IMPACT OF CATTLE GRAZING ON BIGHORN SHEEP HABITAT AT TRICKLE MOUNTAIN, COLORADO

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Abstract: Distribution, diet, and habitat use by cattle during May-October were compared to similar measurements for bighorn sheep (*Ovis canadensis*) during winter and spring. Cattle used only about 4 percent of bighorn winter-spring range. Although cattle and bighorn used similar vegetative types and aspects, cattle avoided the steep slopes inhabited by bighorn. Cattle distribution was also restricted by a limited water supply. Both cattle and bighorns were primarily grazers, but bighorn consumed considerable browse. Dietary overlap was moderate. Forage abundance and percent utilization were estimated on 21 areas identified as critical bighorn winter-spring habitat. Cattle use of bighorn critical areas on 2 grazing allotments was slight. Greatest impact was found on 1 allotment where about 35 percent of the forage was removed from bighorn critical areas by cattle during the summer. Dietary and/or spatial overlaps between cattle and bighorn do not necessarily indicate forage competition. Yet competition can occur with little overlap in these 2 parameters. Limiting forage resources must be identified to verify competition. Methods useful in verification of competition are discussed.

Buechner (1960) showed that the numbers and range of bighorn sheep in the United States have declined over the past several decades. Some authors attribute this decline at least partially to competition from livestock (Bandy 1970, Geist 1971). Most ecological studies of bighorn at least mention conflicts with livestock.

An inverse relationship between numbers of cattle and numbers of bighorn has been noted in the literature. Major reductions in populations of desert bighorns in Arizona and Nevada occurred at the same time cattle numbers reached their peak (Gallizioli 1977, McQuivey 1978). Northern bighorn populations may also have fluctuated in response to changing numbers of livestock (Berwick and Aderhold 1968, McCann 1956).

Cattle grazing has damaged much of the bighorn's range (Jones 1950, Bandy 1970). DeMarchi (1970) found weights and densities of bunchgrass on bighorn range declining due to cattle grazing. Livestock grazing may have been responsible for converting some Idaho bighorn habitat from grassland to shrubland (Morgan 1971).

Lauer and Peek (1976) and Blood (1961) investigated several aspects of the cattle-bighorn relationship, including distributions, food habits, and forage use. Observed overlaps in range use and diet, exacerbated by limited availabilities of preferred forages, led them to conclude that competition was occurring. Four components must be investigated in order to demonstrate forage competition between cattle and bighorn. Three are overlaps in distributions, in habitat uses, and in food habits. In addition, mutually-used resources must limit the productivity of at least one species. Water and possibly space, as well as forage, limit some populations of bighorn (Kelly 1960, Follows 1969). In this study, winter-spring (December 21-June 21) forage was assumed to be limiting to bighorn on the Trickle Mountain study area.

Objectives of this study were to:

(1) identify winter-spring ranges of bighorn;
(2) characterize habitats used by bighorn within these ranges;
(3) measure winter-spring food habits of bighorn;
(4) describe summer distribution of cattle, especially use of winter-spring ranges of bighorn;
(5) characterize habitats used by cattle during summer;
(6) measure summer food habits of cattle;
(7) measure removal of forage by cattle during summer from existing and potential winter-spring ranges of bighorn; and
(8) use the above information to evaluate the potential for competition between cattle and bighorn.

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STUDY AREA

The Trickle Mountain study area is located in the San Luis Valley of south-central Colorado. Field work was conducted primarily on BLM administered lands. Although data were gathered from 7 BLM allotments, work was concentrated on the Poison Gulch, Trickle Mountain, and Cross Creek allotments (Fig. 1). These allotments contain most of the bighorn winter-spring range on the study area.

Elevation varies from about 2500 m at Saguache Creek to about 3600 m at the summit of Trickle Mountain. Topography varies from open meadows and plateaus to rugged cliffs. Soils are mostly Mountain Lithosols, usually dry, shallow, and sandy or gravelly. At the nearby town of Saguache, precipitation averages 33 cm per year. The warmest month is July with a mean temperature of 18 C. January is the coldest month, having a mean temperature of -7 C (Shepherd 1975).

Vegetation of the study area was classified into the following types:

(1) shortgrass; primarily blue grama (*Bouteloua gracilis*) and slimstem muhly (*Muhlenbergia filiculmis*) with scattered patches of sedges (*Carex* spp.). Fringed sage (*Artemisia frigida*) and winterfat (*Ceratoides lanata*) were the major browse species.

(2) shortgrass-pingue; similar to the shortgrass type except pingue (*Hymenoxys richardsonii*) constituted a major portion of the ground cover.

(3) midgrass; principally muhlys (*Muhlenbergia* spp.) and fescues (*Festuca* spp.) with scattered browse and forbs.

(4) mixed grass; the interface of shortgrass and midgrass types where it was impractical to distinguish between the 2 types.

(5) meadow; areas near water sources dominated by grasses and grasslike plants such as bluegrass (*Poa* spp.), rushes (*Juncus* spp.) and sedges.

(6) rabbitbrush; shrublands found in gulches and depressions dominated by rabbitbrush (*Chrysothamnus* spp.)

