as far as 68 km (42 mi) between ranges (associated with billies) in Alaska, and yet had a female that spent 4 years on the same ridge, summer and winter. Nichols' (1985 p.11) comment sums it up: "Herd movements between winter and summer ranges may be generalized, but individual variations occur, and it is not always possible to predict where individual goats can be found or when they might be present in a particular area."

Parturition Areas

Although number 3 spent the majority of time near Line Creek and "Middle" Line Creek, she made movements to other drainages, such as North Bennett Creek and, unexpectedly, to Ruby Creek in Montana, approximately 8 km (5 mi) away. Previously, few sightings had been reported in Ruby Creek. In 1990 she had twin kids there. Nannies often select isolated cliffs away from other goats to have their young (Chadwick 1973). Ruby Creek and similar isolated rocky areas may be parturition areas. Number 3 was also relocated in Ruby Creek once each winter.

Nannies with newborn kids were located the first week in June on Line Creek and "Middle" Line Creek. It is not known whether parturition actually took place there or, like goat number 3, they moved back there shortly after delivering their kids in more isolated, secluded spots. The only parturition area identified with some degree of confidence is Ruby Creek.

Areas where there are concentrations of nannies and kids after

parturition are sometimes called nursery areas. Such concentrations were noted on Line Creek, "Middle" Line Creek, the south side of Deep Lake, and the big cliff face on the north side of the mouth of Clarks Fork Canyon. However, since I was not able to survey all the areas in the early summer, there may be other nursery areas not yet identified.

Mountain Goat Management

Human Disturbance, Hunting, and Roads.--Many wildlife biologists believe goats are particularly sensitive to human disturbance (Smith 1976, Geist 1978, Chadwick 1983, Penner 1988). Goats do not survive well in captivity and are not common in zoos (Rideout 1978). In protected, unhunted populations, such as those in national parks, they seem to adapt to humans, especially when humans are a source of salt (Geist 1971). However, even without overt responses to human interaction, animals may have physiological effects, such as increased heart rates (McArthur et al. 1979).

Mountain goats have become increasingly desirable as trophy animals. In mountain goats it has been shown that hunting mortality may be more additive than compensatory, as with other ungulates (Kuck 1977, 1985). That is, goats do not increase productivity to offset mortality. Therefore, they must be hunted and managed very conservatively.

Roads, often built for development activities, increase the level of general human disturbance and are very much the key to illegal and legal hunter harvest levels. Several herds or populations have declined after increased access and disturbance following development (Brandborg 1955; Quaedvileig et al. 1973; Chadwick 1973, 1983; Foster 1977; Pendergast and Bindernagel 1977; Phelps et al. 1983; Joslin 1986). "Motorized access in or near mountain goat habitat is probably the single biggest threat to goat herds throughout North America" (Joslin 1980 p.3).

Land Management Recommendations.--For land management purposes, mountain goat "crucial range" was mapped on the Shoshone National Forest according to the following criteria: slopes >75%, foraging areas and travel corridors in between steep slopes, and foraging areas within 402 m (0.25 mi) of the tops of cliffs. "Crucial range" for mountain goats on the Beartooth is similar to "occupied yearlong mountain goat habitat" defined by Gorman et al. (1984).

Every season and every goat-use site is important on the Beartooth, because mountain goat habitat is limited, goats do not move or disperse to different areas seasonally, and conditions for survival and reproduction are severe. For many ungulates, summer is not a crucial time, because they are widely dispersed and summer range is not limited. The same is not true for goats. Summers are extremely short, and it "is the summer range...which sustains the population from year to year" (Joslin 1980 p.62), i.e., in 3 or 4 months goats must garner enough physiological resources to prepare and sustain them for the long winter, as well as reproduce. They must do so on the same ranges they occupy year around. Obviously, winter is a crucial time for goats, because it often lasts 8 to 9 months and is metabolically demanding. Therefore, the following management recommendations apply to "crucial range" year around:

1. Timber Harvest. Goats use forested areas as travel corridors between cliffs and for forage (Brandborg 1955, Chadwick 1973, Fox et al. 1989). Chadwick (1973) found that goats either used logged areas less frequently or abandoned them completely.

   Recommendations: (1) There should be a buffer zone of 402-805 m (0.25-0.50 mi) adjacent to goat habitat where no logging activity or road building takes place (Smith 1976, Fox et al. 1989). (2) Completely close and obliterate all logging roads within 1609 m (1 mi) of Crucial range. (3) No activity within 1609 m (1 mi) of goat habitat during birthing (1 May to 30 Jun) or breeding (1 Nov to 31 Dec) seasons (Joslin 1980). (4) Slash should be removed from potential travel corridors between goat habitats (National Council of the Paper Industry for Air and Stream Improvement 1989). (5) Leave vegetation and tree cover to screen activities from goat habitat (Joslin 1980). (6) Promote high-intensity, short duration activities rather than long drawn out activities (Joslin 1980). (7) Schedule operations in adjacent drainages so they are not concurrent (Joslin 1980). (8) A wildlife biologist familiar with mountain goat requirements should help lay out timber sales (Gorman et al. 1984).

