ECOLOGICAL RELATIONSHIPS BETWEEN DESERT BIGHORN SHEEP AND DOMESTIC CATTLE IN SOUTHEASTERN UTAH

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ABSTRACT

Ecological relationships between desert bighorn sheep (Ovis canadensis nelsoni) and domestic cattle were investigated in the White Canyon area of southeastern Utah. Cattle and bighorn sheep utilized different topographic types and had significant differences in diet composition during the winter grazing season. Bighorn failed to move into and use areas vacated by cattle when cattle were moved to summer ranges. At present there are insufficient data to conclusively ascribe failure of bighorn to use areas used by cattle to social intolerance or to differential habitat preferences. Critical management issues with respect to bighorn-cattle interactions in Utah are discussed.

INTRODUCTION

Desert bighorn sheep (Ovis canadensis nelsoni) are native to the harsh canyon country of southeastern Utah. Much of this land is administered by the United States Bureau of Land Management (BLM). In order to adequately plan for the desert bighorn in their livestock grazing environmental statement, the BLM contracted Utah State University to conduct a long-term ecological investigation of desert bighorn sheep on land they administer in southeastern Utah. A major objective of the study was to determine desert bighorn-domestic cattle relationships in the White Canyon cattle allotment in San Juan County, Utah. Ecological relationships between cattle and bighorn were evaluated with respect to overlap in use of topographic types and diet overlap during 1981-1983.

We gratefully acknowledge the Bureau of Land Management and Utah State University for the financial support for the study. The Utah Division of Wildlife Resources provided the vehicle and lodging used throughout the course of the study as well as monthly fixed-wing aircraft flights.

STUDY AREA

The study was conducted in the White Canyon cattle allotment in San Juan County, Utah (Fig. 1). The 1000 km^2 allotment is bordered to the north by Dark Canyon, to the west by Lake Powell, to the south by the Wingate Mesa, and to the east by Natural Bridges National Monument. Large precipitous mesas rise from rough-broken valley floors, creating a rugged environment for both cattle and bighorn. Elevations range from 1458 m to 2478 m throughout the area.

Five distinct topographic types occur in the area (Fig. 2): (1) Chinle talus slopes, characterized by shadscale (Atriplex confertifolia) - galleta grass (Hilaria jamesii) - ephedra (Ephedra spp.) vegetation on slopes that average 60% or greater, (2) Mossback - Shinarump mesa tops, characterized by blackbrush (Coleogyne ramosissima) - galleta grass vegetation interspersed with often dense stands of pinyon pine (Pinus edulis) - juniper (Juniperus osteosperma) on slopes averaging 0-10%, (3) Moenkopi talus slopes, characterized by black brush - galleta grass and pinyon pine- juniper vegetation types on slopes averaging 30-40%, (4) Organ Rock talus slopes, characterized by pinyon pine- juniper stands with blackbrush - galleta grass understory on slopes averaging 20-40%, and (5) Cedar Mesa Valley floors, characterized by blackbrush - galleta grass vegetation interspersed with pinyon pine- juniper on slopes averaging 0-10%.

The history of livestock grazing in the White Canyon area begins as early as 1887 when a few cattle were grazed there (Wilson in Trefethen 1975). During this early period accurate grazing records were not kept; however, in the 1940's and 1950's as many as 7000 cattle and 7180 domestic sheep were grazed in the area that now comprises Canyonlands National Park and south to the San Juan River (BLM grazing records, San Juan Resource Area Office, Monticello, Utah). In 1959 this big allotment was subdivided into 3 smaller allotments, including the White Canyon Allotment essentially as it is today. Current grazing priviledges for the White Canyon Allotment are for approximately 450 cattle managed in a year-round pasture rotation system (R. McClure pers. commun.). Cattle generally remain in the White Canyon portion of the area from early November to late April or early May when they are moved to summer ranges. The permittee runs a cow-calf operation on the allotment.