(7) mountain shrub; hillsides with various grasses and forbs and an overstory of true mountainmahogany (*Cercocarpus montanus*) and currants (*Ribes* spp.)

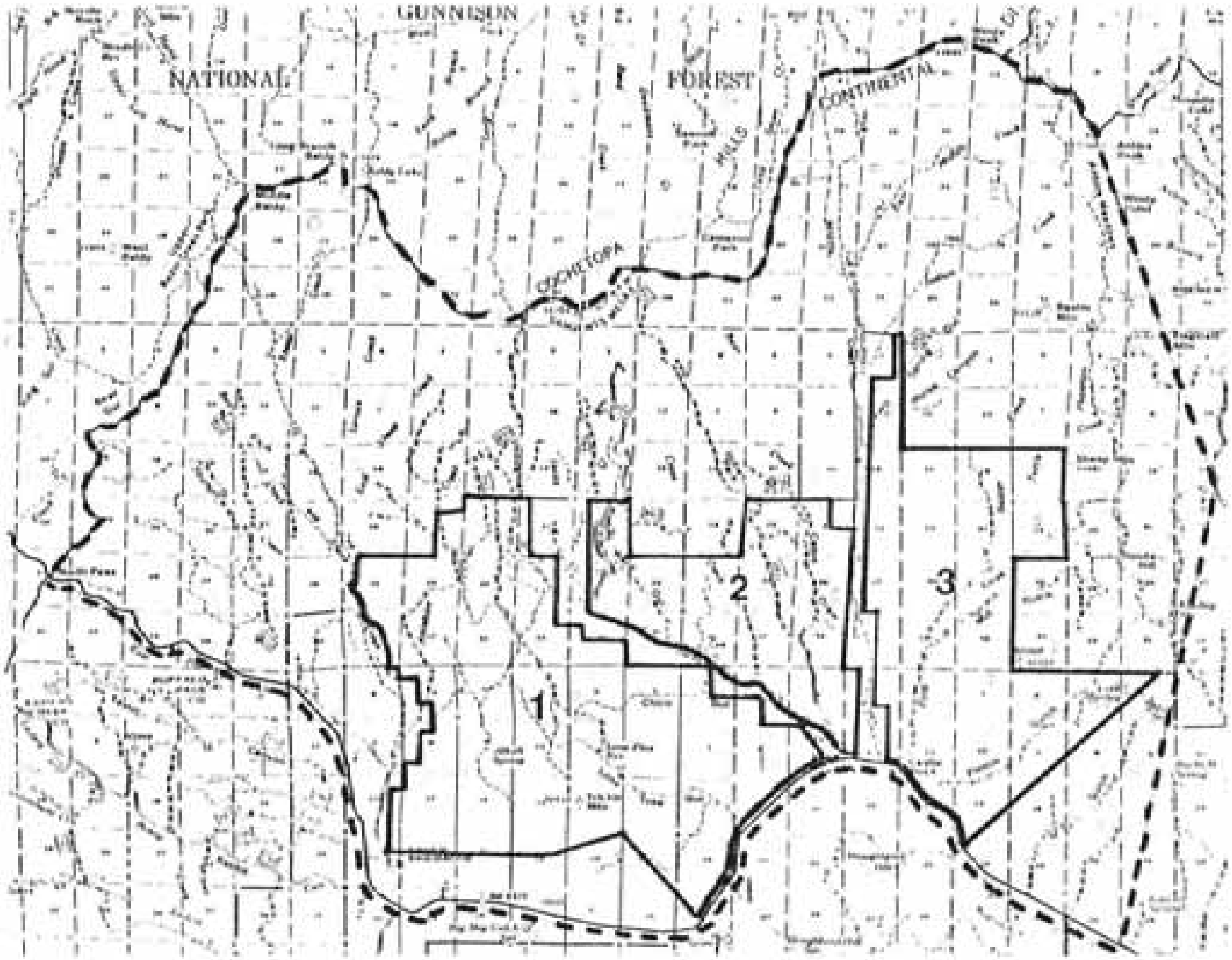

Fig. 1. Trickle Mountain Study Area (dashed line) and boundaries of the Trickle Mountain (1), Cross Creek (2), and Poison Gulch (3) BLM allotments.

(8) ponderosa pine-Douglas fir; a fairly dense canopy of ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga menziesii*) with fescues, muhlys and forbs below.
(9) pinyon-juniper; primarily species found in the shortgrass type with a sparse overstory of pinyon (*Pinus edulis*) and juniper (*Juniperus* spp.).
(10) cliffs; very steep slopes of bedrock or boulders with little or no vegetation.

METHODS

The winter-spring distribution of bighorn was determined by traveling fixed routes through the study area during December 21-June 21, 1978-1979. Similar routes were driven from May through October of 1979 to determine cattle distribution. For each observation of bighorn or cattle, the following data were recorded: vegetative type, slope, aspect, and distance from water. Bighorn observations included estimations of distance to escape terrain and descriptions of the escape terrain. Escape terrain was defined as that terrain to which bighorn fled after being disturbed or subjectively as the nearest steep, rocky slope to the bighorn band.

