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POPULATION DYNAMICS, SEASONAL DISTRIBUTION AND MOVEMENT PATTERNS OF THE LARAMIE PEAK BIGHORN SHEEP HERD

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Abstract: Radio-collared adult bighorn sheep ewes and associates were relocated from fall 1989 to spring 1992. The Laramie Peak bighorn sheep herd appears to be stable to declining based on herd unit numbers and sex ratios. Annual adult ewe morality was 10.8%. Mortality of three radio-instrumented ewes was caused from a fall, from Pasteurella sp., and from coyotes. Lambing rates were as high as 75%, but lamb survival was 33% or less. Lungworm infection levels were higher than levels found in other sheep herds in Wyoming. Ewes exhibited movements greater than 51 km from wintering areas to lambing areas. Bighorn ewes exhibited a social intolerance of domestic livestock when cattle were grazing in riparian areas.

Rocky Mountain bighorn sheep (Ovis canadensis canadensis) were re-introduced into the Laramie Peak area of east central Wyoming in 1964 from the Whiskey Mountain herd near Dubois, Wyoming (Bohne 1989). By 30 June 1989, 186 bighorn sheep had been released in the Laramie Peak Data Analysis Unit (DAU). In spite of the transplants, the Laramie Peak bighorn sheep herd appeared to be declining (Bohne 1989). Quantitative data on the Laramie Peak sheep herd are inadequate. Seasonal ranges, lambing areas and diet quality were poorly documented or unknown. Considerable effort has been expended to document sex and age ratios of the herd. However, due to the rugged and remote terrain, insufficient data have been collected.

The Wyoming Game and Fish Department has set the objective for the Laramie Peak bighorn sheep herd at 500 animals and the harvest objective at 24 rams annually. However, since the first hunting season in 1969, no single year harvest has exceeded 7 rams (Bohne 1989). The postseason 1991 population was estimated at 218 sheep, including 20 sheep released in January 1989 near Marshall.

In this paper we: (1) Evaluate herd composition and productivity, (2) examine mortality factors, and (3) estimate overlap for forage and space with domestic livestock.

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STUDY AREA

The Laramie Peak bighorn sheep herd was composed of subherds that inhabited: the Laramie Peak Wildlife Habitat Management Area and the Laramie River (DUC), the Sheep Creek drainage near Marshall (MAR), the LaBonte Canyon and Horseshoe Creek drainages (LAB), the Black Mountain-Albany Peak area (B-B), and the North Laramie River (NLR) canyon (Fig. 1).

Sheep were primarily found on steep slopes composed of big sagebrush (Artemisia tridentata)/and mixed grass and mixed shrub/mixed grass. Grass-dominated communities on windblown ridges were heavily used during winter months while ponderosa pine (Pinus ponderosa) and lodgepole pine/Douglas fir (Pinus contorta/Pseudotsuga menziesii) forests were used occasionally. Elevation ranged from 1,585 m to 3,131 m. Predominant soil types were very stony sandy loam and very cobbly sandy loam (Malcolm Edwards, Medicine Bow National Forest Soil Scientist, pers. comm.). Temperatures ranged from 33 C in summer to -40 C in winter. Precipitation averaged 35 cm at lower elevations. Wind speed exceeded 100 km/h in January and February during each year of the study.

METHODS

Fifteen adult bighorn sheep ewes were captured using a CODA netgun from a helicopter or immobilized with a dart containing a ketamine/xylazine mixture. Ewes were affixed with Telonics radio collars, aged by tooth replacement and horn annuli, ear tagged and blood samples were drawn by jugular venipuncture. Radio-instrumented sheep were relocated at least twice a week at MAR and DUC.

Herd composition was determined by relocating radio-collared ewes and their associates. Individuals were categorized into: adult ewes, yearling ewes, lambs, yearling rams, Class II, Class III, and Class IV adult rams (Geist 1971). All groups of sheep encountered were classified. Wyoming Game and Fish Department herd composition data collected between 1977 and 1989 were used to supplement population data from this study. These classifications were also used to assess herd productivity and population dynamics.

