
NIKE GOODSON - EFFECTS OF RIVER-BASED RECREATION AND LIVESTOCK GRAZING ON DESERT BIGHORN SHEEP ON THE NAVAJO NATION

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Abstract: During the first 2 years of study of a desert bighorn sheep (*Ovis canadensis nelsoni*) population on the Navajo Nation, responses of bighorn sheep to changes in management of river-based recreation and livestock grazing were investigated. Rapid growth of the bighorn sheep population coincided with above-average precipitation and abundant forage production, providing evidence that the bighorn population was limited by forage availability. Forage availability was related to precipitation, livestock competition, and (to a lesser extent) conflicts with humans in areas of the river corridor used frequently for camping. Conflicts between boaters and bighorn sheep were reduced following implementation of regulations that eliminated dogs accompanying people and that closed areas of important habitat to camping. Heavy cattle grazing reduced available forage at feeding sites used by bighorn sheep; and bighorn sheep used areas less after they were grazed heavily by cattle. A decline in numbers of horses on the mesa top adjacent to the primary bighorn sheep range was followed by an increase in use of the mesa top by the sheep. These shifts in distribution indicated that bighorn sheep responded to changes in forage availability within their range. A lack of mountain lions and few coyotes on the bighorn range may have contributed to the ability of the bighorn herd to increase rapidly in response to increased forage availability.

Many factors influence the ability of desert bighorn sheep populations to persist in environments altered by human activities. Among the most important of these are human recreation and livestock grazing both of which are prevalent on bighorn ranges. Relatively few studies have addressed effects of either factor on bighorn populations, and even fewer have reported bighorn responses to changes in recreation management or livestock grazing. During a study of population dynamics and ecology of an indigenous desert bighorn population on the Navajo Nation we collected data on impacts of river-based human recreation and livestock grazing on the bighorn herd. We also monitored responses of bighorn sheep to changes in cattle grazing and recreation management.

Our study was initiated by the Navajo Nation Department of Fish and Wildlife. The objective was to discover information necessary to conserve

and enhance a native desert bighorn sheep population inhabiting the San Juan River Canyon on the Navajo Nation in southeast Utah. We present evidence that the population is limited by forage resources, depends on the San Juan River for water, and relies on the riparian zone along the river for green forage during late spring and summer. We report effects of human recreation on bighorn access to the river and effects of livestock grazing on forage availability and bighorn distribution. We also report findings on two other potential limiting factors: illegal hunting, and disease.

STUDY AREA AND METHODS: We are studying a native desert bighorn sheep population that inhabits the upper San Juan River Canyon in southeast Utah (Fig. 1), and is isolated from other bighorn sheep populations. The bighorn use only the south side of the river canyon which lies entirely within the Navajo Nation. The area is a cold desert. From late spring through summer high

temperatures range from 95 - 115°F. Winters can be mild or severe. Temperatures may drop below 0°F. and snow cover may persist for weeks. Average annual precipitation is 15 - 23 cm (6 - 9 in). Precipitation is extremely variable from month to month and year to year.

Ten ewes and seven rams were radio-collared during a drop-net capture operation by Helicopter Wildlife Management. We visually located radio-collared bighorn using telemetry tracking equipment approximately once per week year-round. For each observation we recorded location, group size and sex- and age-composition, marked bighorn present, habitat utilization, and movements. We recorded interactions of bighorn sheep with humans and livestock, and mapped observations of livestock on the bighorn range. We recorded vehicle traffic off established roads and on gated roads in the study area. We noted possible signs of sinusitis including persistent sneezing, head-shaking and eye and horn abnormalities, as well as signs that could indicate other health problems.

When we began observations, 10 of 13 ewes aged 3 years or older and 7 of 8 rams aged 3 years or older were radio-collared. Because of the high proportion of radio-collared individuals, we were able to estimate the total population by observing radio-collared individuals and counting and classifying their unmarked companions. We estimated mortality of lambs and yearlings by observing all radio-collared bighorn sheep within a few days when no marked bighorn moved between groups. We counted and classified their unmarked companions, and compared unduplicated counts of lambs and yearlings in succeeding weeks to estimate mortality in each age class. Radio-collared ewes were closely observed during the lambing season to determine if and when each lambed. In most cases, ewes were observed alone with their lambs before they rejoined other bighorn sheep.

