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INTERIOR SHEEP STUDIES

BY
Wayne E. Heimer

Volume V

Final Report
Federal Aid in Wildlife Restoration
Projects W-17-8 through W-17-11, Job 6.11R

and

Project Progress Report
Federal Aid in Wildlife Restoration
Project W-17-11, Jobs 6.9R and 6.12R

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FINAL REPORT (RESEARCH)

State: Alaska

Cooperator: Wayne E. Heimer

Project Nos.: W-17-8 thru W-17-11 Project Title: Big Game Investigations

Job No.: 6.11R Job Title: Seasonal Availability of Dall Sheep Range

Period Covered: July 1, 1975 through June 30, 1979

SUMMARY

Prevalent thought suggests that differences in population "quality," i.e. vigor, between dissimilar Dall sheep populations result from differences in food quality or quantity. As a first test of this hypothesis, Dall sheep densities for two study populations were determined on winter and summer ranges. Density of sheep per km^2 in the low quality (poor) population was about 3 times higher on winter range and 2.5 times higher on summer range than in the higher quality population.

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BACKGROUND

Since Geist (1971) scientifically formalized the common observation that not all populations of wild mountain sheep were the same in his "Quality Hypothesis" (now referred to as the Dispersal Theory, Geist 1979), students of wild sheep have made much of the differences and have observed and speculated on their causes. Several investigators (Shackleton 1973, Horejsi 1976) have documented the phenomenon of population differences in bighorn sheep (*Ovis canadensis*), and Heimer and Smith (1975) published similar data showing differences in Dall sheep (*Ovis dalli*). Many hypotheses have been proposed to explain these differences, but nutritional considerations are common to virtually all of them. Simply stated, the common hypothesis is: "Some populations of wild mountain sheep are more vigorous than others because they eat better than others."

This hypothesis is difficult and involved to test. Successful evaluation requires a thorough knowledge of the total nutritive resource available and its utilization and quality for differing study populations. Knowledge of the environmental parameters which may alter nutritional requirements without directly relating to food or food production is also necessary. A first step in understanding this complex series of interactions is to measure the habitat available to each individual in differing populations. Of course, density will differ with season and year depending on snow conditions. Hence, the beginning step is to determine density on summer and winter ranges over several years in "healthy" and "unhealthy" populations. This report deals with that objective - one portion of an overall study dealing with the basic, food limiting hypothesis stated above. It should not be considered as a complete work in itself. To provide background on both study populations the following information is provided.

Ram horn growth is a sensitive indicator of population quality (health) in mountain sheep (Geist 1971). Heimer and Smith (1975) assessed Dall ram horn growth in 18 different areas in Alaska. They analyzed three areas from the eastern Alaska Range (ARE). The area designated ARE I ranked 17th of 18 areas studied statewide while ARE III ranked 4th of 18. Both areas are on the north side of the eastern Alaska Range and are separated by a distance of 200 km (Fig. 1).