Desert bighorn sheep also have a long grazing history in the area as evidenced by the common occurrence of bighorn representations in aboriginal petroglyphs and pictographs dating back 4000-8000 years (Turner 1971). Accurate estimates of desert bighorn for the area are not available because of the difficulty in getting aerial survey data in such a rugged area. Bates (pers. commun.) estimates that approximately 20-25% of the bighorn in an area are observed during annual helicopter surveys based on double-count estimates (Magnussen et al. 1978) conducted by Utah Division of Wildlife Resources (UDWR). During the 1983 aerial survey, UDWR personnel classified approximately 40 sheep in the White Canyon area. A liberal estimate for desert bighorn in the area would therefore be 150-200 animals.

Figure 1. White Canyon area of southeastern Utah.

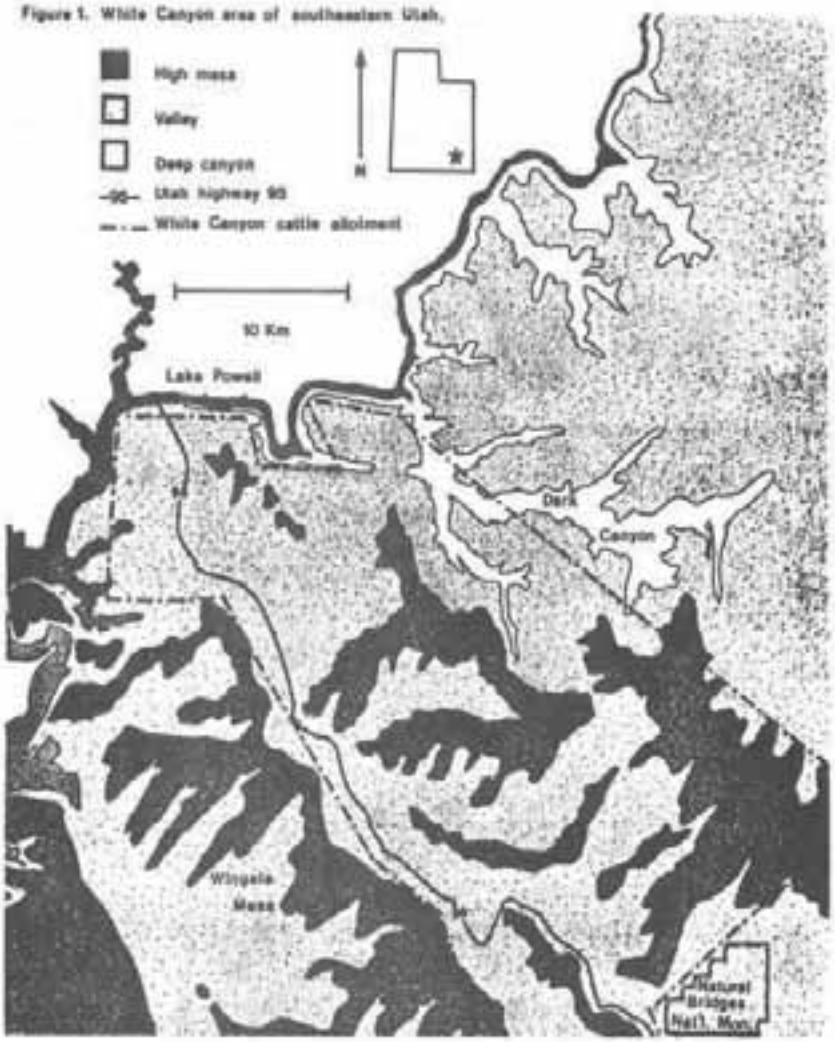
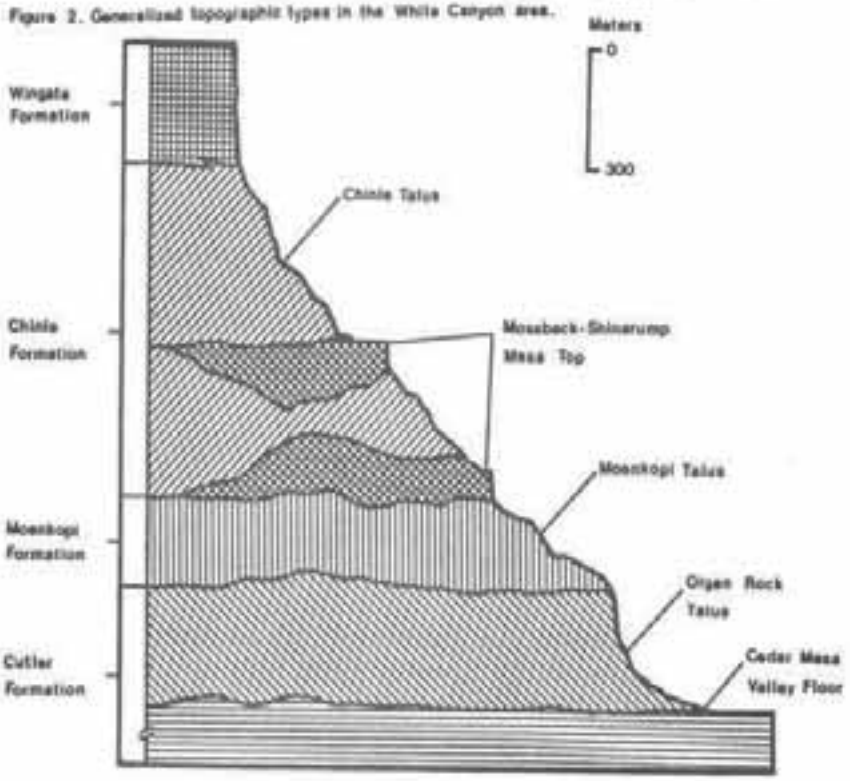