Forage biomass available to bighorn sheep was measured at foraging sites which were sampled during late winter and spring, 1998. Foraging sites were located wherever it was possible to observe ewe groups feeding. At each site, available shrub

biomass was estimated by counting leaders of shrubs by species and weighing a sample of each. Biomass of forbs and grasses was estimated by clipping. Shrub biomass was estimated and forbs were clipped in 5 to 6 2-meter square plots per site, and grasses were clipped in 5 1-meter square plots per site.

RESULTS: Population Growth: Our study began in January 1997 following a 9 - year period of below-normal precipitation and a serious drought in 1996. Heavy cattle grazing occurred on most of the river corridor throughout the bighorn range during the summers of 1994 and 1995. The first year of the study (1997) was an El Nino year with abundant winter, spring and late-summer-fall precipitation. The desert responded with abundant growth of annual and perennial forbs and grasses.

There were 31 bighorn sheep in the population, including 13 ewes 3 years or older, and 3 2-year-old ewes. Lamb production was excellent in 1997. All healthy ewes 3 years and older (one ewe with sinusitis did not lamb) and 2 of 3 2-year-old ewes produced lambs. One set of twins was born. Precipitation was near normal and lamb production was good in 1998. Eleven of 15 ewes age 3 or older and 1 of 4 2 - year - old ewes produced lambs. No twin lambs were born in 1998.

Survival of lambs and yearlings was excellent both years. Fourteen lambs were born in 1997 and 10 lambs survived through winter. All were still alive in early April 1999. In 1998, 12 lambs were born and 10 survived. The 10 lambs born in 1998 were still alive in early April 1999.

We documented mortalities due to natural causes (one ewe died in lamb birth, a ram fell off a cliff, a second ram died of an unspecified infection possibly related to an injury). Human-related mortalities included one ram that was killed by an illegal hunter and a ewe that died from sinusitis (a disease believed to be introduced from domestic sheep and the incidence of which is related to proximity to domestic sheep; Bunch et al. 1978, Jessup 1985).

In the 2 years since the study began, the population grew from 31 to 47 bighorn sheep, a 52% increase. The greater percentage increase (26%) occurred in 1997 apparently in response to above-normal precipitation, abundant forage production and reduced competition from cattle. The population continued to increase in 1998 although the rate of growth (20%) declined coincident with a return to normal precipitation and increased cattle grazing on the bighorn range.

Impacts of River-based Recreation: The San Juan River is the only permanent year-round water source on the bighorn range. The bighorn access the river to drink at a limited number of areas where they have good visibility, protection of nearby cliffs, and secure footing. The number of areas that bighorn access the river to drink is most limited for lactating ewes with young lambs.

Bighorn clearly preferred areas near the river in summer. During July through September 1998, only 4 locations of 130 visual locations of bighorn groups were >1 km from the river. Two of these observations were of a single ram and 2 were of ewe-juvenile groups. During July through September we saw ewe-juvenile groups drinking at the river 18 times. We observed bighorn groups within 30 m of the river 30 times. The same radio-collared ewes were observed drinking on consecutive days twice (August 6 and 7, and August 23 and 24). Tracks at the river's edge and visual observations indicated that groups including lactating radio-collared ewes drank on successive days on three more occasions. Bighorn usually drank and fed on vegetation in the riparian zone when they were near the river. It was clear that the river attracted bighorn because it provided water and riparian vegetation remained green after upland herbaceous vegetation was uniformly dry.

The San Juan River is a very popular and busy recreation river. Numbers of boaters are regulated by permits allocated by the Bureau of Land Management. When the study began dogs were allowed with boaters floating through the bighorn range. Although permits were nominally required for camping on the Navajo side there were no effec-

tive restrictions on landing, camping, or picnicking within the bighorn range.

Early in the study we noted conflicts between recreation and bighorn in the Eight-Foot Rapid area. There were two very popular and heavily-used campsites above the rapid and three sites below the rapid. We also learned that the sandy beach above the rapid was the primary river access for bighorn using the central valley of their range. During the first year of the study we observed bighorn access the river to drink at Eight-Foot Rapid seven times (more times than at any other site). We also observed hikers and campers prevent bighorn from accessing the river. We never saw bighorn drink from the river when campers were present. The loose dogs that accompanied many groups were particularly disturbing to the bighorn.