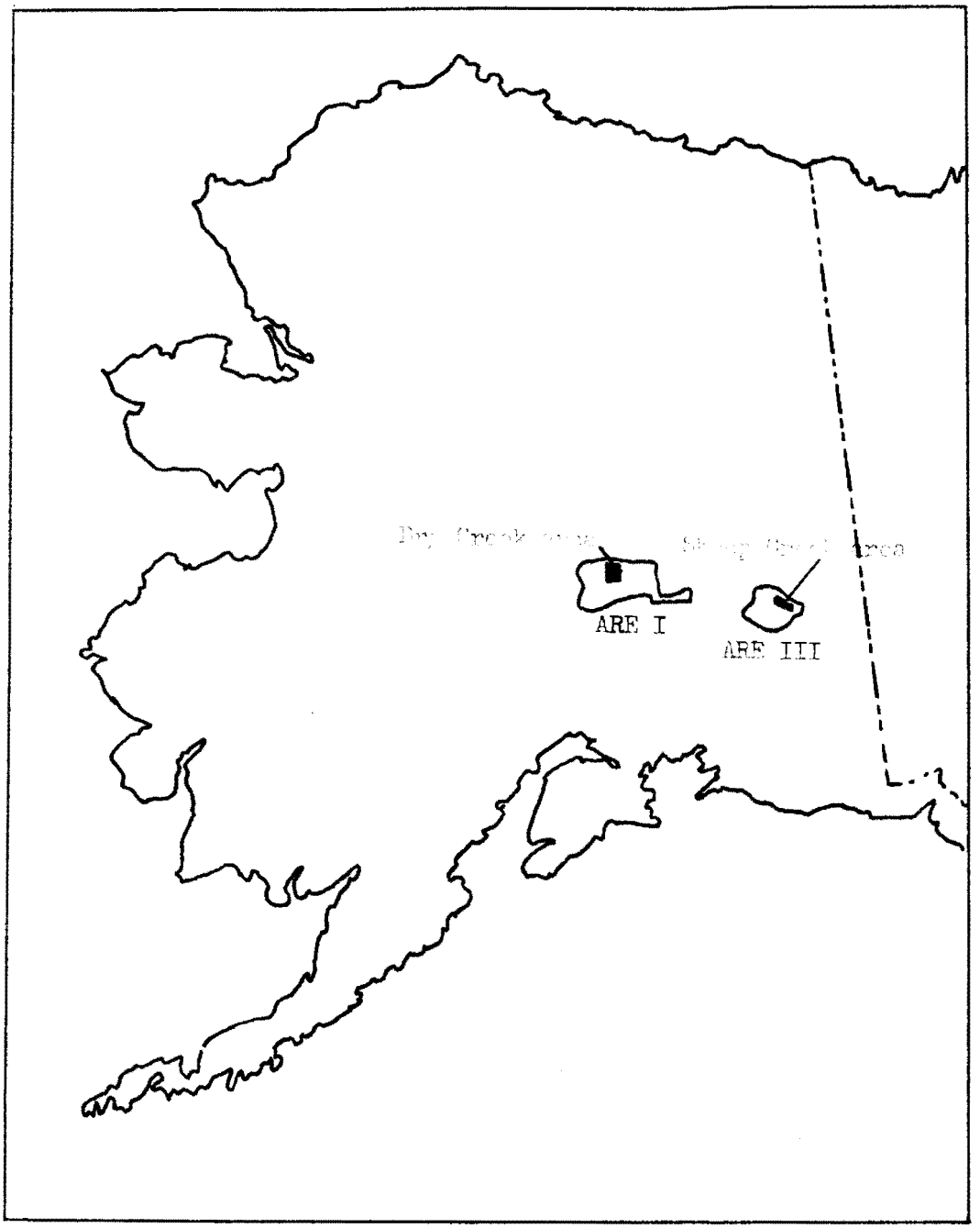

Fig. 1. Study area location within Alaska.

The Dry Creek study area, within the low quality ARE I, is characterized by fairly gentle hills, short drainages, and relief which ranges from about 2,500 to 5,000 feet (800 to 1,700 m). Few glaciers persist in this area, and vegetative cover is extensive. The Sheep Creek study area, in the high quality ARE III, is characterized by long drainages with greater elevational relief, more recent glacial activity, steep, unstable slopes, and vegetative cover which is sparse compared to Dry Creek.

Heimer and Smith (1975) characterized the horn growth patterns in ARE I and ARE III as shown in Table 1.

Table 1. Differences in ram horn characteristics between ARE I and ARE III.

	Mean volume at 7 years (cubic centimeters)	Maximum expected volume (cubic centimeters)	Maximum sustained growth rate (cc/yr)
ARE I	1282	1841	282
ARE III	1796	2301	402

In addition to considering the differences in growth rate and attainable size between the two study populations, Heimer (1978) summarized initial production figures from 1974 through 1977 for both areas. The healthy Sheep Creek population averaged 47 lambs per 100 ewes for the period, and the less vigorous Dry Creek population averaged 38 lambs per 100 ewes. Yearling recruitment for the Sheep Creek population averaged 26 yearlings per 100 ewes (55% survival), while Dry Creek averaged 20 yearlings per 100 ewes (53% survival) for the same period. During 1974 surveys sheep density on summer range for ARE I was 0.83 animals per km^2 and that for ARE III was 0.36 animals per km^2 (Heimer and Smith 1975).

OBJECTIVES

To determine the population density of Dall sheep in two populations of differing vigor.

To compare the extent of winter range limitation to two Dall sheep populations of differing vigor.

To test the hypothesis that differences in Dall sheep population vigor are nutritionally generated.

PROCEDURES

Population Size

Aerial surveys of each study area were used to estimate total population numbers. The Dry Creek area was surveyed in 1975 using a Helio Courier 250 with a pilot and two observers (Heimer 1976). The area was surveyed again in 1979 using a Piper PA-18-150 Super Cub with a pilot and one observer. Total survey time in 1979 was 1 hour and 55 minutes.

The Sheep Creek study area was surveyed during 1974 while sheep were on their summer range (Heimer 1975). Winter range numbers were determined by a survey in late September 1976. These surveys were done using a Helio Courier 250 with a pilot and one observer. The late September survey in 1976 required 2 hours and 30 minutes.

Winter Range Availability

The area available to sheep at the end of winter was estimated in early April by making low-level helicopter flights to determine areas of sheep use. Feeding sites, tracks, and the presence of sheep were used as indicators. After initial data were gathered by helicopter, fixed-wing overflights were used to map the area of available winter range.

Range Area

The areas of winter and summer range for each population were determined by plotting known areas of sheep use on 1:63,360 scale USGS topographic maps and measuring the areas with a compensating polar planimeter. The extent of seasonal ranges was determined in both study areas on the basis of resightings of marked individuals (see Heimer 1973 for details in Dry Creek). The resighting data for Sheep Creek animals have not yet been fully compiled and published.