2. Minerals Development. Oil, gas, and mineral developments are increasingly affecting mountain goat habitats. It is the one management activity that can increase human disturbance manyfold in the rugged back-country goat ranges. Roads and access are a significant impact as mentioned previously. In addition, many minerals activities include the impacts of helicopters, drilling, blasting, noisy machinery, and toxic chemicals. Mountain goat populations, kid production, and nanny survivorship have significantly declined following energy exploration and development (Pendergast and Bindernagel 1977, Joslin 1986).

   Recommendations: (1) Avoid constructing wells, pipelines, or roads within 1609 m (1 mi) of occupied yearlong habitat (Gorman et al. 1984). (2) Helicopter activity should be at least 500 m (1641 ft) above ground (Stockwell 1989) and over forested areas (Joslin 1980).

3. Livestock Operations. Since mountain goats forage on a wide variety of plants, any livestock grazing within 402 m (0.25 mi) of cliffs is potential competition. A lack of success in mountain goat introductions has been linked to prior heavy grazing by sheep (Rideout 1978). Finally, livestock operators often have dogs with them. MacArthur et al. (1979) found, with the exception of direct helicopter passes, that bighorn sheep (very similar to goats ecologically and behaviorally) had the highest heart-rate increases in response to dogs.

   Recommendations: (1) Livestock operators should be discouraged from grazing within 402 m (0.25 mi) of goat habitat. (2) Two crucial "peninsulas" (surrounded by cliffs on 3 sides) should not be grazed by domestic livestock: (a) Cyclone Mountain, between Little Rock Creek and Clarks Fork Canyon; (b) the Line Creek peninsula between Line Creek and "Middle" Line Creek. (3) Place salt for livestock at least 1207 m (0.75 mi) from goat habitat, preferably much further.

(4) Livestock operators should keep dogs at least 402 m (0.25 mi) from goat habitat. (5) Allotments should not be expanded to include more livestock (Joslin 1980). (6) Grazing should take place between 1 July and 15 Oct (Joslin 1980). (7) Joslin (1980) recommended that no sheep grazing be allowed in goat range, although that is not often possible, given land management multiple-use precedences. If the opportunity arises, however, the Beartooth sheep allotments should be converted to cattle or eliminated.

4. Recreation. "Although certain forms of recreational activity are legal and socially accepted, they may become detrimental to mountain goats and other wildlife if they are undertaken by increasing numbers of people or if recreation managers fail to identify conflict areas and thus do not take steps to avoid impacts to the wildlife" (Joslin 1980 p.76). Goats in a hunted population avoided suitable habitat in areas of intense hiker use (Benzon and Rice 1987). The key to managing recreation on or near goat habitat is to keep it primitive and low density.

   Recommendations: (1) All roads and trails on the Beartooth should stay very primitive, especially the Morrison Jeep Trail, including "the switchbacks" and the road in Clarks Fork Canyon. (2) No new permanent roads. (3) All developed recreation sites should be limited to the Beartooth Corridor (Highway), except between the East and West Summits, where it should be disallowed. (4) Snowmobiling should be prohibited within 1609 m (1 mi) of goat habitat and limited to the Beartooth Corridor, if possible.

The areas on the south side of the Clarks Fork River can be managed somewhat differently. This is "suitable low occupancy mountain goat habitat" (Gorman et al. 1984). Prior to initiation of a development activity, surveys should be made by a wildlife biologist to determine if goats are starting to use the area consistently. If so, then the area should be changed to "crucial range". If not, activities such as exploratory drilling, road construction and maintenance, timber harvest, off-road and trail vehicle travel, and any other mechanized activity which extends beyond 1 week in duration should have timing restrictions from 1 Nov to 31 Dec, for breeding, and from 1 May to 30 June, for parturition (Gorman et al. 1984).

SUMMARY

The evolutionary adaptations of mountain goats to their cliff habitat make them more vulnerable to management impacts than most other ungulates. Goats are restricted to cliffs which leaves them with few options when faced with disturbance other than to move to different, probably already occupied, cliffs. Geist (1978) noted that displacement into areas already occupied results in increased social contacts. Goats are aggressive to each other just for the purpose of avoiding aggregations in the face of limited habitat options. The other option they have is to acclimate to human disturbance (Smith 1982). It is clear from the evidence that hunted populations do not acclimate well. "Regardless of the mechanism of interaction, the ultimate result of a close association between humans and mountain goats seems to be the eventual reduction or elimination of goats"

(Joslin 1980 p.27).

Mountain goats seem especially sensitive to cumulative effects of human impacts (Joslin 1986, Penner 1988). Managers cannot have both the impacts of hunting and land development activities on the same herd of goats at the same time (Chadwick 1978). Goats can probably get by, conservatively, with 1 or the other, but not both. Since the Beartooth population is highly valued for hunting (and viewing), other potentially disturbing activities should be carefully managed if hunting is to continue, especially since the Beartooth population is essentially an "island" population. There are no opportunities for goats to immigrate from other areas.

The main key to goat habitat management was best expressed by Kuck (1985 p.6.), "Encourage the public land management agencies to avoid or limit use or access into, or adjacent to, goat habitat".

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