Mortality factors and lamb survival were assessed from classifications of radio-collared ewes and their associates. Dead sheep

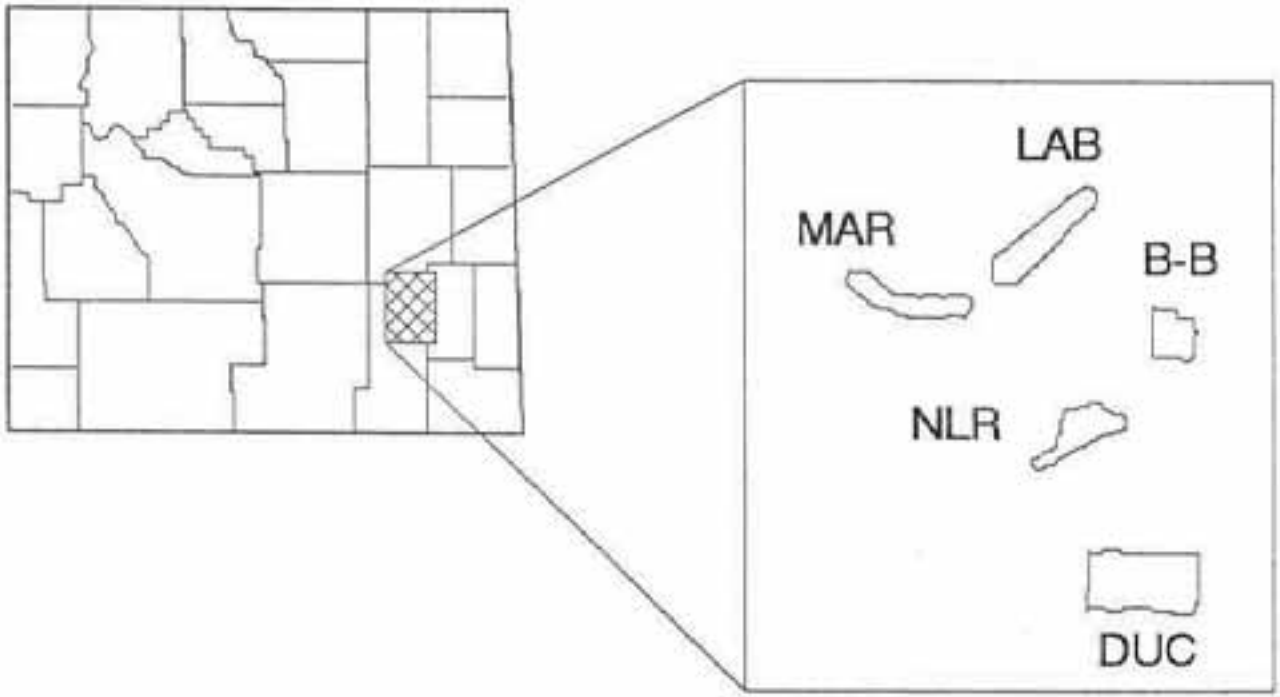

Fig.1. Study area and subherd locations of the Laramie Peak Bighorn Sheep Herd, Wyoming. (Laramie Peak Wildlife Habitat Management Area and the Laramie River (DUC), Sheep Creek Drainage near Marshall (MAR), LaBonte Canyon and Horseshoe Creek drainages (LAB), Black Mountain-Albany Peak Area (B-B), and North Laramie River (NLR)).

encountered were necropsied in the field or taken to the Wyoming State Veterinary Lab in Laramie for diagnosis.

Levels of lungworm infection in sheep were estimated by counting lungworm larvae per gram of dried fecal material using the Baermann technique (Beane and Hobbs 1983). Fecal samples were collected whenever found fresh in the field. They were grouped together for each area. Comparisons were made on a monthly basis. Fecal samples were divided into adult or lamb based on size of pellet. We were not able to collect in all winter months. Density of larvae in bighorn fecal material generally reflects severity of lungworm infection in lungs (Forrester 1971, Uhazy et al. 1973).