FINDINGS

Population Sizes

The 1975 Dry Creek aerial survey (Heimer 1976) indicated a total estimated population of 350 sheep within the study area. Another survey during 1979 yielded an estimated total population of 410. There is little doubt that the population actually increased from the 1975 level. Favorable conditions resulted in high initial lamb production and yearling recruitment during the 1976-1979 period.

In the Sheep Creek study area during 1974 (Heimer 1975) the summer population was estimated at 450 sheep. An early winter survey supported this estimate when 360 sheep were observed on winter ranges in the same area before snowfall in 1976.

Table 2 shows the calculated density of sheep on summer and winter ranges from 1975 through summer 1979 for the Dry Creek study area, as well as the available data from Sheep Creek.

Estimates of summering populations (Table 2) indicate the density of sheep in the area with greater population vigor (Sheep Creek) is 39 percent of that within the area of poorer population health (Dry Creek). This figure agrees with that of Heimer and Smith (1975) whose data showed the population in ARE III to be 42 percent of that in ARE I. Expressed another way, the population in the poorer quality area is 2.5 times as dense as that where the population shows signs of better vigor.

Table 2. Dall sheep density on summer and winter ranges for the Dry Creek and Sheep Creek study areas.

Study Area	Year	Summer population	Summer range area (km^2)	Summer density sheep/ (km^2)	Winter population	Winter range area (km^2)	Winter density sheep/ (km^2)
Dry Creek	1975	350	112	3.1	350	80*	4.4
	1976	350**	112	3.1	350	62*	6.0
	1977	370**	112	3.3	370	65***	5.7
	1978	390**	112	3.5	390	75***	5.2
	1979	410	112	3.7	410	--	--
				x=3.3			x=5.3
Sheep Creek	1974	270	190	1.4	450	--	--
	1975	450	350	1.3	450	--	--
	1976	450	350	1.3	450	250***	1.8
				x=1.3			

* Fixed-wing survey of winter range availability.
** The population increased between 1975 and 1979, but there was probably no increase in 1976 because of poor lambing that spring. The increase was arbitrarily calculated as linear from 1976 through 1979.
*** Helicopter survey of winter range availability.

Winter range density averaged 5.3 sheep per km^2 in the poorer quality Dry Creek area, and the single measurement from Sheep Creek was 1.8 sheep per km^2. Thus densities on winter range at Dry Creek are almost three times those at Sheep Creek.

The increase in sheep density from summer to winter in Dry Creek averaged 61 percent over 4 years, in contrast to a 38 percent increase in density on winter range in Sheep Creek. It should be noted that the one year an estimate of winter range availability at Sheep Creek was made was followed by lamb production of 52 lambs per 100 ewes. This was only slightly greater than the average, indicating the winter was neither extremely favorable nor harsh, and the increase in density may have been "average." The limited data indicate there may be less winter range restriction for sheep in the area where population vigor is better.

The use of map area is only an indication of the actual area of range available. Actual range availability would be disproportionately greater in the Sheep Creek study area because of greater topographic relief. This would lead to a greater disparity in sheep density between the two areas. Even using the map area as an index of range availability, all evidence points to a genuine difference in habitat availability between the two study populations. There is no doubt that the

density of sheep per available habitat unit is greater in the less healthy population.

The question of whether this difference in habitat availability translates directly into a nutritional advantage for the less dense population still remains. Further studies are underway which should answer this question. Preliminary results from these studies (as yet unpublished) indicate the answer is negative.

MANAGEMENT RECOMMENDATIONS

This study is only a small part of an overall attempt to evaluate the food limiting hypothesis. It should not be used as the basis for management recommendations.

ACKNOWLEDGMENTS

I would like to thank William Gasaway of the Alaska Department of Fish and Game for gathering the 1976 data on winter range availability in Dry Creek when I was too ill to do it.

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JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperator: Wayne E. Heimer

Project No.: W-17-11 Project Title: Big Game Investigations

Job No.: 6.9R Job Title: Dynamics of Selected Sheep Populations

Job No.: 6.12R Job Title: Dall Sheep Condition and Nutritional Profile

Period Covered: July 1, 1978 through June 30, 1979

SUMMARY

Comparative studies of two differing sheep populations continued. Initial lamb production and yearling recruitment were observed in both populations. Forty sheep were trapped and marked in the Sheep Creek population. No differences in food quantity or quality in the study populations were revealed by gross body composition or proximate analysis of washed rumen contents.

CONTENTS

BACKGROUND

The introduction and background of this Dall sheep (*Ovis dalli*) study were detailed in earlier reports (Heimer 1977). The most recent discussion relative to progress of the study is that of Heimer (1978).

OBJECTIVES

To determine initial lamb production, yearling recruitment, survival, and reproductive frequency in the low-quality Dry Creek sheep population and these same variables in the high-quality Sheep Creek population.