Microhistological analysis of feces (Free et al. 1970, Ward 1970) was used to determine the food habits of bighorn and cattle. Fifteen cattle fecal samples were collected from each allotment every 2 weeks during May to October, 1978. From December 21 to June 21, 1978-1979, 10 bighorn fecal samples were collected every 2 weeks. All samples were analyzed at the Composition Analysis Laboratory at Colorado State University.

Based upon observed consistent and frequent concentrations of bighorns, 18 areas within bighorn winter-spring range were identified as critical to bighorn welfare. In addition, 3 areas were identified as potential bighorn winter-spring habitat. These areas had juxtaposed combinations of escape terrain and forage resources that bighorns were observed to prefer. The 18 used areas and 3 potential areas are hereafter referred to as critical areas.

Prior to the 1979 grazing season, 3 pairs of circular, 0.46-square m plots were randomly located in 3 strata on each of the 21 critical areas. The 3 strata represented expected differences in cattle grazing pressure.

A wire cage protected one plot of each pair from grazing. In October, after all cattle had been removed from BLM land on the area, forage in all plots was clipped, air-dried, and weighed. Weights of forage in the caged plots were used to estimate total forage production on critical areas. Differences in forage weights between caged and uncaged plots were used to estimate summer forage utilization. Observations of cattle and wild ungulates on the critical areas provided indications of the species responsible for most of the grazing.

RESULTS

Distribution

From May to October, cattle used only limited portions of the Poison Gulch, Trickle Mountain, and Cross Creek allotments. On the Poison Gulch allotment, cattle were observed along Middle and Ford Creeks and in Poison Gulch. Areas of cattle concentration on the Trickle Mountain allotment included Antelope Creek and Houghland Gulch. Most cattle on the Cross Creek allotment ranged along Jack's Creek (Fig. 2).

Most bighorn winter-spring range was located on 3 allotments that were under intensive study. A large segment of the herd, however, used a lambing ground west of these BLM allotments during May to about mid-August.

The herd had 2 apparently separate winter ranges (Fig. 2); an area south of Trickle Mountain and the Poison Gulch-Ford Creek area. In spring, bighorn moved to Lone Tree Gulch, the east side of Alkali basin, Jack's Creek, and Middle Creek.

Only about 4 percent of the winter-spring bighorn range was used by cattle during May-October (Fig. 2). Although cattle groups were observed on 7 critical areas, observations were consistently made only on those critical areas near Jack's Creek on the Cross Creek allotment.

Habitat Use

Bighorn usually used areas with steeper slopes than did cattle (Fig. 3). The median slope angle for all bighorn observations was 20° while the median slope for cattle observations was 2°. Over 75 percent of all observed cattle groups were on slopes of 5° or less.

Distribution of cattle was further restricted by a limited water supply. Approximately 50 percent of observed cattle groups were within 240 m of

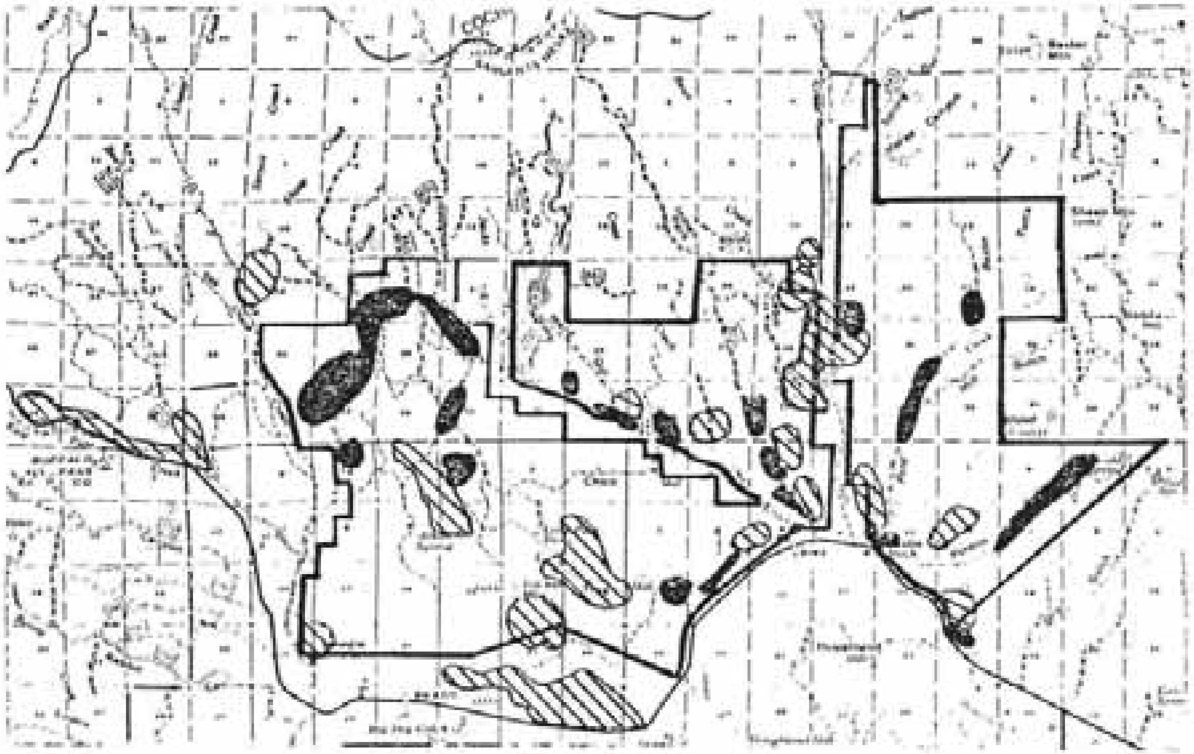

Fig. 2. Distribution of bighorn during December - June, 1978-79 (crosshatch) compared to distribution of cattle during May - October, 1979 (shading) at the Trickle Mountain Study Area.

