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The Effect of Range Condition Upon the Production, Nutritive Intake and Digestibility of Desert Range Forage in Southwest Utah

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THE EFFECT OF RANGE CONDITION UPON THE PRODUCTION, NUTRITIVE INTAKE AND DIGESTIBILITY OF DESERT RANGE FORAGE IN SOUTHWESTERN UTAH

by

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INTRODUCTION

The 65 million acres of winter range in the Intermountain region furnish forage for about five million sheep and four million cattle each winter for approximately six months. These arid ranges are well suited for winter grazing, and are of paramount importance to the livestock industry. Many of these ranges were fully stocked by 1900 and as livestock continued to increase, many winter ranges were seriously overgrazed (Hutchings and Stewart, 1953). Today many of these ranges remain in a deteriorated condition. Forage production has decreased and desirable plants have been replaced by less desirable species.

Little is known about the relative production, palatability, digestibility, and nutrient content of forage plants found on ranges in poor condition compared to ranges in good condition, yet such information is fundamental to good range and livestock management.

In order to learn more about the effect of range condition upon the forage intake and nutrient content for sheep a study was conducted on typical winter range in southwestern Utah during the winter grazing season of 1957-58.

REVIEW OF LITERATURE

It is generally acknowledged that ranges in good condition produce more forage and control erosion and runoff better than ranges in poor condition. However, information on production of livestock from ranges in high condition compared to ranges in lower condition is almost lacking. McCorkle and Heerwagon (1951) studied the effects of range condition on livestock production and reported that ranches in good, fair, and poor condition produced 14.3 pounds, 11.2 pounds, and 8.9 pounds of beef per acre respectively. Steer ranches as well as cow-calf operations showed greater total livestock production from ranges in good condition than ranges in poor condition.

Hutchings and Stewart (1953) reported grazing capacity on salt-desert shrub ranges in good condition averaged about 1.0 to 3.5 acres per sheep per month and similar range in poor condition required five or more acres per sheep per month.

Crane (1950) stated that grazing capacity on wet meadows of the eastern slope of the Sierra Nevada Mountains decreased considerably with lower range condition classes.

Cook *et al.* (1953) and Pieper (1958) conducted studies in Utah and found that increased grazing intensity resulted in a decrease in the more desirable nutrients, a reduction of the digestibility of these nutrients and a decrease in daily consumption. Thus it was shown that serious nutritional deficiencies may result from heavy grazing.

Hutchings and Stewart (1953) reported that ewes on moderately grazed range maintained body weights of four to 18 pounds greater than those on heavily grazed range. They also produced about one pound more wool and 11 percent more lambs.

The nutritive value of an individual plant can be considered only relative because that value is subject to change according to the combination in which the plant is used with respect to other associated species. There is much variability in the species composition of sheep diets on winter ranges and the consequent nutrient value of individual plants varies accordingly.

Accurate appraisals of the nutritional deficiencies in the range animal's diet must consider not only the type and quality of forage consumed but also the quantity of forage consumed. Such information is important in nutritional studies since factors affecting daily intake of forage directly affect nutrient intake.

The foraging sheep's diet may change materially from day to day depending upon many interrelated factors. Sheep prefer certain plants and certain portions of the plants in different plant associations. The preference and amount consumed may vary with soil, site, vegetation type, plant composition, season, and intensity of grazing (Cook _et al._ 1948). On ranges that produce forage of low quality, the amount of feed consumed daily often determines whether or not a nutritional deficiency occurs in the diet of the grazing animal (Sharp 1949 and Green _et al._ 1951).

Stapledon and Jones (1927) found that the quantity of herbage consumed by grazing sheep varied widely from day to day. This was believed to be a result of varying moisture content of the herbage, or varying botanical and chemical composition of the pasturage.

Grazing animals tire frequently of diets composed of a single species and decreased consumption results (Cook and Harris 1950, 1952). From a practical standpoint poor palatability means a poor ration. Low feed consumption may indicate that the ration is nutritionally inadequate, or that it is merely unacceptable (Swift, 1957).