To determine the quality of forage and seasonal body composition in two sheep populations of greatly differing population quality.

PROCEDURES

Procedures for Job 6.9 have been discussed in detail by Heimer (1977). However, during the past report period new trapping techniques were developed for application on Dall sheep. Dall sheep were captured using a 40x60-foot rocket net obtained from Wildlife Materials Inc. in Carbondale, Illinois. Some sheep were also captured by immobilization with M-99. A dosage of 3 mg of M-99 was found to be sufficient for adult Dall sheep. Acepromazine maleate, a tranquilizer, was also used. All captured animals received intramuscular injections of 3 to 8 mg depending on body size and anticipated handling time.

Collection and preparation techniques for the body composition work were identical to those reported in detail by Heimer (1977). Calculation of body composition of component parts was done as illustrated below:

Basic Data

Accession No. 4565 female, age 18 months, collected 10/29/76
Total live mass - 42.7 kg
Rumen-Reticulum fill - 5.68 kg
Other gut contents - 0.75 kg

One-half carcass at analysis - 14.1 kg
One-half carcass fresh weight - 16.4 kg
Bones in one-half carcass - 1.94 kg
Visceral mass (exclusive of alimentary contents) - 3.46 kg
Visceral homogenate composition - 54% water, 2.2% fat, 2.25% protein
Carcass homogenate composition - 15.2% fat, 11.1% protein, 33.8% water

Calculations

14.1 kg carcass at analysis x 0.152	=	2.14 kg fat
14.1 kg carcass at analysis x 0.111	=	1.57 kg protein
one-half total bone mass	=	1.94 kg bone
		5.65 kg non-water materials

5.65 kg of non-water material subtracted from the fresh carcass weight of 16.4 leaves 10.75 kg water or 65% water in the fresh carcass

Similarly:	3.46 kg viscera x 0.54	=	1.87 kg H_2O
	3.46 kg viscera x 0.214	=	0.74 kg fat
	3.46 kg protein x 0.225	=	0.78 kg protein

Summing:	Sampled body mass	=	36.19 kg as below
	2 x 10.75 kg H_2O	=	21.50 kg in carcass
	2 x 2.2 kg fat	=	4.28 kg in carcass
	2 x 1.57 kg protein	=	3.14 kg in carcass
	2 x 1.94 kg (1/2 bones)	=	3.88 kg bones
			1.87 kg H_2O in viscera
			0.74 kg fat in viscera
			0.78 kg protein in viscera
			36.19 kg total mass

Percent of sampled body by component equals:

Water - 64.6%
Fat - 13.7%
Protein - 10.8%
Bone - 10.7%

Reconstruction of body as a check on calculations: Live mass = 42.7 kg. Subtracting sample mass of 36.19 kg leaves 6.51 kg, and subtracting the mass of rumen/reticulum contents of 5.68 leaves 0.83 kg. This mass minus gut contents of 0.75 leaves 0.08 kg error, or an error of 0.02 percent.

FINDINGS

Dynamics of Selected Sheep Populations

Production of lambs in Dry Creek during 1978 was 41 lambs per 100 ewes. Survival of last year's high lamb production (58 per 100 ewes) was 43 percent giving an observed ratio of 25 yearlings per 100 ewes. Total population was not estimated for 1978. It is interesting that the yearling:ewe ratio is not greatly different from that observed during years of lesser initial production of lambs. Table 1 shows the 1978 results and past population history.

Production of lambs in the Sheep Creek study area during 1978 was 57 lambs per 100 ewes. Survival of the 1977 lamb cohort was 67 percent for a yearling recruitment of 35 yearlings per 100 ewes. Table 2 shows the 1978 results as well as the past population history.

Trapping efforts from 4 through 26 July 1978 resulted in the capture and marking of 36 individual sheep. Adding four sheep marked during 1977 gives a total of 40 marked sheep in the population. The data on capture method, collar identification; and morphological measurements are given in Table 3. Data on the lactation status of all ewes captured are given in Table 4. Yearling females were not included in this listing because none of the six yearling females captured was lactating. No 2-year-old ewes were captured, and it is impossible to say whether lambing at 2 years of age is common in this population. Lambing at 2 years of age is common in the Dry Creek population. One of the three ewes whose lactation status was noted in 1977, was killed by a hunter in 1977. The other two were still lactating in 1978 for the second consecutive year. This incidence of lactation (in two ewes) is much greater than that observed in the low-quality Dry Creek herd where biennial lactation is the predominant pattern.

Of the 22 sheep for which tongue color was noted, two had pink tongues. The remainder had the common, black tongue found in Dall sheep. The significance of tongue pigmentation is unknown, but it may be a genetic marker which is of academic interest (hence, inclusion of these data).