We worked with the Bureau of Land Management to develop new regulations to reduce conflicts. The following changes were implemented in 1998: Dogs were not allowed on the river through the bighorn range and two popular campsites above Eight-Foot Rapid were closed to camping from April 15 through September 15. Three heavily used campsites immediately below the rapid were left open, but below these 3.2 km of shoreline on the Navajo side were closed to camping for the same period. This area had not been used heavily for camping in the past, however, we were concerned that the new limitations would cause an increase of use in this area which was an important lambing and nursery range.

In 1998, we monitored compliance with the new regulations. We observed no campers in the closed areas during the closure period. Groups continued to use the area above Eight-Foot Rapid for picnicking. We observed no groups hiking on the Navajo side with dogs in 1998, although a few parties were observed floating with dogs in their boats.

We saw bighorn drink at Eight-Foot Rapid twice as many times in 1998 following the closure as we did in 1997 before the closure was established

(Table 1). However, conflicts were not eliminated. On four occasions in 1998 some or all bighorn were prevented from drinking by people picnicking at the closed campsites or hiking into the valley from the lower campsites. We observed bighorn drink without being disturbed more times in 1998. In 1998 we saw one group with a week old lamb drink at Eight-Foot Rapid. In 1997 no lambs younger than one month old were observed drinking at Eight-Foot Rapid. In 1998 in comparison with 1997, bighorn appeared to better tolerate people using the shoreline, and were more likely to stay in the area remaining watchful, rather than leave the area when they saw humans.

Livestock Grazing and the Bighorn Sheep Range: The range of the San Juan Canyon bighorn sheep population includes approximately 26 km². The range consists of the upper and lower river corridors (7.2 and 5.2 km in length, respectively; about 6 km² in area) the central valley and ridges extending into it from Raplee Ridge (9 km²), Raplee Ridge and its west ridges (8 km²), and the mesa top adjacent to the central valley and the river corridor (3 km²). Of this total, about 60% is used exclusively by bighorn sheep. This includes the ridges east and west off Raplee Ridge and steeper areas of the river corridor. Cattle graze the riparian zone and gentler slopes on over 90% of the river corridor through the bighorn range (approximately 2 km²) and the bottom and lower slopes of the central valley (3 km²). Horses and burros graze the top and upper benches of Raplee Ridge and the mesa top adjacent to the central valley and river corridor (5 km²). Areas grazed by livestock were generally areas of greater natural productivity and included much of the gentler terrain and over 90% of the productive riparian zone within the bighorn range.

Most of the Navajo Nation is open range with no fences. Livestock wander over large traditional grazing areas that are passed down within families. Our knowledge of the grazing history of the area is based on interviews with Charles DeLorme, owner of Wild Rivers Expeditions, Bluff, Utah, a rafting company which has run the San Juan River through the bighorn range regularly since 1957.

He told us that the central valley of the bighorn range was grazed by horses from about 1977 to 1994 when the entire herd (15-20 head) was removed. The river corridor was grazed sporadically by cattle from 1970 through the early 1990's, and very heavily by cattle in 1994 and 1995.

From local grazing officials of the Navajo Nation we learned that cattle grazing the upper and lower river corridors during the first two years of our study belonged to Navajo ranchers who did not have traditional permits for these areas. The upper river corridor was grazed by cattle that graze on adjacent area by permit. They drift or are herded into the canyon periodically. The lower river corridor was grazed by cattle belonging to a resident of a nearby village (Halchita) who did not have a traditional permit, but allows his cattle to roam freely in the area. The central valley area was grazed under traditional permit.

Domestic Sheep and Goats: A primary reason for the survival of this bighorn sheep population is the lack of water and, therefore, lack of Navajo homes for 8 km south from the canyon rim. Navajos traditionally pasture their sheep and goats close to their homes and pen them at night for protection from predators. The closest domestic sheep herd south of the river is about 8 km from the bighorn range, although a small herd of domestic sheep is grazed about 5 km east of the bighorn range on the north side of the river.

Horses and Burros: Horses and burros are capable of traveling long distances for water and use areas with water inadequate for sheep or cattle. In 1997, higher elevations of the study area were grazed by at least 15 horses, 2 colts, and a burro on a regular basis. Other small groups of horses and burros were observed occasionally near the bighorn range. Following years of below normal precipitation, the mesa top vegetation had been overgrazed.