Schneider <u>et al</u>. (1955) reviewed the studies of a number of workers who have used various indicator substances in the determination of daily intake and digestibility. An ideal inert reference substance or indicator for digestibility studies, according to Maynard (1951), should be totally indigestible, pass through the tract at a uniform rate, be readily determined chemically, and preferably be a natural constituent of the feed under test.

Lignin has been used as an indicator substance by several investigators, with diverse results. Hale <u>et al</u>. (1939) claimed that lignin ratios were not reliable measures of digestibility. Forbs and Swift (1943) found lignin to vary in digestibility from negative values to plus 29 per cent. Crampton and Jackson (1944) concluded that lignin could not be relied on as an indicator of digestibility. Ellis <u>et al</u>. (1946) gave a "72 percent H_2SO_4 method" for the determination of lignin and that with the cow, sheep, and rabbit, lignin determined by their method was not digested. Swift <u>et al</u>. (1947) obtained very satisfactory results by using the lignin ratio technique. Forbes <u>et al</u>. (1946), Chi (1951), and Kane <u>et al</u>. (1950) obtained good results with lignin as an indicator. However, Davis <u>et al</u>. (1947), and Bondi and Meyer (1948) were not satisfied with this method.

Forbs and Garrigus (1948) found the average recovery of lignin from seven digestion trials with steers to be 102 $\pm$ 7 percent. Dry matter digestibility and total digestible nutrient content of the various forages were found to vary inversely with the lignin content of the forage.

Smith et al. (1956) encountered difficulty in making consistant lignin determination in the laboratory from studies with mule deer. No clear answer could be found as to whether the apparent digestion of lignin was a result of the inability to chemically isolate the lignin material or actual digestion.

Recently a procedure has been developed which enables the researcher to obtain representative samples of actual diets of grazing animals. This is possible by use of the esophageal-fistula and esophageal-fistula cannula as reported by (Torell, 1954; Bathe, et al. 1956; Cook, et al. 1958; and Edlefsen, 1960).

Dyksterhuis (1949) described range condition as the state of health or productivity of both soil and forage on a given site in terms of what it could or should be under normal climate or best practicable management. Humphrey (1949) stated that range condition is measured directly in terms of forage production and indirectly in pounds of meat or wool produced.

Goebel (1960) used fence-line contrasts in southwestern Utah to study effects of range condition. He concluded that good condition ranges had a significantly higher density of good forage species than poor condition ranges and total herbage production was significantly higher on the good condition ranges. The calculated diet of sheep on good condition ranges was higher in total protein, lignin, cellulose, and other carbohydrates; whereas, on poor ranges the diet was higher in ash, calcium, phosphorus, and gross energy. Also, range condition had a significant influence upon infiltration rate and bulk-density of soils.

The carrying capacity and forage value are generally the highest where the cover represents a state in close proximity to the herbaceous climax and lowest in the type most remote from the climax (Dyksterhuis, 1949).

Obviously it is vital to understand the relative production, nutritional assets and defects of range forage for maintenance of both the ranges and the livestock industry.

METHOD AND PROCEDURE

Forage yield and botanical composition were determined on both good and poor condition ranges as displayed by fence-line contrasts (Figure 1) on eight study areas. This was done by use of a 25 square-foot method as described by Sharp (1949) and Goebel et al. (1958). The 25 square-foot frame was equipped with a sliding crosspiece five feet long and one foot wide which was divided into units 1/16 square foot in size. The crosspiece was moved along the frame at five one foot intervals. At each position the number of units filled by foliage of each species was recorded while observing the vegetation from directly above. The plots were systematically taken along transect lines throughout the area. Herbage production was determined by multiplying the number of 1/16 square-foot units of cover for each species by the average air-dry weight per unit for the species. The average unit weight for each species was determined by clipping several individual units for each species. The same procedure was repeated on each study area for both good and poor range condition.