Dall Sheep Condition and Nutritional Profile

Data for gross body composition of Dall sheep collected from both study areas after summer's end (presumed maximum fatness) in 1975 and 1976 are given in Table 5. From the summary it can be noted that the Dry Creek sheep (poor quality) averaged 2 years older than the Sheep Creek sheep. The weights of Dry Creek sheep were about 2.5 kg greater, but there was no great difference between the two populations. Sheep from Dry Creek were older, larger, slightly fatter, and slightly lower in protein and bone content than those from Sheep Creek at the end of summer. No further analysis of these data will be attempted until data from subsequent collections are available.

Table 1. Productivity, survival, and estimated number of Dall sheep influenced by the Dry Creek mineral lick from 1970 through 1977.

Year	Lambs per 100 Ewes	Yearlings per 100 Ewes	Percent of Lambs Surviving 1st Winter	Estimated Population
1968*	63	13		
1969*	64	31	49	--
1970*	55	31	48	1500
1971*	50	51	93	
1972	15	16	32	1473
1973	38	11	73	1315
1974	28	25	66	1270
1975	28	23	82	1150
1976	36	16	57	1240
1977	58	17	47	1400
1978	41	25	43	--

* Data gathered at mineral lick using observation schedules not described in procedures (see Heimer 1975).

Table 2. Productivity, survival, and sample size of Dall sheep classified at the Sheep Creek mineral lick from 1974 through 1978.

Year	Lambs per 100 Ewes	Yearlings per 100 Ewes	Percent of Lambs Surviving 1st Winter	Sample Size
1974	56	21		116
1975	43	37	66	273
1976	35	26	60	257
1977	52	18	51	593
1978	57	35	67	757

Table 3. Capture and morphology data for Dall sheep from Sheep Creek mineral lick, July 1978.

Age (mo.)	Sex	Collar Number	Collar Color	Eartag No.	Eartag Color	Capture Method	Contour	Girth	Hindfoot	Shoulder Height
1	M	--	--	L07 Blk	Yellow	Drop Net	97cm	62cm	26cm	54cm
1	M	--	--	L17 Blk	Yellow	Drop Net	--	--	--	--
1	-	--	--	L27 Blk	Yellow	Rocket Net	--	--	--	--
1	M	--	--	L37 Blk	Yellow	Rocket Net	--	--	--	--
1	M	--	--	L47 Blk	Yellow	Rocket Net	--	--	--	--
13	F	1 Yellow	Red	1 Wht	Red	Drop Net	125cm	92cm	29cm	73cm
13	F	0 Yellow	Red	0 Wht	Red	Drop Net	--	--	--	--
13	F	2 Yellow	Red	2 Wht	Red	Drop Net	--	--	--	--
13	F	3 Yellow	Red	3 Wht	Red	Drop Net	--	--	--	--
13	F	4 Yellow	Red	4 Wht	Red	Rocket Net	115cm	88cm	30cm	70cm
13	F	X Yellow	Red	X Wht	Red	Rocket Net	125cm	75cm	31cm	65cm
13	M	--	--	47 Blk	Yellow	Rocket Net	--	--	--	--
13	M	--	--	37 Blk	Yellow	Rocket Net	--	--	--	--
13	M	--	--	X7 Blk	Yellow	Drop Net	--	--	--	--
13	M	--	--	07 Wht	Blue	Rocket Net	127cm	92cm	32cm	81cm
13	M	--	--	17 Wht	Blue	Rocket Net	122cm	82cm	31cm	74cm
37	F	1 Yellow	Blue	1 Wht	Blue	Drop Net	131cm	101cm	31cm	82cm
37	F	2 Yellow	Blue	2 Wht	Blue	Drop Net	139cm	98cm	34cm	84cm
37	F	4 Yellow	Blue	4 Wht	Blue	Darted	137cm	98cm	34cm	78cm
37	F	5 Yellow	Blue	5 Wht	Blue	Drop Net	--	--	--	--
37*	F	X Yellow	Blue	X Wht	Blue	Cannon Net**	--	--	--	--
37	F	7 Yellow	Blue	7 Wht	Blue	Cannon Net**	--	--	--	--
37	F	- Yellow	Blue	- Wht	Blue	Drop Net**	--	--	--	--
37	F	0 Yellow	Blue	0 Wht	Blue	Cannon Net**	--	--	--	--
37	M	--	--	07 Blk	Yellow	Drop Net	144cm	94cm	36cm	90cm
37	M	--	--	27 Blk	Yellow	Darted	131cm	87cm	36cm	87cm

Table 3. Continued.