Relocations of radio-collared sheep were plotted on USGS 1:24,000 topographic maps. Spatial and temporal overlap of habitats by domestic cattle (Bos taurus) and bighorn sheep in the Duck Creek subherd were estimated by recording location, date, time, number, habitat type, and activity of the 2 species when encountered. Relocation points of cattle and radio-instrumented bighorn sheep ewes were plotted on USGS 1:24,000 topographic maps. Movement maps were constructed to compare seasonal ranges for cattle and bighorn sheep.

To monitor cattle grazing on the Duck Creek allotment, 5 square exclosure cages (1.2 m x 1.2 m x 1.2 m [4 ft. x 4 ft. x 4 ft.]) and 2 cone-shaped exclosure cages (0.9 m x 0.9 m at the base [3 ft. x 3 ft.]) were placed along Duck Creek in the riparian zone. Five cone-shaped exclosure cages of the same size as above were placed from 45 m (ca. 50 yds.) to 90 m (ca. 100 yds.) up the slope from the riparian zone. Vegetation inside and adjacent to the cages was clipped in May 1991 and 1992 prior to turnout of cattle on the allotment. Vegetation was clipped in and adjacent to the cages in September or October 1990 and 1991 after cattle were removed from the allotment. Three 0.089-m^2 (0.96-ft^2) random circular plots were clipped inside the exclosure cages and 5 were clipped outside the cages.

RESULTS

Herd Composition

Herd composition consisted of a minimum of 29 adult ewes at DUC, 22 at MAR, 24 at NLR, and 3 at B-B (Table 1). Number of adult males included a minimum of 14 at DUC, 9 at MAR, 8 at NLR, and 3 at B-B. The single day non-repetitive high count of Class III rams was 5 at DUC, 4 at MAR, and 1 each a NLR and B-B. Single day non-repetitive high counts for lambs were 12 at DUC, 11 at MAR, 16 at NLR, and 2 at B-B.

Yearling male and female ratios per 100 adult ewes declined from 27.5 in 1989 to 12 in 1991 apparently at DUC. Similar declines were observed at the other subherds. Lamb ratios at DUC were variable between years and declined within the year (Table 1). Similar results were observed at other subherds (Table 1).

A group of 5 ewes wintering south of the main herd at MAR during 1990 and 1991 apparently was not bred and did not produce lambs for 2

Table 1. Minimum, non-repetitive estimates of sheep at Duck Creek, and the North Laramie River, Wyoming.

Year	Adult ewes	Yearling ewes	Yearling rams	Summer lambs	Winter lambs
			Duck Creek		
1989	29	4	4	4	2
1990	27	5	1	8	3
1991	25	2	1	12	4
			Marshall		
1989	19	4	4	7	6
1990	21	4	2	7	2
1991	22	4	1	11	4
			North Laramie River		
1989	10	3	3	5	3
1990	18	1	2	9	3
1991	24	2	1	16	12

Table 2. Seasonal lungworm infection levels for the Laramie Peak bighorn sheep herd and from other studies.

	L. Peak		N. Platte[a]		Encampment[a]		Whiskey Mtn.[b]		Alberta[c]		Alberta[d]		Montana[e]	
	mean	n	mean	n	mean	n	mean	n	mean	n	mean	n	mean	n
Winter	492	28	306	366	112	95	385	152	185	153	520	80	337	146
Spring	413	68	144	152	-	-	-	-	218	231	535	96	554	142
Summer	88	118	92	433	55	116	32	98	23	5	135	52	337	158
Fall	128	73	87	405	40	100	35	120	80	80	472	32	327	137

[a]Cook et al. 1989

[b]Thorne et al. 1979

[c]Gates 1975

[d]Uhazy et al. 1973

[e]Forrester and Senger 1964

consecutive years. One radio-instrumented ewe, after spending the majority of the winter with these non-breeding ewes in 1991, rejoined the main group of sheep at MAR during April 1991. This ewe made a substantial movement to LaBonte Creek (LAB) during July-August 1991. The ewe subsequently died apparently from a fall on 19 August 1991. When necropsied, the ewe was pregnant with a near term ewe lamb.