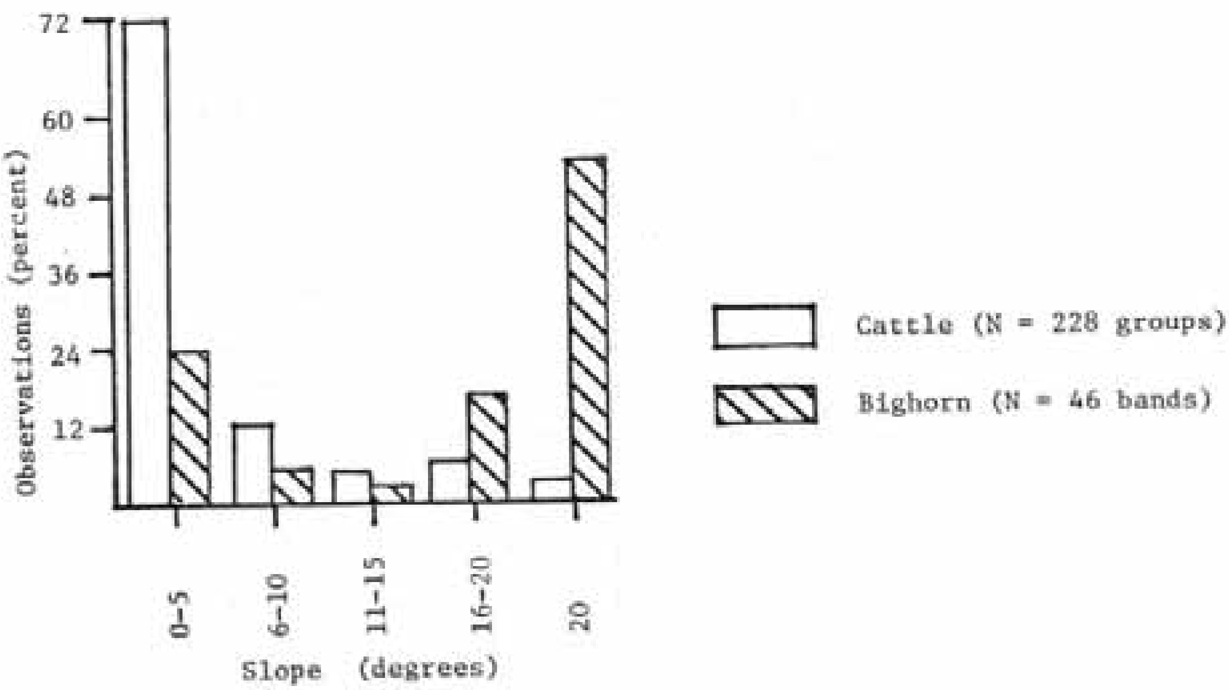

Fig. 3. Slopes used by cattle during summer and by bighorn during winter and spring on the Trickle Mountain Study Area, December, 1978 - October, 1979.

water (Fig. 4). Bighorn distribution also appeared related to the distribution of water. Half of all bands observed were within 300 m of water. However, much of the escape terrain used by bighorn borders streams. These areas provided not only escape terrain but abundant streamside forage as well as water. The relative values of these 3 factors to bighorn of the Trickle Mountain area are unclear.

Both cattle and bighorn preferred the more open vegetation types (Fig. 5). The limited amount of meadow type with its abundant forage accounted for about 8 percent of bighorn observations and 9 percent of cattle observations. Both species used the extensive shortgrass and shortgrass-pingue types. Cattle were not observed in the dry pinyon-juniper type nor in the cliff type. Bighorn generally avoided rabbitbrush types found in gulches. Bighorn did not use the ponderosa pine-Douglas fir forests which accounted for 4 percent of cattle observations. No cattle observations and only a small percentage of bighorn observations were made in limited amounts of mixed grass and mountain shrub types.

There were no major differences between cattle and bighorn in their uses of aspects available on the study area (Fig. 6). Bighorn relied heavily on southerly aspects which were snow-free in winter. Cattle showed a slightly higher use of northerly aspects and a greater tendency to use level areas.

Potential Bighorn Habitat

The heights and lengths of 18 cliffs used by bighorn for escape were estimated. The minimum height and length were 8 m and 200 m, respectively. Escape terrain was usually characterized by sparse vegetation, southerly aspect, and steep slope. Of all bands observed, 90 percent were within 240 m of such escape terrain. This information and data on foraging habitat were used as criteria for identifying and determining the sizes of potential but currently unused winter-spring ranges for bighorn.