Age (mo.)	Sex	Collar Number	Collar Color	Eartag No.	Eartag Color	Capture Method	Contour	Girth	Hindfoot	Shoulder Height
49	F	- Yellow	Green	- Wht	Green	Drop Net	129cm	90cm	--	83cm
49	F	01 Yellow	Green	01 Wht	Green	Darted	131cm	86cm	35cm	84cm
49	F	00 Yellow	Green	00 Wht	Green	Rocket Net	135cm	98cm	33cm	76cm
49	M	--	--	57 Blk	Yellow	Drop Net	155cm	110cm	35cm	90cm
49	M	--	--	77 Blk	Yellow	Drop Net	--	--	--	--
61	F	0 Black	Red	0 Blk	Red	Darted	--	--	--	--
61	M	--	--	-7 Blk	Yellow	Rocket Net	--	--	--	--
85	F	00 Black	Red	00 Blk	Red	Darted	137cm	98cm	33cm	81cm
85	F	01 Black	Red	01 Blk	Red	Drop Net	137cm	86cm	34cm	84cm
85	F	02 Black	Red	02 Blk	Red	Darted	--	--	--	--
97	M	--	--	17 Blk	Yellow	Snared	144cm	110cm	34cm	92cm
121	F	40 Black	Red	40 Blk	Red	Rocket Net	135cm	98cm	32cm	84cm
121	F	41 Black	Red	41 Blk	Red	Darted	--	--	--	--
109	M	--	--	67 Blk	Yellow	Drop Net	horns 98cm long			

* Age uncertain
** Captured in 1977

Table 4. Lactation status of ewes captured in 1977 and 1978.

Collar Number and Color	Collar Color	Age (mo.)	Lactating	Date	Lamb in 1978
1 Yellow	Blue	37	yes	7/6/78	
2 Yellow	Blue	37	yes	7/19/78	
4 yellow	Blue	37	no	7/20/78	
5 Yellow	Blue	37	yes	7/22/78	
X Yellow	Blue	37	yes	7/22/78	
7 Yellow	Blue	37	no	7/23/77	no, dead
- Yellow	Blue	37	yes	7/24/77	yes
0 Yellow	Blue	37	yes	7/24/77	yes
- Yellow	Green	49	yes	7/4/78	
01 Yellow	Green	49	yes	7/19/78	
00 Yellow	Green	49	yes	7/19/78	
0 Black	Red	61	yes	7/20/78	
00 Black	Red	85	yes	7/17/78	
10 Black	Red	85	no	7/19/78	
02 Black	Red	85	yes	7/21/78	
40 Black	Red	121	yes	7/21/78	
41 Black	Red	121	yes	7/19/78	

None of the six yearling females captured was lactating. No 2-year-old females were captured during this trap effort.

Table 5. Gross body composition of ewes collected after summer fattening.

Body composition of Dall sheep collected near Sheep Creek, fall 1976.

Accession Number	Age (mo.)	Weight (kg)	Percent Water	Percent Fat	Percent Protein	Percent Bone
4593	6	27.7	74.1	8.5	9.0	8.4
4594	30	54.5	65.4	14.1	21.9	15.4
4595	6	30.9	68.7	12.5	10.8	8.0
4596	66	53.6	67.4	9.9	13.1	9.6
4597	90	63.6	74.8	6.8	6.2	12.2
4598	54	56.8	68.1	12.4	9.5	9.0
4599	90	65.5	68.3	12.2	11.5	8.0
4600	30	54.6	62.3	15.4	10.8	8.5
4601	90	53.7	67.0	11.9	12.4	8.7
	$\bar{x}$ = 51.3	$\bar{x}$ = 51.2	$\bar{x}$ = 68.5	$\bar{x}$ = 11.5	$\bar{x}$ = 11.5	$\bar{x}$ = 9.8

Body composition of Dall sheep collected near Dry Creek, fall 1976.

Accession Number	Age (mo.)	Weight (kg)	Percent Water	Percent Fat	Percent Protein	Percent Bone
4565	18	42.7	64.6	13.9	10.8	10.7
4566	162	66.3	70.9	13.6	9.5	5.9
4567	78	55.7	63.5	16.9	10.7	8.9
4568	78	68.6	64.0	15.7	11.7	8.7
	$\bar{x}$ = 84	$\bar{x}$ = 58.3	$\bar{x}$ = 65.6	$\bar{x}$ = 15.0	$\bar{x}$ = 10.6	$\bar{x}$ = 8.6

Body composition of Dall sheep collected near Dry Creek, fall 1975.

Accession Number	Age (mo.)	Weight (kg)	Percent Water	Percent Fat	Percent Protein	Percent Bone
4331	114	62.3	69.3	11.7	11.9	8.0
4332	78	55.9	65.9	13.9	11.6	8.6
4333	90	67.5	65.0	14.1	11.8	9.1
	$\bar{x}$ = 94	$\bar{x}$ = 61.9	$\bar{x}$ = 66.7	$\bar{x}$ = 13.2	$\bar{x}$ = 11.8	$\bar{x}$ = 8.6

Summary: Mean composition of adult ewes* collected through fall 1976.