Mortality

Three radio-collared ewes died during the study. Two died at LAB, 1 from a fall (the pregnant ewe) and the other from Pasteurella- induced pneumonia. Coyotes killed a radio-collared ewe at DUC. Fifteen adult ewes were monitored for an average of 1.84 years, yielding an average annual adult ewe mortality of 10.8%.

Parasites

Mean monthly lungworm larvae per gram dried fecal material for adults ranged from 279 in February 1992 to 24 in July 1991 at DUC. Lungworm levels were higher at MAR ranging from 1,811 in November 1991 to 60 in August 1990. Lungworm larvae in lambs at MAR ranged from 0 in October 1991 to 571 in August 1991. Lungworm infestation rates at NLR were 1,166 larvae per gram in April 1991 and 26 in August 1990. Lungworm larvae in lamb feces from NLR ranged from 0 in August 1991 to 294 in January 1990. Seasonal lungworm infection rates for the Laramie Peak sheep herd were higher than levels reported from herds in other parts of Wyoming (Table 2).

Spatial and Temporal Overlap

Bighorn sheep ewes used the Duck Creek riparian zone and adjacent canyon walls extensively during April-June (Fig. 2). Bighorn sheep ewes were not found in or near the Duck Creek riparian area during July (Fig. 3). From August to September, bighorn sheep ewes again used the riparian zone and canyon walls extensively (Fig. 4). Bighorn sheep seasonal diet composition shifted from grasses and forbs in April-June to bitterbrush (Purshia tridentata) browse in July and back to grasses and forbs in August-September. Cattle used the Duck Creek and Ashley Creek riparian zones exclusively while on the allotment in July. Cattle were not observed grazing up the slopes of the canyon walls.

Forage utilization by cattle in the Duck Creek riparian zone indicated moderate to heavy grazing. Forage removal was 66% in 1989, 52% in 1990, and 57% in 1991. Pre-turnout utilization was 51% in May 1992 compared to 15% in May 1991.

Small bands of 15 to 75 domestic sheep (Ovis aries), occurred within 1.0 km of most of the subherds of the Laramie Peak bighorn sheep herd. At MAR, a flock of domestic sheep occupied range frequented by bighorn sheep.

Radio-collared ewes at DUC used the Duck Creek riparian area extensively during April-May, June, and August-September. These ewes were not observed in that riparian zone during July, 1991. Winter distribution of sheep at DUC was more dispersed than at any other time of year.