Food Habits

Analysis of fecal samples collected during May-October, 1978 from all BLM allotments showed a predominance of grasses and grass-like plants in the cattle diet (Table 1). Most of the browse in the "summer" diet was consumed in September and October. Forb consumption was insignificant.

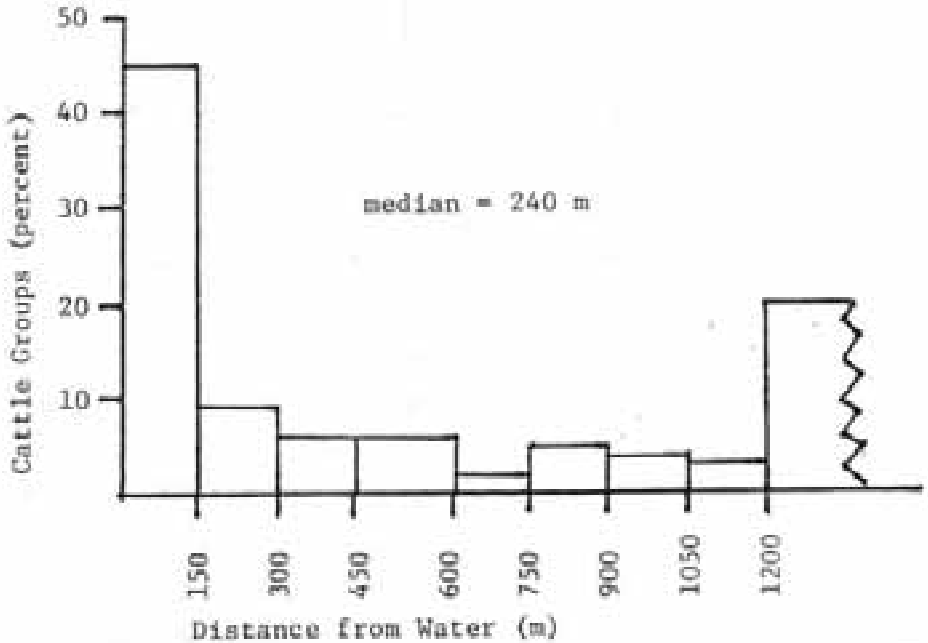

Fig. 4. Distance of 230 observed cattle groups from water on the Trickle Mountain Study Area during May - October, 1979.

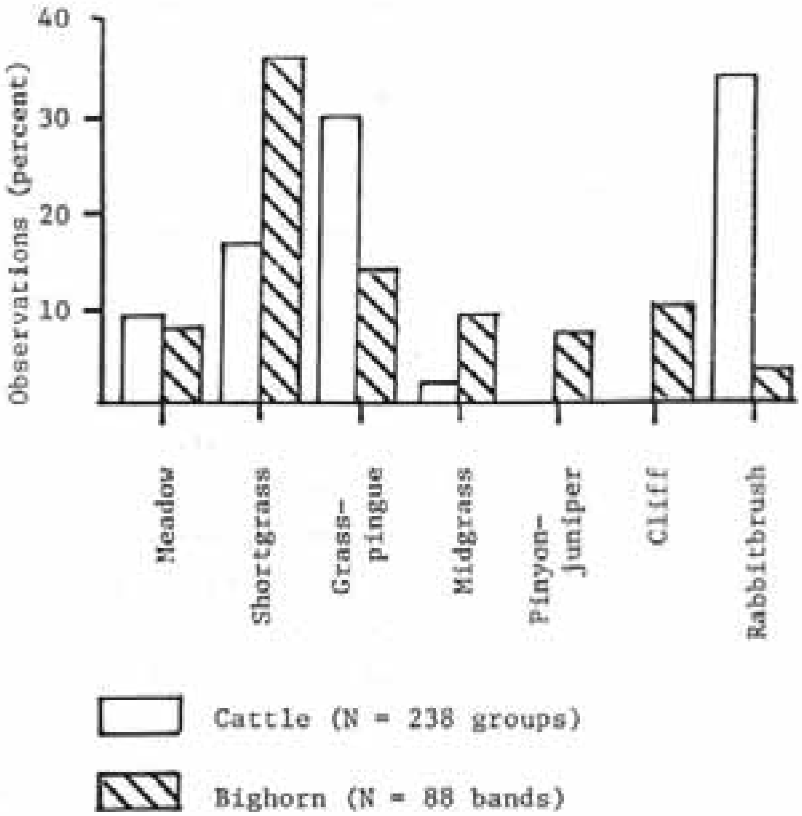

Fig. 5. Vegetation types used by cattle during summer and by bighorn during winter and spring on the Trickle Mountain Study Area, December, 1978 - October, 1979.