Small enclosures were fenced on both the poor and good condition ranges on each side of the fence in each of the eight study areas. Each of the adjacent enclosures was fenced to include approximately equal amounts of herbage production from all species present. The size of the fenced areas varied from 1.5 to 5.0 acres depending upon the amount of available herbage. Separate areas were fenced adjacent to the trial areas where the sheep were allowed to graze for about four days prior to

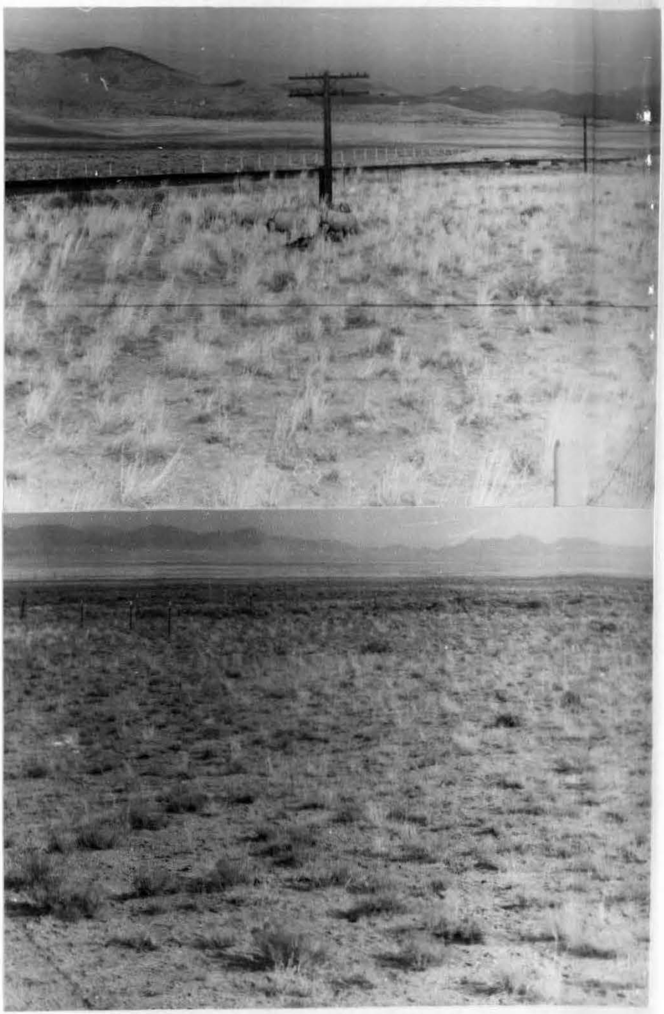

Figure 1. Fence-line contrast showing good condition range (top) and poor condition range (bottom)

going on the actual trial areas. The good and the poor condition enclosures on opposite sides of the fence line were grazed simultaneously. While the trial was being conducted at one location, the next study areas were being fenced. These enclosures were constructed of triangle mesh wire which was held up by placing steel posts on alternate sides of the fence. After the trial was completed, the fence was rolled up by a power-driven wire roller on a Dodge power wagon (Figure 2) and transported to another area.

Sheep used for the study were selected from a range herd and were considered typical range sheep. All were of about equal size. Five wethers equipped with harnesses and fecal bags as shown in Figure 3, were grazed on each of the good and poor condition enclosures. In addition, three sheep equipped with esophogeal-fistula cannulae were grazed with the wethers.

Eight trials varying from eight to 12 days were conducted. All trials were not of the same duration because the amount of herbage was not always adequate to run 12 full days. Each trial was divided into two or three periods of equal duration.

Utilization of each species was estimated on a series of 9.6 square feet circular plots at the end of each period.

The animals equipped with esophageal-fistula cannulae were used to collect daily samples of forage which were considered representative of the material eaten by all other sheep grazing the study areas. Early each morning, the caps were removed from the cannulae and a collection bag was secured around the neck to collect the ingested material (Figure 4). These animals were then allowed to graze normally two to three hours with the other sheep before they were returned to the pen.

Figure 2. Powered wire roller in operation

Figure 3. Wether fitted with harness and fecal bag

Figure 4. Sheep equipped with esophageal-fistula cannulae and canvas bags for collecting forage samples

After the bags containing the sample were removed, the sheep were turned out to graze with the rest of the sheep till evening. The fistula samples were dried in a heated room and kept separate for each sheep. At the end of the period the samples from each sheep were placed in one composite sample. The diet samples were collected one day earlier than the fecal samples so that the fecal material would be more representative of the diet samples for the same period.