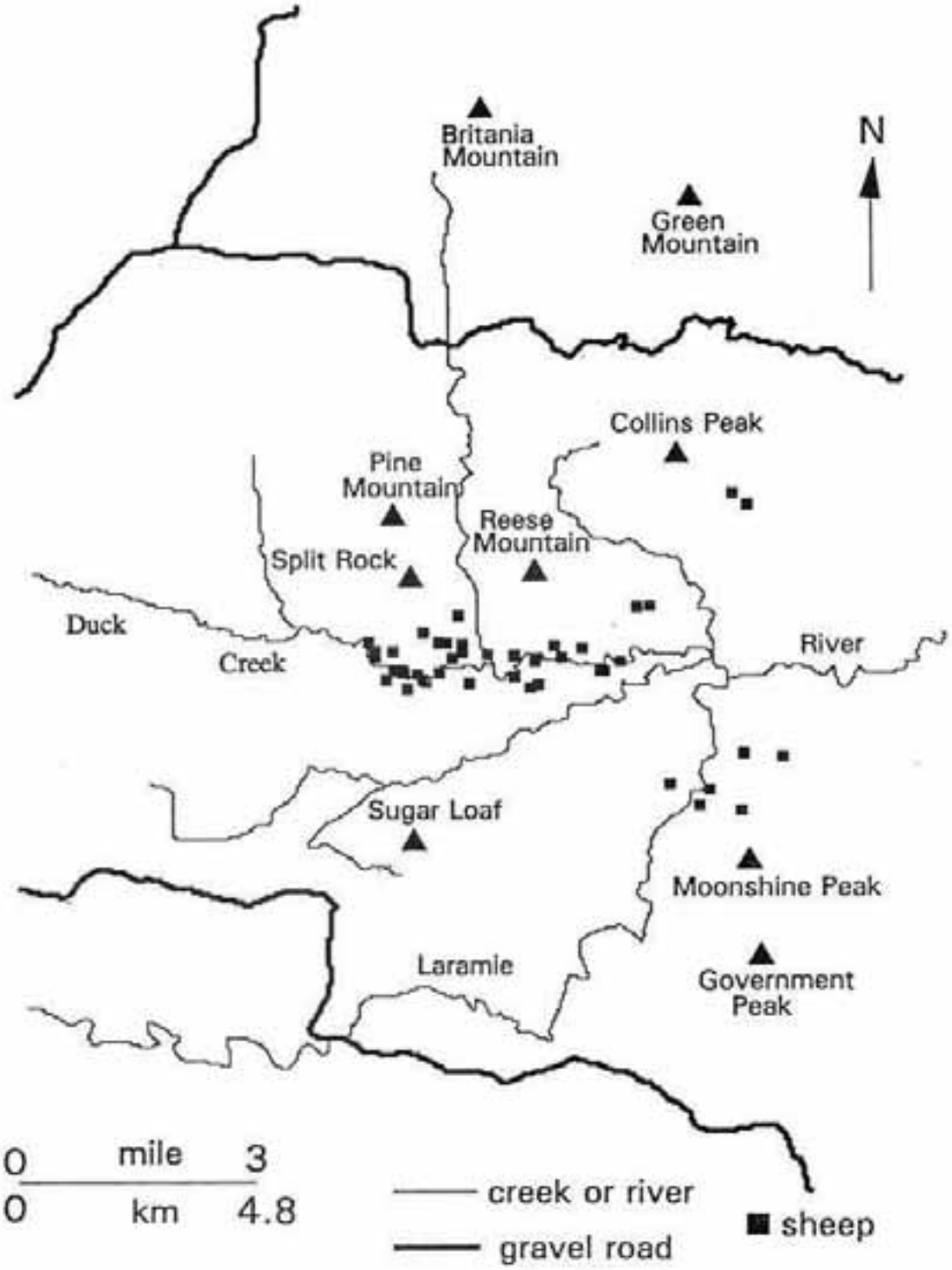

Fig. 2. Distribution of radio-collared sheep ewes and associates in the Duck Creek subherd near Laramie Peak, Wyoming, April-June 1990-92.