During summer 1997 most of the horses on the mesa were removed leaving about 7 head. The decline in utilization and excellent precipitation in 1997 resulted in improvement of vegetation condi-

tions on the mesa top. We did not observe any bighorn ewe groups on the mesa top during 1997. During January-late March in 1998 7% of observations of ewe groups were on the mesa top in the area used by horses.

Cattle: During 1997, cattle grazing on the bighorn range was limited to small groups that drifted in from both ends of the canyon when river levels dropped. High river flows during much of spring and summer 1997 blocked access by cattle along the river banks above and below the bighorn range and limited cattle grazing to low levels.

During the second year of the study, use of the bighorn range by cattle increased dramatically. In late December 1997, 29 head of cattle were herded into the central valley of the bighorn range. They produced 20 calves during February and March. At first they foraged on the flat areas and shallow slopes, but as forage was consumed in these areas the cattle moved higher on the slopes and up the side drainages.

By April, they were foraging above the lower rims, on slopes greater than 80% and had moved a half kilometer below Eight-Foot Rapid. On May 2, Navajo herders separated the 20 cows with calves and moved them out of the valley - leaving 9 head of yearlings and young cows. The remaining cattle concentrated their use in the riparian zone and the valley bottom. These areas were severely overgrazed by late July when the rest of the cattle were removed.

We compared biomass of herbs and shrubs among sites with different levels of cattle grazing in 1998. Comparisons were made within the desert shrub type which is the most abundant habitat. Comparisons made in late winter (mid-February - late March) when cattle had been on the range for 7 - 12 weeks, indicated a decline in biomass of herbs and shrubs in moderately to heavily grazed areas (Table 2). Comparisons in spring (early April - early June) when cattle had been on the range for 14 - 22 weeks indicated significant reductions in availability of herbs and shrubs with grazing (Table 2).

In 1997 prior to grazing by cattle, the central valley was preferred by bighorn sheep during late winter and spring. During January - March 21 of 1997, 71% of observations of ewe groups were in the central valley, although it comprised only 12% of the total bighorn range. In January - March 21 of 1998, after cattle were introduced to the range in late December, bighorn use of the central valley declined to 40% of total observations. During March 22 - June 21 in 1997, prior to cattle grazing, 24% of observations of ewe groups were in the grazed area. In March 22 - June 21 of 1998 after cattle had been on the bighorn range for more than 2 months, observations in the area used by cattle declined to 11% of total observations of ewe groups. By spring of 1998, most of the few observations in the grazed area were in marginal, steeper areas where cattle use was moderate or light.

During the first week of July, 1998, over 30 head of cattle belonging to a different Navajo rancher moved into the upper river corridor. By July 18, the cattle had moved down river to near the center of the bighorn range. Representatives of the Navajo Nation Department of Fish and Wildlife determined that the rancher did not have a permit for the area. Grazing officials contacted the rancher who removed his cattle the following week. Because of the prompt removal of the cattle, damage to the riparian zone was limited although heavy use occurred in some areas.

During late summer of 1998, normal monsoonal precipitation was scant and bighorn sheep were dependent on the riparian zone along the river corridor for green forage. Twenty-seven percent of total observations of bighorn during July - September 1998, occurred within the area used by cattle in the upper river corridor and within 0.1 km of the river. Had the cattle remained they would have grazed this area heavily and significantly reduced the amount of green forage available to the bighorn.

During 1997 and 1998 groups of up to 6 cattle grazed the lower river corridor intermittently. Less grazing occurred in 1997 because of high river flows that blocked access by cattle during much of

the summer.

Social Interactions between Bighorn Sheep and Cattle: We observed several interactions between bighorn and cattle. On March 19, 1998, after cattle had been on the bighorn range for approximately 2.5 months, a group of 6 bighorn ewes and juveniles moved down the side of a draw toward a sandy wash in the central valley. Approximately 12 cattle were in the valley bottom, mostly bedded. Several cattle rose and started moving along a trail in the bottom of the wash. One steer appeared to be curious and approached to within about 100 m of the bighorn. Frightened, the bighorn ran uphill away from the cattle about 100 m and then moved quickly across the slope parallel to the wash. Finally, they dashed down and across the valley through an area where cattle were absent and up the side of the opposite slope to the first rocky outcrops.