The feces of each sheep were collected daily and stored in separate containers with tight lids. The fecal material was glazed with a solution of 97 percent ethyl alcohol and three percent hydrochloric acid solution to prevent fermentation and decomposition. The winter temperature was usually cold enough to keep the feces frozen to aid preservation. At the end of each collection period, the total feces from each sheep were weighed and thoroughly mixed. A sample was obtained and placed in an air-tight, moisture-proof plastic bag. The fecal samples were then transported to the laboratory and dried in a forced-air dryer at 65° centigrade for a minimum of 48 hours. The samples were then ground in a Wiley mill to pass a one mm screen and placed in containers for chemical analysis.

The fistulae and fecal samples were analyzed for ether extract, ash, nitrogen, lignin, cellulose, and gross energy. The other carbohydrate fraction was determined by difference. The analytical procedures used were those outlined by Cook et al. (1951). Metabolizable energy values were calculated by the method described by Cook et al. (1952).

Digestion coefficients were determined by the lignin-ratio technique (Cook et al. (1951). This method uses lignin as the indicator substance and assumes that the lignin in the feces represents all the lignin consumed in the forage. The percentage of each nutrient digested was calculated by the formula:

$$100-\left(100 \times \frac{\%\ \text{lignin in forage}}{\%\ \text{lignin in feces}} \times \frac{\%\ \text{nutrient in feces}}{\%\ \text{nutrient in forage}}\right) = \%\ \text{digestibility of nutrient.}$$

The amount of dry matter consumed by each sheep per day was calculated by the following formula:

$$\text{lbs. dry matter consumed} = \frac{(\text{lbs. dry matter excreted})(\%\ \text{lignin in dry matter excreted})}{\%\ \text{lignin in dry matter consumed}}$$

DESCRIPTION OF AREA

The study was carried out in the vicinity of Modena, Utah 52 miles west of Cedar City, Utah, and about eight miles from the Utah-Nevada state line. Topography in the area consists of a broad, semi-arid valley about 20 miles wide and 80 miles long, and bordered by foothills and low-lying mountains. Elevation is approximately 5,000 feet. The soils are variable, ranging from heavy clay loam to sandy loam and are often high in salt content. The parent material is sedimentary dolomite and limestone.

Much of the vegetation is typical of the salt-desert shrub areas of Utah and adjacent states. The plants grow during the spring and summer, and remain dormant during the fall and winter. The vegetation is grazed by both sheep and cattle during the winter months and sometimes by cattle the entire year. The species most common to the area include winterfat (Eurotia lanata (Pursh.) Moq), yellowbrush (Chrysothamnus stenophyllus Nutt.), big sagebrush (Artemisia tridentata Nutt.), galleta or curly grass (Hilaria jamesii (Torr.) Benth.), Indian ricegrass (Oryzopsis hymenoides (R. and S. Ricker) Piper), and needle-and-thread grass (Stipa comata Trin. and Rupr). Associated species of less prominance include squirreltail grass (Sitanion hystrix (Nutt.) J. G. Smith), sand dropseed (Sporobolus cryptandrus (Torr.) Gray), snakeweed (Gutierrezia sarothrae Pursh.), and Russian thistle (Salsola kali var. tenuifolia Tausch.).

The average annual precipitation at Modena, is about 10.5 inches. Most of the precipitation occurs during the winter as snow or during the spring as rain. Weather conditions during the winter months are normally mild, but severe snow storms and extreme temperatures are not uncommon. Sub-zero temperatures during the winter are common and maximum temperatures during the summer may exceed 100 degrees Fahrenheit.

RESULTS AND DISCUSSION

Production

Data from the eight study areas showed that each of the enclosures considered to be in good condition produced more air dry herbage than the adjacent enclosures in poor condition. Average production on the good condition range was 143.2 pounds per acre greater than on poor condition range. The increased herbage production is even more significant when kind of forage is considered. The proportion of more desirable plants was consistantly higher on the good condition ranges (Table 1).