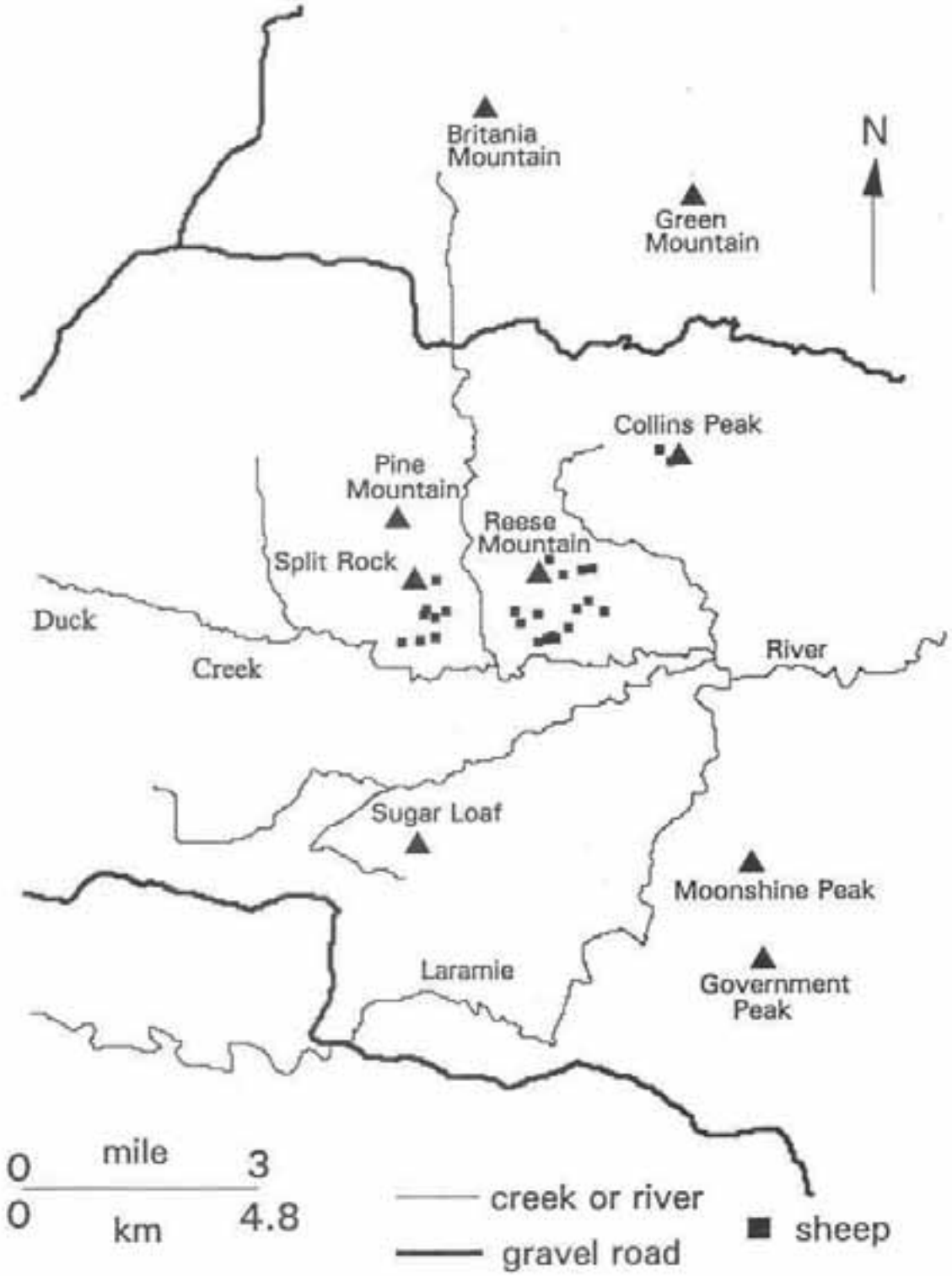

Fig. 3. Distribution of radio-collared bighorn sheep ewes and associates in the Duck Creek subherd near Laramie Peak, Wyoming, July 1989-91.