We also observed groups of bighorn avoid cattle on the beach above Eight-Foot Rapid on 2 occasions when the bighorn approached the river to drink. On May 31, 1998, 4 bighorn (3 lactating ewes and a female yearling) drank from the river above Eight-Foot Rapid when cattle were present. The cattle were at the beach area where the bighorn normally went to the river. On this occasion bighorn did not use their normal approach route, but accessed the river along the edge of a neighboring cliff apparently to avoid proximity to cattle occupying the beach.

Impacts of Illegal Hunting: Prior to our study, poaching was suspected but not documented for this herd. During early November 1997, a radio-collared ram was poached by a group of Navajos that accessed the study area through a gate that was vandalized in July. We found the collar under a gut pile a couple of days after the ram was shot. Following an investigation by a Wildlife Conservation Officer, 6 men were cited.

Impacts of Disease: In order to mark bighorn for this study, 24 bighorn 1.5 years of age or older were captured during helicopter operations in 1997, from a total of 30 bighorn over 1.5 years of

age. Of these 1 ram had 1 horn, having lost the other, including the entire core, due to sinusitis. A ewe had 1 horn that was severely infected and the horn sheath was loose. The ram was still alive in early April 1999. The ewe was captured in February of 1997, lost 1 horn including the entire core between February 1997 and May 1997, was observed looking emaciated and weak in July of 1998, and died in the late summer or fall of 1998. Her death was confirmed in spring 1999 when we found her skull and partial skeleton.

DISCUSSION: When our study began the bighorn population was precariously low following 9 dry years and 2 years of heavy grazing by cattle on the river corridor within their range. The population grew rapidly in response to increases in moisture and forage production, and declines in cattle and horse grazing on the bighorn range. This response provided evidence that forage availability was a primary limiting factor for the bighorn population.

Our observations indicated that the bighorn were dependent upon the river for water and on its adjacent riparian zone for high-quality green forage during summer. The beach above Eight Foot Rapid was both an important access to the river for the bighorn and a popular camping area for boaters. Bighorn were frequently disturbed there in 1997. Regulations that eliminated dogs on the river and closed the Eight-Foot Beach to camping appeared to benefit the bighorn, although they did not eliminate disturbance. We believe that bighorn habituated to humans more easily once the regulations were established because boaters were no longer accompanied by dogs and human recreation use was confined to a smaller area, thus becoming more concentrated and predictable.

The Navajo pattern of grazing livestock differs in major ways from livestock management on public lands in the rest of the United States. On U.S. Forest Service and Bureau of Land Management lands permits are based on the number of animals that areas can support during annual grazing seasons. Under normal conditions the areas are grazed similarly each year with the same stocking

rate, and the same season of use. Under unusually dry, wet, or snowy conditions, season of use and/or stocking rates may be modified.

In contrast, Navajo ranchers graze their cattle in an opportunistic way. An area with poor access, such as the central valley of the bighorn range, may not be grazed for several years, especially if conditions are dry and little forage is available. When they do graze, high stocking levels may devastate the vegetation. The grazing patterns that we observed were not unusual. In 1998, the stocking rate of cattle in the central valley was approximately 5 acres per animal-unit-month (AUM) which is about 4 times the stocking rate (20 acres per AUM) that the Bureau of Land Management uses as a general rule for similar range north of the San Juan River (pers. commun. Paul Curtis, Range Conservationist, Bureau of Land Management, Monticello, UT).

The heavy grazing by cattle reduced forage availability causing declines in use of the grazed area by bighorn sheep. On the mesa top surrounding the central valley, forage availability improved in 1998 relative to 1997 after horse use was reduced and late summer rains stimulated growth of perennial grasses and shrubs. Our observations indicated bighorn ewes responded positively to increased forage availability on the mesa top. These shifts in distribution demonstrated the capacity of desert bighorn to adapt their habitat use in response to changes in forage conditions.

During the 2 years of this study, illegal hunting and disease caused few deaths and did not appear to be important limiting factors. However, both of these factors were confounded by effects of the study itself. Navajo hunters probably prefer rams as targets because of the greater value of their horns for ceremonial purposes. It was well known among the local Navajos that a study was being conducted on the bighorn, all but 1 of the adult rams carried radio transmitters, and 6 hunters who killed a bighorn ram illegally in 1997 were cited. These factors may have made potential poachers hesitant to hunt bighorn.