Study Area	Age (mo)	Weight (kg)	% Water	% Fat	% Protein	% Bone
Dry Creek (n=7)	88	59.9	66.3	14.3	11.1	8.6
Sheep Creek (n=7)	64	57.5	67.6	11.8	12.2	10.2

* at least 18 months of age

Table 6. Gross body composition of ewes collected at winter's end.

Body composition of Dall sheep collected near Sheep Creek, spring 1977.

Accession Number	Age (mo.)	Weight (kg)	Percent Water	Percent Fat	Percent Protein	Percent Bone	Pregnant
4762	10	20.5	77.2	5.0	11.8	6.0	no
4763	94	49.5	71.4	7.6	11.3	8.4	yes
4764	34	51.4	71.9	10.2	9.3	8.5	yes
4765	22	45.0	71.4	7.3	11.7	10.1	yes
4766	94	53.6	75.5	6.1	10.5	7.9	yes
4767	94	50.0	70.8	8.4	11.7	9.1	yes
4768	70	44.1	72.8	6.6	11.0	9.6	yes
	$\bar{x}$ = 60	$\bar{x}$ = 44.9	$\bar{x}$ = 73.0	$\bar{x}$ = 7.3	$\bar{x}$ = 11.0	$\bar{x}$ = 8.5	

Body composition of Dall sheep collected near Dry Creek, spring 1977.

Accession Number	Age (mo.)	Weight (kg)	Percent Water	Percent Fat	Percent Protein	Percent Bone	Pregnant
4741	10	30.4	70.4	11.5	10.7	7.4	no
4742	10	32.3	71.9	7.7	11.7	8.8	no
4743	70	51.8	69.9	9.0	10.8	10.3	yes
4744	70	49.1	72.1	8.4	11.4	8.1	yes
4745	130	48.1	72.1	6.4	11.8	9.7	no
4746	70	53.2	72.7	7.0	12.5	7.8	yes
	$\bar{x}$ = 60	$\bar{x}$ = 44.2	$\bar{x}$ = 71.5	$\bar{x}$ = 8.3	$\bar{x}$ = 11.5	$\bar{x}$ = 8.7	

Body composition of Dall sheep collected near Dry Creek, spring 1976 (May 25).

Accession Number	Age (mo.)	Weight (kg)	Percent Water	Percent Fat	Percent Protein	Percent Bone	Pregnant
4384	70	51.4	75.5	5.4	10.8	8.3	yes
4385	118	42.3	78.7	3.2	11.4	6.8	no*
4386	58	42.3	73.5	5.6	12.9	8.0	no*
4387	58	42.7	77.3	5.6	11.1	5.9	no
4388	82	41.4	79.8	2.5	8.9	8.8	no*
	$\bar{x}$ = 77	$\bar{x}$ = 44.0	$\bar{x}$ = 76.9	$\bar{x}$ = 4.5	$\bar{x}$ = 11.0	$\bar{x}$ = 7.6	

* lactating when collected

Summary: Mean composition of adult ewes* collected through spring 1977.

Study Area	Age (mo.)	Weight (kg)	% Water	% Fat	% Protein	% Bone
Dry Creek (n=4)	70	51.4	72.3	7.5	11.4	8.6
Sheep Creek (n=6)	88	48.9	72.3	7.7	10.9	8.9

* pregnant adults

Table 7 contains data from proximate nutrient analysis of forage from ewe rumens collected after the summer fattening period. These ewes were on winter ranges when the collections were made in late fall. The summary indicates minimal differences in gross available nutrients between the two populations (100% minus % neutral detergent fiber = soluble carbohydrate content which is 100% digestible). The only other difference of note was a lower lignin content in the Dry Creek forage. This indicates greater food value in Dry Creek forage which supports the poorer quality sheep herd.

Table 8 contains similar data from late winter. The results are similar to those from forage ingested by ewes on the winter range in late fall. Note that total digestibility is similar, but there is less lignin from Dry Creek forage than from Sheep Creek forage. For 1976 and 1977, lignin values for the Dry Creek forage were markedly different, with that of 1976 matching almost exactly the value from early winter of the same year (Table 7). The lignin values from Dry Creek and Sheep Creek in spring 1977 were almost identical. It is unknown whether this represents a difference in food quality over a year's growing and/or curing seasons, or a sampling error resulting from differences in food selection by the individuals represented in the small samples collected in Dry Creek over two different collection periods. It is clear that there is no obvious qualitative nutritional advantage for sheep of the higher quality area, Sheep Creek. This tentative finding, plus the observation of lower sheep density in Sheep Creek than in Dry Creek (Heimer 1979, in press) indicates that the differences in quality are probably not definable in terms of gross body composition or nutrition. Jack Winters' (Grad. student, U. of Alaska, pers. comm.) also indicates that plant nutrient quality on sheep ranges is similar where population quality is greatly different. It appears that energy resources are not easily identifiable as the proximate cause of quality differences between populations. The failure of these analyses to demonstrate noticeable differences in the nutritive quality of rumen contents and gross body composition between these two vastly different sheep populations indicates that food resource quality is not the sole, and perhaps not a major, contributing factor to the documented differences in productivity, growth rate, etc.