Figure 2. Generalized topographic types in the White Canyon area.



METHODS

Fieldwork was conducted from 1981-1983. Bighorn and cattle were observed during each of 2 grazing seasons (November-April, 1981-1982 and 1982-1983) to determine habitat and forage use patterns when cattle and bighorn were sympatric. Bighorn were also observed during 2 non-grazing seasons (May-October, 1982 and 1983), when cattle were not present on the range to determine if patterns of bighorn habitat use were different after cattle were removed from the area.

HABITAT USE

Bighorn and cattle were located while hiking or driving through the study area. Observations were made during all daylight hours and throughout the grazing season. Each time bighorn or cattle were located, the number of animals in each of the 5 topographic types was recorded. Data were analyzed by constructing a 2 x 5 contingency table comparing use of the 5 topographic types by bighorn and cattle (Steel and Torrie 1980). The same analysis was used to compare selection of topographic types by bighorn during the grazing season vs. the non-grazing season.

FORAGE USE

Food habits of bighorn and cattle were investigated by observing feeding animals with 10 x 50 binoculars and a 15-60 power spotting scope (generally from distances less than 100 m) and recording frequencies of plant use. Observations were made during all daylight hours and throughout the grazing season. Use of a culm of grass, leaf or stem of forbs, or leader or leaf of trees or shrubs constituted one feeding instance (Lauer and Peek 1976). Feeding instances were recorded for each bighorn or cow in a feeding group at 2 minute scan sampling intervals during feeding bouts (Altmann 1974). Diet items were recorded by plant species when possible or by forage class (grass, forbs, browse) when species couldn't be identified. Feeding records were expressed as frequencies and, therefore, do not represent actual quantities of forage ingested.

Diet similarities were determined by constructing a 2 x 3 contingency table comparing use of each of 3 forage classes by bighorn and cattle (Steel and Torrie 1980). A Percent Similarity Index (PSI) was also calculated to determine equity of bighorn and cattle diets with respect to proportions that shared diet items contributed to total diets for each animal species (Whittaker 1975).

RESULTS

HABITAT USE

During the 2 grazing seasons, a total of 288 bighorn and 618 cattle sightings was recorded in the White Canyon area (Table 1). Contingency analysis indicated a highly significant difference in selection of topographic types between bighorn and cattle ($X^2 = 689.2$, df = 4, $P < 0.01$). Cattle were only observed on Cedar Mesa valley floors (81%) and Organ Rock talus

slopes (19%), whereas bighorn were observed in all topographic types, but primarily on Moenkopi (39%) and Chinle (31%) talus slopes (Fig. 3). Bighorn were selecting higher, steeper talus slopes and cattle were using lower, gentler slopes and valley floors.

Table 1. Comparison of numbers of cattle and bighorn in various topographic types during the grazing season (November-April 1981-82, 1982-83) in the White canyon Area in southeastern Utah. Numbers in parentheses are expected values based on the assumption of no difference.