A large proportion of the bighorn population was captured in 1997 for marking and each captured bighorn was treated for parasites. This treatment should have killed any bot fly larvae present in the bighorn and reduced the probability that any bighorn would develop sinusitis during the next year.

It is possible that illegal hunting which is suspected to be common on the Navajo Nation and heavy periodic grazing by cattle may benefit the bighorn sheep population by reducing the prey base for large predators. Desert mule deer populations are sparse on the study area, likely due to lack of forage and to both permitted and illegal hunting. Coyotes are uncommon. We have observed no evidence of mountain lions in the study area. It is possible that heavy livestock grazing and hunting have combined to keep mule deer populations low, and prevent lions from establishing territories on the bighorn range.

Lack of large predators may significantly benefit the bighorn. New Mexico desert bighorn populations coexist with mule deer populations. Lion predation is the most important mortality factor for many herds and may limit some populations (Rominger and Weisenberger 2000). We may not have observed the rapid population increase that occurred over the last 2 years had large predators been more abundant on our study area.

LITERATURE CITED

- Bunch, T.D., S.R. Paul, and H. McCutchen. 1978. Chronic sinusitis in the desert bighorn (*Ovis canadensis nelsoni*). Desert Bighorn Council Trans. 1978: 16-20.
- Jessup, D.A. 1985. Diseases of domestic livestock which threaten bighorn sheep populations. Desert Bighorn Council Trans. 1985: 29-33.
- Rominger, E.M. and M.D. Weisenberger. (2000). Biological extinction of desert bighorn sheep in the San Andres Mountains. Transactions, 2ND North American Wild Sheep Conference. 293-307.

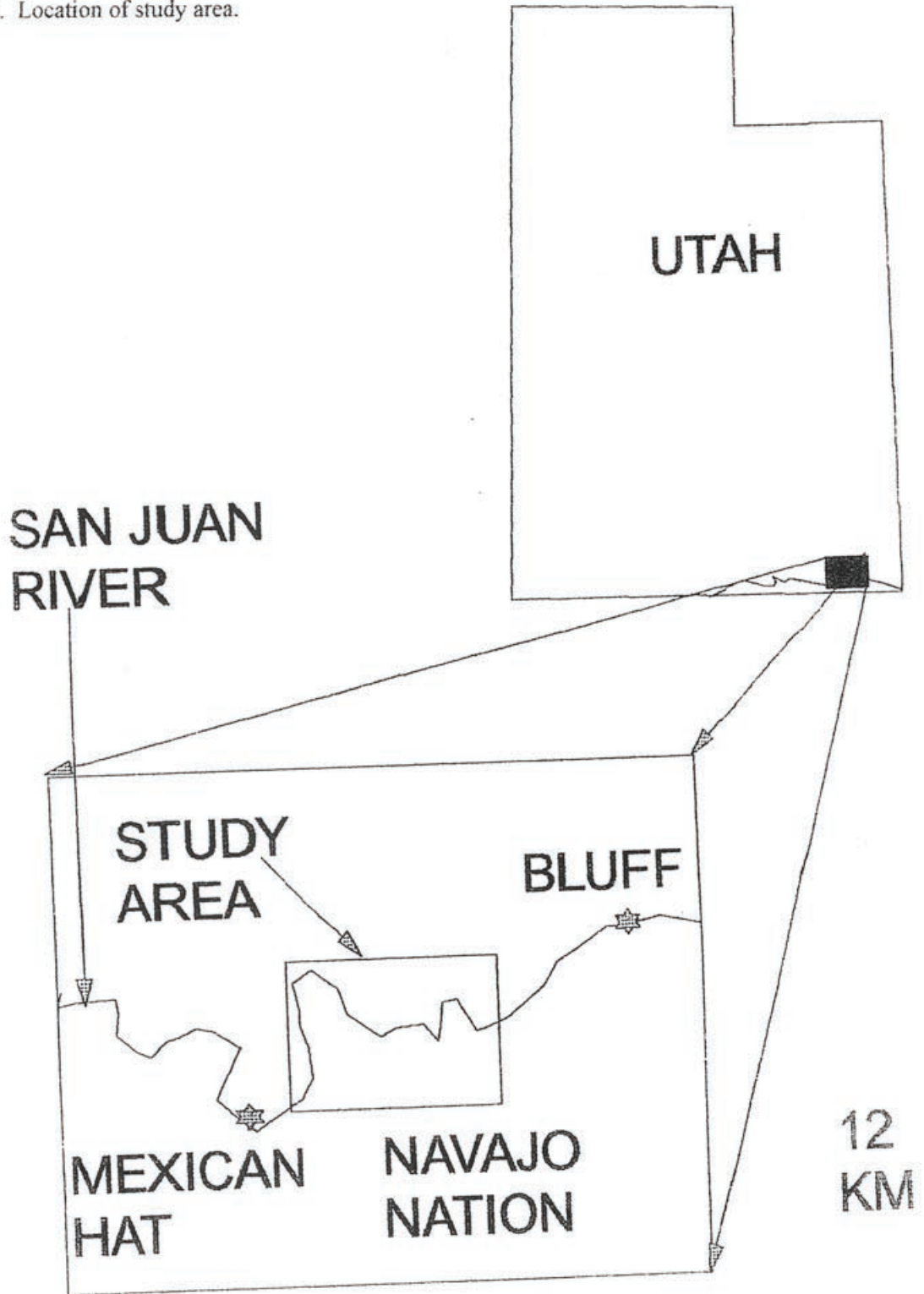
Table 1. Observations of bighorn sheep at the beach above the Eight-Foot Rapid during March - September 1997 when the area was open to camping compared with the same period in 1998 after regulations closed the beach to camping.