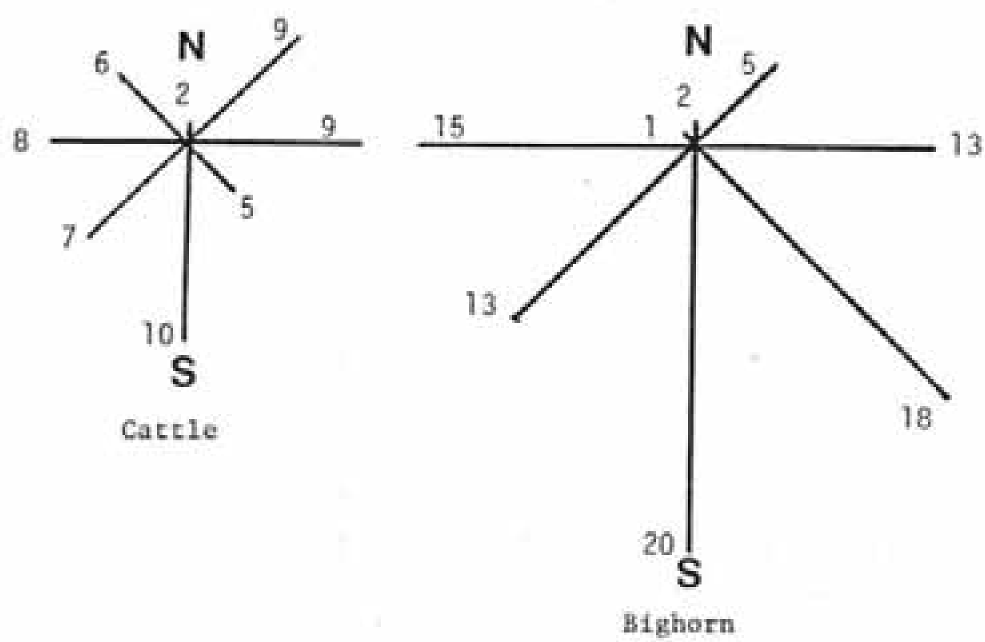

Fig. 6. Aspects used (percent) by 234 groups of cattle during summer and by 88 bands of bighorn during winter and spring on the Trickle Mountain Study Area, December, 1978 - October, 1979.

Analysis of bighorn fecal samples collected in late 1978 and 1979 from winter-spring range demonstrates that bighorn also consumed grasses and sedges abundantly (Table 1). Bighorn browsed more than did cattle, with fringed sage especially important in their diet. Few forbs were taken.

Summer diets of cattle and winter-spring diets of bighorn were compared using Kulcysnski's index of similarity (Oosting 1956): Similarity Index = $[\Sigma 2w/\Sigma(a+b)]x100$, where w is the lesser percentage of a food item in the 2 diets and a+b is the sum of percentages of food items in the 2 diets. The index represents the percent of 2 diets that is shared between 2 herbivore species. Indices reported below were calculated only for those food items constituting at least 1 percent of either the cattle or bighorn diets.

Comparing the summer diet of cattle on all BLM land on the study area to the winter-spring diet of bighorn produced a similarity index of 73. Comparing cattle diets for the 3 major allotments within bighorn range to the bighorn diet produced the following similarity indices: Poison Gulch, 65; Trickle Mountain, 62; and Cross Creek, 62.

Forage Utilization

Standing crops of forage and rates of forage removal on bighorn winter-spring critical areas were calculated by allotment (Table 2). The Cross Creek allotment produced the largest standing crop of forage on bighorn critical areas, followed by the Trickle Mountain allotment and, lastly, the Poison Gulch allotment. Likewise, the estimated amount of forage removed from critical areas during the 1979 cattle grazing season was greater on the Cross Creek allotment (35 percent) than on either the Trickle Mountain or Poison Gulch allotments (7 and 4 percent, respectively). Based on the relative numbers of cattle, bighorn, pronghorn (Antilocapra americana), and mule deer (Odocoileus hemionus) observed on critical areas during June-October, 1979 (Table 3) and considering that a cow consumes much more forage than does any of these wild ungulates, it is concluded that most of this forage was removed by cattle.

The indicated low levels of forage use by cattle on 13 bighorn critical areas on the Poison Gulch and Trickle Mountain allotments is supported by the above-noted observation that there was little overlap between cattle

Table 1. Food items in May-October, 1978 cattle diet and December-June, 1978-1979 bighorn diet as determined by microhistological analysis of feces.[1]

Food Item	Percent in Diet	
	Cattle	Bighorn
Grass and grass-like		
Muhlenbergia spp.	22	11
Bouteloua gracilis	11	11
Agropyron spp.	8	2
Festuca spp.	7	3
Sporobolus cryptandrus	3	5
Oryzopsis spp.	-	2
Carex spp.	9	10
Juncus spp.	10	-
Forbs		
Descurainia obtusa	-	2
Sphaeralcea coccinea	-	2
Browse		
Atriplex spp.	5	7
Artemisia spp.[2]	4	10
Ceratoides lanata	4	8
Yucca spp.	tr	4
Salix spp.	-	2
Symphoricarpos palmeri	-	2
Potentilla spp.[3]	1	1

[1]Only food items constituting at least 1 percent of the diet of either cattle or bighorn are included.

[2]Mostly *A. frigida*.

[3]Herbaceous *Potentilla* species occur on the study area but most of this genus consumed is considered to be *P. fruticosa*.

tr = less than 1 percent.