	Topographic type					
	Mossback-Shinarump mesa top	Chinle talus	Moenkopi talus	Organ Rock talus	Cedar Mesa valley floor	Total
Desert bighorn	33 (10.5)	89 (28.3)	112 (35.6)	29 (46.1)	25 (167.5)	288
Cattle	0 (22.5)	0 (60.7)	0 (76.4)	116 (98.9)	502 (359.5)	618
Total	33	89	112	145	527	906

Chi-square = 689.2**, df = 4, $P < 0.01$

A total of 677 bighorn were observed and classified with respect to topographic type during 2 non-grazing seasons (Table 2). Contingency analysis indicated no significant difference in use of topographic types by bighorn during grazing vs. non-grazing seasons ($X^2 = 5.6$, df = 4, $P > 0.10$) suggesting that bighorn did not use habitat differently when cattle were not on the range (Fig. 4).

Figure 3. Topographic types selected by bighorn and cattle in White Canyon during the grazing season.

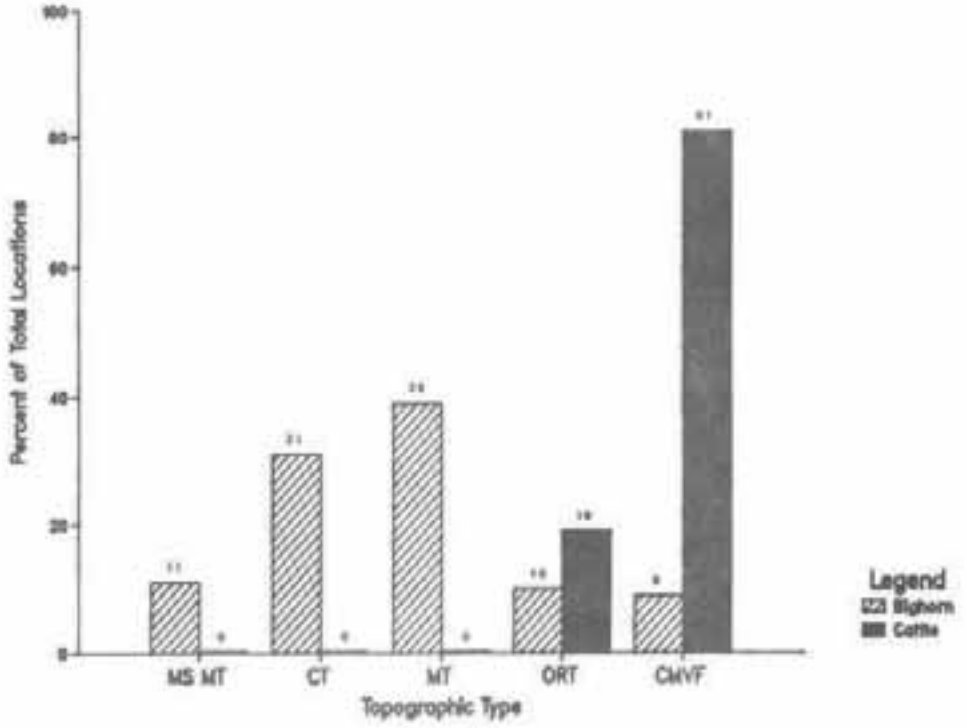


Figure 4. Topographic types selected by bighorn in White Canyon during the grazing and non-grazing seasons.