Number of Observations	1997	1998
Total Observations	11	16
Bighorn Drink at River	7	14
Bighorn Interact with Boaters	3	4
Boaters Prevent Bighorn from Drinking	3	4
Bighorn Drink Undisturbed	4	10

Table 2. Biomasses of forages at feeding sites of bighorn sheep in the desert shrub vegetation type in relation to intensity of grazing by cattle, 1998.

Period	Grazing Intensity	Number of Sites	Herb Biomass g/10m ² (SE)	Shrub Leader Weight g/10m ² (SE)
Feb-Mar	None	4	125 (22.8)	189 (47.5)
	Light	5	119 (21.2)	175 (38.3)
	Mod-Heavy	4	109 (18.2)	76 (33.6)
Apr-Jun	None	8	160 (22.9)	237 (53.1)
	Light	7	130 (12.0)	150 (54.5)
	Heavy	2	31 (2.4)	97 (3.7)

Figure 1. Location of study area.



QUESTIONS, ANSWERS AND COMMENTS - NIKE GOODSON PRESENTATION

JON HANNA, ARIZONA: I didn't see that you mentioned any loss of radio collared sheep due to predation. Is that because there are no lions or coyotes there or are these predators present?

NIKE GOODSON: I know predation is a problem in many study areas. There are coyote and fox on our study area. We didn't document any losses due to predation. We haven't documented any lions. There are very low populations of deer on our study area and we think that may be one reason why we don't have lions and we haven't seen predation losses.

But we do have coyotes. We had a ewe that broke a leg and was vulnerable for a period of weeks because she was pretty helpless until her leg healed, but she was not predated.

NORMAN McKEE, UTAH: Is there any thought of putting water catchments away from the rivers so you have an alternative water source? Secondly, I remember a few years ago the Navajo Nations offered a bid permit on this herd. How was that received and what is the future of that program?

GOODSON: There's been a little discussion of water catchments, however, I don't think that's a very good idea. The water situation is the reason we don't have domestic sheep grazing and is the main limitation on grazing of cattle. If we were to put in water sources for bighorns, the Navajo would probably use them to water domestic stock. They don't graze domestic herds or live close to the river because there are no water resources. We're concerned about developing water resources that would encourage them to increase their grazing in the area.

With regard to the permit, there were two permits offered, they were sold, and that's one of the sources for funding this study. The permits were offered and sold through the Foundation for North American Wild Sheep. There have been none since then, because the purpose of selling those permits was to obtain funding to obtain better information on the population and to establish an idea of whether we had surplus rams for auction. If the herd continues to increase, it is likely that more permits will be auctioned in the future.