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Table 7. Nutritive quality of washed rumen contents from ewes collected in early winter.

Nutritive quality analysis of washed rumen contents of Dall sheep from the Sheep Creek study area, early winter 1976.

Accession Number	Percent Acid Detergent Fiber	Percent Acid Detergent Lignin	Percent Neutral Detergent Fiber	Percent Neutral Detergent Ash	Percent Protein	Age (mo.)
5493	46	23	75	2.5	9	6
4594	46	19	82	3.0	7	30
4595	41	18	69	1.5	10	6
4596	46	23	76	2.0	11	66
4597	44	21	71	2.0	8	90
4598	51	22	75	2.5	12	54
4599	48	22	74	3.0	10	90
4600	49	24	77	3.5	8	30
4601	52	25	76	2.0	9	90
	$\bar{x}$ = 47	$\bar{x}$ = 22	$\bar{x}$ = 75	$\bar{x}$ = 2.4	$\bar{x}$ = 9	$\bar{x}$ = 51

Nutritive quality analysis of washed rumen contents of Dall sheep from the Dry Creek study area, winter 1976.

Accession Number	Percent Acid Detergent Fiber	Percent Acid Detergent Lignin	Percent Neutral Detergent Fiber	Percent Neutral Detergent Ash	Percent Protein	Age (mo.)
4565	39	9	77	2.5	8	18
4566	44	10	78	1.5	4	162
4567	39	19	76	3.0	13	78
4568	45	10	83	2.5	8	78
	$\bar{x}$ = 42	$\bar{x}$ = 12	$\bar{x}$ = 79	$\bar{x}$ = 2.4	$\bar{x}$ = 8	$\bar{x}$ = 84

Summary: Means for all early winter rumens analyzed through 1977.

Study Area	Percent Acid Detergent Fiber	Percent Acid Detergent Lignin	Percent Neutral Detergent Fiber	Percent Neutral Detergent Ash	Percent Protein
Sheep Creek (n=9)	47	22	75	2.4	9
Dry Creek (n=4)	42	12	79	2.4	8

Table 8. Nutritive quality of washed rumen contents from ewes collected in early spring.

Nutritive quality analysis of washed rumen contents of Dall sheep from the Sheep Creek study area, spring 1977.

Accession Number	Percent Acid Detergent Fiber	Percent Acid Detergent Lignin	Percent Neutral Detergent Fiber	Percent Neutral Detergent Ash	Percent Protein	Age (mo.)
4762	46	21	79	3.0	11	10
4763	42	23	75	2.0	8	94
4764	44	20	79	2.5	13	34
4765	43	24	78	3.0	12	22
4766	46	27	77	2.5	9	94
4767	46	26	81	2.5	13	94
4768	47	25	77	2.0	10	70
	$\bar{x} = 45$	$\bar{x} = 24$	$\bar{x} = 78$	$\bar{x} = 2.5$	$\bar{x} = 11$	$\bar{x} = 60$

Nutritive quality analysis of washed rumen contents of Dall sheep from the Dry Creek study area, spring 1977.

Accession Number	Percent Acid Detergent Fiber	Percent Acid Detergent Lignin	Percent Neutral Detergent Fiber	Percent Neutral Detergent Ash	Percent Protein	Age (mo.)
4741	54	26	75	3.0	15	10
4742	53	25	79	3.5	13	10
4743	53	25	81	2.5	12	70
4744	50	26	77	3.0	13	70
4746	51	24	80	3.0	10	130
	$\bar{x} = 52$	$\bar{x} = 25$	$\bar{x} = 78$	$\bar{x} = 3.0$	$\bar{x} = 13$	$\bar{x} = 60$

Nutritive quality analysis of washed rumen contents of Dall sheep from the Dry Creek study area, spring 1976.

Accession Number	Percent Acid Detergent Fiber	Percent Acid Detergent Lignin	Percent Neutral Detergent Fiber	Percent Neutral Detergent Ash	Percent Protein	Age (mo.)
4384	45	15	77	2.0	7	70
4385	45	14	77	2.5	6	118
4386	44	14	75	3.0	6	58
4387	44	14	77	3.0	8	58
4388	46	13	76	2.0	5	82
	$\bar{x} = 45$	$\bar{x} = 14$	$\bar{x} = 76$	$\bar{x} = 2.5$	$\bar{x} = 6$	$\bar{x} = 77$

Table 8. Continued.

Summary: Means for all rumens analyzed through spring 1977.

Study Area	Percent Acid Detergent Fiber	Percent Acid Detergent Lignin	Percent Neutral Detergent Fiber	Percent Neutral Detergent Ash	Percent Protein
Sheep Creek (n=7)	45	24	78	2.5	11
Dry Creek (n=10)	49	20	77	2.8	10

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