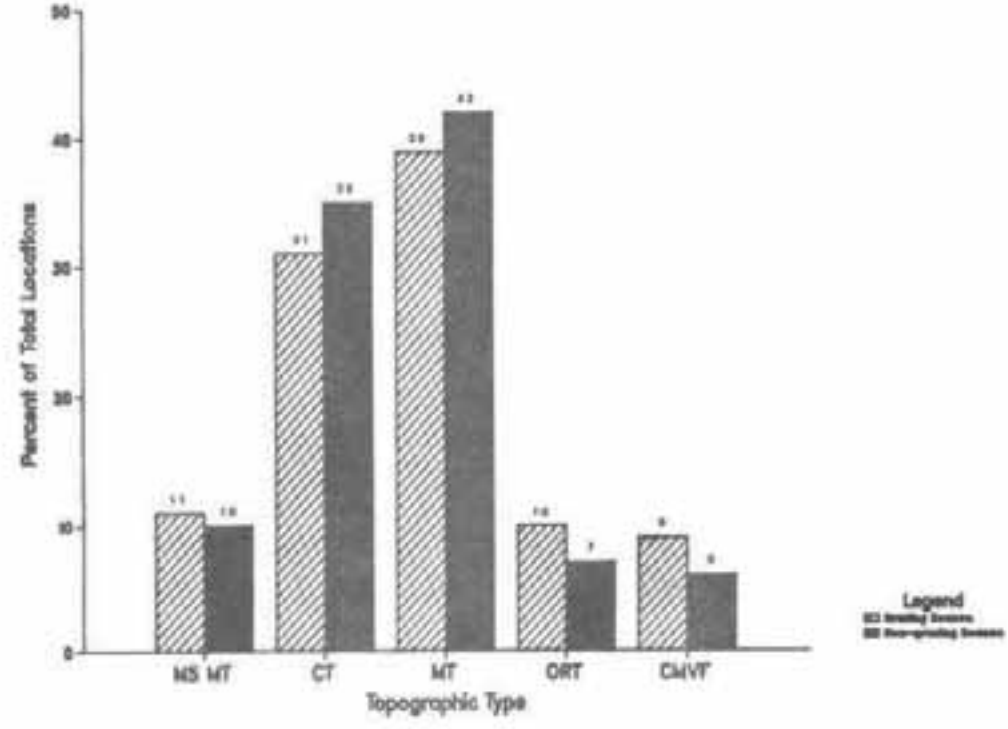


Table 2. Comparison of number of bighorn in various topographic types during the grazing season (November-April 1981-82, 1982-83) and the non-grazing season (May-October 1982, 1983) in the White Canyon area. Numbers in parentheses are expected values based on the assumption of no difference.

Season	Topographic type					
	Mossback-Shinarump mesa top	Chinle talus	Moenkopi talus	Organ Rock talus	Cedar Mesa valley floor	Total
Grazing season	33 (29.8)	89 (97.3)	112 (117.6)	29 (23.6)	25 (19.7)	288
Non-grazing season	67 (70.2)	237 (228.7)	282 (276.2)	50 (55.4)	41 (46.3)	677
Total	100	326	394	79	66	965

Chi-square = 5.6 ns, df = 4, P > 0.10

FORAGE USE

During 2 winter grazing seasons 91 cattle were observed during feeding behavior and 2331 feeding instances were recorded. Grass (56%) was most often selected by cattle, but browse (43%) was also an important component of cattle diets (Table 3). Important plant species selected by cattle were: (1) cheatgrass (Bromus tectorum), 31%, (2) galleta grass, 21%, (3) blackbrush, 14%, and (4) shadscale, 14% (Table 4).

One hundred thirty-four bighorn were observed during feeding behavior and 2306 feeding instances were recorded. Browse (91%) was highly selected over grass (8%) and forbs (1%) by bighorn (Table 3). Important plant species selected were: (1) blackbrush, 73%, (2) cliffrose (Cowania mexicana), 16%, (3) cheatgrass, 3%, and (4) galleta grass, 2% (Table 4).

Contingency analysis indicated a highly significant difference in diets between cattle and bighorn with respect to forage class (X^2 = 1214.2, df = 2, P < 0.01). Cattle were primarily grazers and secondarily browsers, while bighorn were almost exclusively browsers (Fig. 5).

Although forage classes were used differently by bighorn and cattle, there was considerable overlap in plant taxa selected. During the grazing

season, cattle and bighorn both used 10 identified taxa, 8 of which were common to both animals. However the relatively low PSI value of 21 (Table 4) is indicative of minimal diet overlap on a proportional basis (as PSI approaches 100, diets approach equity).

Table 3. Comparison of cattle and bighorn diets by forage classes during the grazing season (November-April 1981-82, 1982-83) in the White Canyon area. Numbers in parentheses are expected values based on the assumption of no difference.