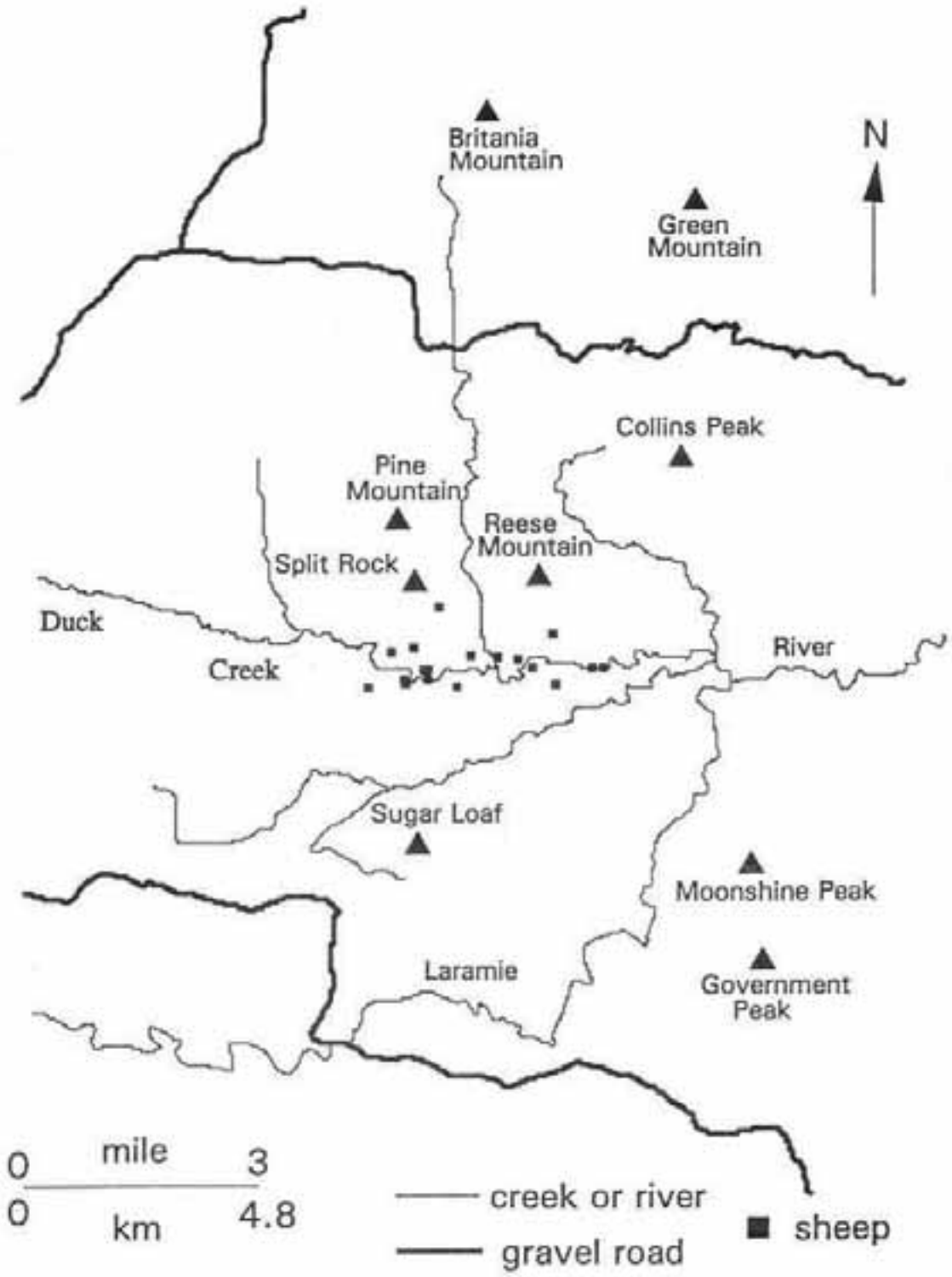

Fig. 4. Distribution of radio-collared bighorn sheep ewes and associates in the Duck Creek subherd near Laramie Peak, Wyoming, August-September 1989-91.

DISCUSSION

Variation in productivity among the subherds could have been due to available forage. For example, bighorn sheep in the MAR subherd had access to irrigated meadows. These meadows provided lush forage during hot summer months. Sheep in the NLR subherd had access to large alfalfa fields, while sheep at DUC did not have access to irrigated meadows or alfalfa fields, but had access to riparian vegetation. Sheep at DUC used springs and seeps on the higher slopes of Reese Mountain and Split Rock if other forage was not available.