Table 2. Standing crops and removal of forage from winter-spring critical areas of bighorn sheep in 3 BLM allotments, Trickle Mountain study area, summer 1979.

Allotment	No. of Critical Areas	Standing Crop ($Kg x 10^3$)	Amount Removed ($Kg x 10^3$)	Utilization (%)
Poison Gulch	5	121	5.0	4
Trickle Mountain	8	131	9.5	7
Cross Creek	8	260	92.0	35

Table 3. Numbers of ungulates observed on bighorn winter-spring critical areas within 3 BLM allotments on the Trickle Mountain study area, June-October, 1979.

Allotment	Cattle	Bighorn	Pronghorn	Mule Deer
Poison Gulch	31	35	0	1
Trickle Mountain	34	0	6	0
Cross Creek	148	50	0	0
Totals	213	85	6	1

distribution and bighorn winter-spring distribution on these allotments. Furthermore, on the Cross Creek allotment, over half of the measured summer forage removal occurred on 1 of 8 critical areas. Most cattle observed on Cross Creek critical areas were also sighted on this 1 area.

DISCUSSION

Interspecific competition occurs when there is mutual use of resources that are limiting to one or both species. This study demonstrated little mutual use of forage resources by cattle in summer and bighorn in winter and spring on the Trickle Mountain study area. While overlap in the species' food habits was moderate, overlap in geographic distributions of cattle and sheep was minimal. Separation of cattle and bighorn ranges has also been reported by McCullough and Schneegas (1966) and Dean (1975). On the Trickle Mountain area, separation of the ranges of cattle and bighorn was due mostly to the reluctance of cattle to use steep slopes or to wander far from water.

Food habits and geographic distribution are dynamic characteristics of any ungulate population. These characteristics can vary in response to changes in population size or in response to habitat change. On the Trickle Mountain study area, a greater overlap in food habits and distributions could occur if either cattle or bighorn numbers should increase. In addition, range improvements, especially water developments, that would expand the distribution of cattle, could cause greater overlap in ranges used by cattle and bighorn. To protect bighorns, water developments can be planned to be more than 1.5 km from critical winter-spring ranges of bighorns (Fig. 4), especially those critical ranges having forage on level-to-moderate slopes.

As an indicator of the level of competition between 2 species, the degree of overlap in use of all forage resources can be misleading. At one extreme, great overlap in food habits can occur without competition if none of the mutually-used forages are limiting to either species. In contrast, slight overlap in food habits can occur with intense competition if all the mutually-used forages are severely limiting to either species. Thus, the key to measuring forage competition lies in measuring overlap in use of limiting forage resources. However, it is difficult to verify that certain forage resources, perhaps particular forage species used during a particular season, are limiting to a wild population. The ultimate test is to prove that productivity of the population is somehow correlated with variation in availability of the particular forage resource.

In this study, it was assumed that winter-spring forages were limiting to bighorn on the Trickle Mountain study area. This assumption was based on accepted concepts of bighorn ecology and physiology, including reproductive physiology. Using this assumption, competition between cattle and bighorn has been detected on the Cross Creek allotment where it has been estimated that cattle consume 35 percent of the forage assumed limiting to bighorn (Table 2). Most of this competition occurs on 1 bighorn critical area at the junction of Ward Gulch and Jack's Creek (Fig. 2). The proximity of water and productive meadows to bighorn escape terrain creates this conflict. The presence of lambing grounds on the Cross Creek allotment strengthens the assumption that this forage limits bighorn productivity.

Results of this study illustrate that the potential for competition may occur on only a small part of an entire study area. Wildlife biologists can make a major contribution to multiple-use management of grazing lands by identifying such areas.

The assumption that forage consumed by cattle on the Cross Creek allotment is limiting to bighorn might be challenged. A hypothesis that a habitat resource is limiting to a wildlife population can be tested in 2 ways. First, the habitat-population system can be analyzed in greater detail. This could strengthen or weaken the evidence that the resource is limiting. Second, performance of the population can be tested for correlation with variation of the presumed limiting habitat resources. Either approach could be applied to the situation on the Cross Creek allotment, as suggested below.

For a more detailed analysis of the situation on the Cross Creek allotment, seasonal patterns of forage production, removal, and availability on the area of range overlap could be measured more precisely. This would require replicated plots, some with cages, to measure (1) forage removed by cattle during summer, (2) forage available to and removed by bighorn during winter and spring, and (3) forage remaining before the growing season begins. If it can be demonstrated that quality forages are available to bighorn on these areas throughout winter and spring, including periods of deep snow, the assumption that these forages are limiting to bighorn will be questionable.

A second approach to testing the assumption that forage on the Cross Creek allotment is limiting to bighorns would involve testing data on lamb production and survival for correlation with variation in availability of forage. Lamb production and survival could be measured by lamb:ewe ratios obtained periodically during summer and fall over several years. Variation in availability of forage on the Cross Creek allotment could be measured at various times during winter and spring over several years. These data could be analyzed to test if years with poor availability of winter-spring forage on critical areas of the Cross Creek allotment are also years with low lamb:ewe ratios. A positive correlation would support the hypothesis that this forage limits the population. If one accepts the natural variation in forage availability due to among-years variation in weather, many years may be necessary for this test. However, the test may be accelerated by active manipulation of forage on the Cross Creek allotment in order to provide extremes of forage availability to bighorn within a relatively few years. This manipulation could be accomplished by varying cattle numbers among years or by varying cattle access to the critical areas used by bighorn.