	Forage class			
	Grass	Browse	Forbs	Total
Cattle	1306 (751.5)	1016 (1566.9)	9 (12.6)	2331
Desert bighorn	189 (743.5)	2101 (1550.1)	16 (12.4)	2306
Total	1495	3117	25	4637

Chi-square = 1214.2**, df = 2, P < 0.01

Figure 5. Percentage of forage classes in diets of cattle and bighorn during the grazing season (Nov.-Apr. 1981-82, 1982-83).

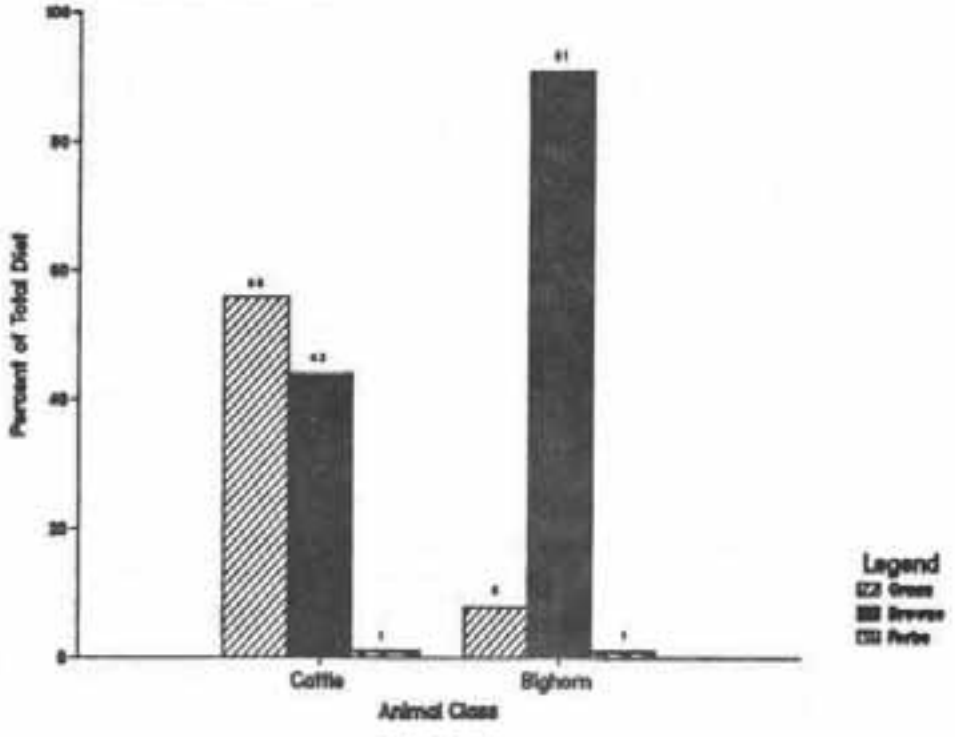


Table 4. Plant species selected by cattle and desert bighorn in the White Canyon area during the grazing season (November-April 1981-82, 1982-83).

	Bighorn (n=134)		Cattle (n=91)		
	Feeding instances (n)	Percent total	Feeding instances (n)	Percent total	PSI value
Coleogyne ramosissima	1690	73	346	14	14
Cowania mexicana	376	16	0	0	0
Bromus tectorum	81	3	734	31	3
Hilaria jamesii	47	2	492	21	2
Oryzopsis hymenoides	40	2	66	3	2
Rhus trilobata	18	1	0	0	0
Elymus salinus	15	1	0	0	0
Ephedra sp.	7	tr	74	3	0
Stanleya pinnata	7	tr	0	0	0
Guteirrezia sorothrae	4	tr	120	5	0
Juniperus osteosperma	3	tr	2	tr	0
Chrysothamnus sp.	3	tr	4	tr	0
Atriplex confertifolia	0	0	320	14	0
Atriplex canescens	0	0	150	6	0
Unidentified forbs	9	tr	9	tr	--
Unidentified grass	6	tr	14	tr	--
Unidentified browse	0	0	0	0	--
Total	2306	100	2331	100	21

tr = < 1%

DISCUSSION

The current relationship between desert bighorn and cattle appears to be one of ecological separation with respect to use of topographic types and forage selection. Bighorn select higher, steeper, more rugged talus slopes, while cattle select lower, gentler slopes and valleys not far from roads and developed water sources. This differential use of available topographic types occurred during the winter grazing season when cattle and bighorn were sympatric as well as during the non-grazing season after cattle were moved to summer ranges. Bighorn and cattle diets have several common taxa during the winter grazing season, however, cattle diets are dominated by grass whereas bighorn were almost exclusively browsers.