Ewes at NLR had higher lambing rates and higher lamb survival than ewes in the Marshall or Duck Creek subherds perhaps due to the higher quality alfalfa diet. Lambing rates and survival were higher in 1991 than the previous 2 years due to increased forage from heavy summer rains. Over 20.3 cm (8 in.) of rain fell in the Duck Creek area from 15 May to 15 June 1991. Another 6.9 cm (2.7 in.) fell on 24 July 1991. Increased forage production due to above average rainfall could have been responsible for the increased lamb recruitment in winter 1991. High lamb:ewe ratios in 1989 at MAR were probably due to release of 9 adult ewes and 5 lambs from the Whiskey Mountain herd in January 1989. The ewes were likely pregnant prior to release. High yearling:ewe ratios at MAR during winter 1989 could also be attributed to the transplant.

Bighorn sheep ewes avoided the riparian zone of Duck Creek during July 1991 when cattle were present. Other studies indicate conflicts between bighorn and cattle for forage in Idaho (Anderson 1976) and British Columbia (Demarchi 1970). In Utah, desert bighorn sheep did not move into an area after it had been grazed by cattle (King and Workman 1984). When cattle grazed areas year-round, bighorn sheep avoided the areas (Bodie and Hickey 1980). Other studies concluded little overlap in distribution by desert bighorn (*O. c. mexicana*) and cattle or a social intolerance of cattle by bighorn sheep (Wehausen and Hansen 1986, Dodd and Smith 1988). Cook et al. (1989) found little impact on bighorn sheep grazing from livestock at Douglas Creek, Wyoming. Bighorn sheep that used Duck Creek when cattle were not present, avoided the area when cattle were present, and returned to the area after cattle were removed indicate a social intolerance to cattle. Our results show sheep were displaced to higher slopes that the cattle did not utilize. Because of displacement, lactating bighorn ewes were deprived of high quality forage found in the riparian zone. Cook et al. (1989) inferred that milk production by lactating ewes declines when forage quality decreases. Lamb survival was also reported to decline when ewes produce low levels of milk during July and August (Cook et al. 1989). Lamb survival declined during September at DUC.

Four trespass horses were confined to approximately 1.25 km (0.78 mi.) of the Duck creek riparian zone for 4 weeks in early 1992. This stretch of the Duck Creek riparian area was severely grazed when checked in May 1992.

A combination of factors appeared to control the Laramie Peak bighorn sheep herd. Lamb survival and recruitment could drop to levels that cannot maintain the herd if lactating ewes are unable to find high quality forage from riparian areas, alfalfa fields or irrigated meadows.

Although lamb productivity and yearling recruitment were variable among subherds, data for 1989-1991 suggest sufficient recruitment for the herd to maintain itself most years (Table 1). If adult mortality of radio-collared ewes is representative of this segment of the sheep population, then adult ewe mortality may offset recruitment.

Small isolated bands of ewes that were not bred indicated rams were few or could not locate ewes during the normal breeding season. Differences in available forage could explain variation in juvenile:adult ewe ratios between subherds. Alfalfa fields at NLR provided high quality forage for lactating ewes during late summer, when lamb:ewe ratios were 67:100 in 1991 (Table 1).

More important than high quality forage, small bands of domestic sheep occurred within 1.0 km of most of the subherds of the Laramie Peak bighorn sheep herd. Transmission of pathogens from domestic sheep to bighorn sheep has been implicated (Foreyt 1990, Foreyt 1992). Exposure of domestic sheep to bighorn sheep, permitting nose to nose contact has caused 100% mortality of bighorn sheep (Foreyt 1992). No amount of high quality forage will compensate for exposure to lethal pathogens. Bighorn sheep and domestic sheep are not compatible on the same range according to Foreyt (1992).

MANAGEMENT IMPLICATIONS

Disease and inadequate forage are major problems facing biologists attempting to manage the Laramie Peak bighorn sheep herd.

If habitat for bighorn sheep is the primary goal, and forage is a limiting component of the habitat, domestic livestock and horse grazing must be curtailed. A major problem for bighorn sheep in the Duck Creek subherd was displacement from an area containing high quality and quantity of forage at a time when lactating ewes were under nutritional stress. Appropriate fences or removal of livestock grazing are needed to resolve the problem.

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