LITERATURE CITED

Bandy, P. J. 1970. The paradox of the bighorn sheep. Trans. Northern Wild Sheep Counc. Pages 1-4.

Berwick, S., and M. Aderhold. 1968. A history of land use and herd dynamics in a Montana population of bighorn sheep. N. W. Sci. 42(1):30. (Abstr.)

Blood, D. A. 1961. An ecological study of California bighorn sheep in southern British Columbia. M.S. Thesis. University of British Columbia, Vancouver. 127pp.

Buechner, H. K. 1960. The bighorn sheep in the United States, its past, present and future. Wildl. Monogr. No. 4. 177pp.

Dean, H. C. 1975. Bighorn investigations in Canyonlands National Park. Trans. Desert Bighorn Counc. 19:7-11.

DeMarchi, D. A. 1970. Bighorn sheep and overgrazing in the lower Chilocatin River region, British Columbia. Trans. Northern Wild Sheep Counc. Pages 39-45.

Follows, D. S. 1969. Desert bighorn in Canyonlands National Park, Utah. Trans. Desert Bighorn Counc. 13:33-42.

Free, J. C., R. M. Hansen, and P. L. Sims. 1970. Estimating dryweights of foodplants in feces of herbivores. J. Range. Manage. 23(4):300-302.

Gallizioli, S. 1977. Overgrazing on desert bighorn ranges. Trans. Desert Bighorn Counc. 21:21-23.

Geist, V. 1971. Mountain sheep: a study in behavior and evolution. University of Chicago Press, Chicago. 383pp.

Jones, F. L. 1950. A survey of the Sierra Nevada bighorn. Sierra Club Bull. 35:29-76.

Kelly, W. E. 1960. Bighorn sheep management recommendations for the state of Arizona. Trans. Desert Bighorn Counc. 4:41-44.

Lauer, J. L., and J. M. Peek. 1976. Big game-livestock relationships on the bighorn sheep winter range, East Fork, Salmon River, Idaho. Coll. For., Wildl. and Range Sci., Bull. No. 12, University of Idaho, Moscow. 44pp.

McCann, L. J. 1956. Ecology of the mountain sheep. Am. Midl. Nat. 56:297-325.

McCullough, D. R., and E. R. Schneegas. 1966. Winter observations on the Sierra Nevada bighorn sheep. California Fish Game 52(2):68-84.

McQuivey, R. P. 1978. The desert bighorn sheep of Nevada. Nevada Dept. of Fish and Game, Biol. Bull. No. 6. 81pp.

Morgan, J. K. 1971. Ecology of the Morgan Creek and East Fork of the Salmon River bighorn sheep herds and management of bighorn sheep in Idaho. M.S. Thesis, Utah State Univ., Logan. 156pp.

Oosting, H. J. 1956. The study of plant communities. W. H. Freeman and Co., San Francisco. 440pp.

Shepherd, H. R. 1975. Vegetation of two dissimilar bighorn sheep ranges in Colorado. Div. of Wildl., Rep. No. 4. 223pp.

Ward, A. L. 1970. Stomach content and fecal analysis: methods of forage identification. Pages 146-158 in Range and Wildlife Habitat Evaluation. U.S. For. Serv. Misc. Publ. No. 1147.

QUESTION - RESPONSES

Bill Wishart: What was the age structure of the cattle?

Scott McCollough: It was a calf-cow operation.

Bill Wishart: Didn't have yearlings in that set-up? We fould that yearlings don't seem to have any problems in going up the slopes.

Scott McCollough: Almost all the cattle that I observed, regardless of age class, would avoid slopes.

Lanny Wilson: If you remove the livestock would you expect a re-distribution of the sheep use?

Scott McCollough: I looked at only winter-spring distribution of the bighorn. So there is no spatial competition.

Lanny Wilson: I know that. I'm just saying, do you think that they would use areas that they are not using now if the livestock were removed?

Scott McCollough: I don't think so, they might some places, but I really don't know.

Daryll Hebert: Some might be interested in some of our examples in B.C. You quoted Demarchi, Bandy and Blood from some of the early work in East Kootanies and Ashnola. And I think if you look back at the history of our examination of bighorn sheep ranges in the early 60's by Blood, Demarchi and Marker, and about 5 or 6 Masters Degrees done on the Asnola, the conclusions at that time were basically that there was a major competition between cows and bighorn sheep. Cattle were removed in 1968, completely off the main winter range in the Ashnola and there really hasn't been any response at all in reproduction, recruitment and total population in terms of the bighorn population in that area. I am not saying there wasn't competition and I'm not saying there wasn't an impact by cattle on sheep. But, I think it certainly is more complex than suggesting that we remove cattle off any ranges. We're in the process now of bringing cows back on to a lot of our sheep ranges to condition them similar to the programs in Oregon. So I think it certainly is more complex. I don't know if we are even close to determining effects of cows on bighorn sheep ranges.