This evidence may lead land managers to infer there is little or no conflict between desert bighorn and domestic cattle in the White Canyon area. However, there are several fundamental issues that must be resolved before a

more liberal grazing management plan can be prescribed.

First, there is the question of whether observed ecological differences between bighorn and cattle result from differing preferences or from a social intolerance-avoidance factor. Evidence from previous studies on this issue is largely divided between those suggesting differences are based on habitat preferences (McCann 1956, Barmore 1962, Ferrier and Bradley 1970) and those suggesting bighorn avoid areas used by cattle (McCullough and Schneegas 1966, Follows 1969, Albrechtsen and Reese 1970, Dean 1975, Horejsi in Trefethen 1975).

In Utah there is evidence that bighorn avoid areas that have been grazed for long periods. Bates (1982) described habitat expansion by desert bighorn into areas once grazed by cattle after cattle were removed from Canyonlands National Park. Irvine (1969) and Wilson (in Trefheten 1975) describe a case of vacation of normal home range areas by desert bighorn when cattle were experimentally introduced into an area. It is also noteworthy that when bighorn were located on valley floors and lower slopes during the current study in White Canyon, their stay was short-lived or transitory, generally during escape or travel from one mesa to another.

The most powerful test for this problem would be to remove one species or the other from the area so that a response by the remaining species could be monitored (Connel 1977). In this manner, critical proof of competitive effects of the removed species on population growth or habitat expansion by the remaining species could be established (Wagner 1978). It would be enlightening to remove cattle from White Canyon or similar areas for a period of several years so that population effects could be monitored.

Second, although food habits were quite different in 1981-1983, they could change with different environmental conditions. It is not surprising that bighorn and cattle diets are different considering they use different topographic types. Much of the disparity in diets was likely a function of differences in plant compositions among the topographic types in the White Canyon area (Wilson 1968). Since bighorn were only rarely observed in areas used by cattle, food habits of bighorn in those areas could not be adequately sampled to determine degree of diet overlap. However, considering the high percentage of shared diet taxa (80%) it is not unlikely that diets might converge if cattle and bighorn were forced to use the same topographic types (Wagner 1978). McCullough (1982) studied Rocky Mountain bighorn sheep (O. c. canadensis) and cattle in a Colorado area where summer grazing by cattle was on bighorn winter range. Based on habitat type and diet overlap, he concluded that if cattle were removed, an additional 117 bighorn could have been supported in this area.

A situation like this in which cattle may be more directly competing with bighorn for food or space may occur in the White Canyon area if livestock operators are allowed to use mesa tops and upper talus slopes by driving cattle up existing roads, or to manipulate vegetation on mesa tops to make them more favorable to cattle grazing. This situation occurred during the winter of 1983 when a state school section was chained on top of a mesa within 1-2 miles of an area actively used by desert bighorn. Another state school section in the same area is scheduled to be chained in the spring of 1984. This chaining may act to further reduce already limited bighorn habitat. If

cattle are moved into close proximity of bighorn, diets may converge or bighorn may leave the area.

Third, there may be problems of disease transmission between bighorn and cattle. Positive titers for blue tongue, a viral disease that can be fatal to lambs or adults, have been found in bighorn and cattle in the White Canyon area (King and Workman 1983a, 1983b). Blue tongue is one of several diseases suspected to be responsible for high rates of lamb mortality by predisposing lambs to secondary pneumonia infections (DeForge et al. 1982). Cattle and bighorn may be serving as reservoirs from which the blue tongue virus is transmitted between populations. Further studies should be encouraged to determine if cross transmission occurs between cattle and bighorn and the potential effects of the disease.

The cautionary examples presented in the foregoing discussion do not by any means prove, nor do they disprove, there are competitive relationships between cattle and desert bighorn sheep in southeastern Utah. However, the current study and those previous have raised several issues that need to be resolved through appropriately designed research programs before any liberalized grazing plans should be implemented.

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