On four of the study areas, shrubs were more abundant than grass on the poor ranges, two areas had a greater proportion of grass on the poor range and two areas were nearly equal in the percentage of shrubs and grasses on each range condition. There was also a considerable variation in the relative amounts of individual species between study areas (Table 2).

Vegetation composition, utilization and diets of individual trials

Dominant species on the poor condition range of area I were yellowbrush, Indian ricegrass and winterfat. During the first period, approximately 80 percent of the diet on poor range was Indian ricegrass and only 1.52 percent yellowbrush. In nearly all the trials, this grass was a preferred species. During the second period, 55.2 percent of the diet on the poor range was yellowbrush and less than 28 percent Indian ricegrass. Utilization of Indian ricegrass was 98.7 percent at the end

Table 1. Species composition, production, utilization and diet of sheep during two grazing periods for good and poor range condition displayed by fence-line contrasts (Area I).

		Period 1 (5 days)			Period 2 (5 days)		
Species[1]	Pounds per acre	Utiliza-tion at end of period	Amount consumed	Diet	Utiliza-tion at end of period	Amount consumed	Diet
		(%)	(lbs/A)	(%)	(%)	(lbs/A)	(%)
Poor condition range							
Sco	1.77	65.0	1.15	1.28	85.0	.36	.73
Ohy	87.09	82.9	72.20	80.33	98.7	13.76	27.77
Cst	235.78	.6	1.37	1.52	12.2	27.35	55.21
Ska	4.68	53.3	2.49	2.77	56.4	.15	.30
Hja	9.72	35.0	3.40	3.78	65.0	3.21	6.48
Ela	21.12	32.6	6.89	7.67	47.5	3.15	6.35
Sgr	.88	90.2	.80	.89	98.5	.07	.15
Alo	1.50	.0	.00	.00	65.0	.97	1.96
Atr	4.19	37.5	1.57	1.75	50.0	.52	1.05
	366.73	24.5	89.87	100.00	38.0	49.54	100.00
Good condition range							
Sco	500.66	50.6	253.33	67.64	92.3	208.78	78.23
Ohy	127.14	70.5	89.63	23.94	97.0	33.69	12.62
Cst	66.05	4.3	2.84	.76	28.2	15.79	5.92
Ska	.84	25.0	.21	.06	40.0	.13	.05
Hja	19.43	48.5	10.49	2.80	71.7	4.51	1.69
Ela	26.69	62.8	16.76	4.48	75.8	3.47	1.30
Sgr	1.77	67.0	1.19	.32	96.5	.52	.19
	742.58	50.4	374.45	100.00	86.5	266.89	100.00

[1]For species identification with symbols see Appendix, Table 6.

Table 1. Continued (Area II)

Species	Pounds per acre	Period 1 (5 days) Utilization at end of period	Amount consumed	Diet	Period 2 (5 days) Utilization at end of period	Amount consumed	Diet
		(%)	(lbs/A)	(%)	(%)	(lbs/A)	(%)
Poor condition range							
Ela	54.80	67.8	37.15	23.34	96.3	15.62	17.20
Hja	207.74	39.1	81.23	51.04	70.0	64.19	70.72
Ohy	10.37	94.3	9.78	6.14	100.0	.59	.65
Alo	31.49	43.3	13.64	8.57	56.4	4.13	4.55
Ska	.77	.0	.00	.00	45.0	.35	.38
Cst	26.50	53.8	14.26	8.96	75.0	5.62	6.19
Sgr	3.46	90.0	3.11	1.95	98.0	.28	.31
	335.13	47.5	195.17	100.00	74.6	90.78	100.00
Snow cover on poor side was 36.19%							
Good condition range							
Ela	191.42	58.9	112.75	53.43	93.0	65.27	38.99
Hja	146.27	34.6	50.61	23.99	86.4	75.77	45.26
Ohy	40.78	72.9	29.73	14.09	98.8	10.56	6.31
Alo	7.53	23.3	1.75	.83	66.4	3.25	1.94
Ska	1.92	.0	.00	.00	72.5	1.39	.83
Sco	14.67	40.0	5.87	2.78	94.0	7.92	4.73
Cst	7.33	20.0	1.47	.70	51.0	2.27	1.36
Sgr	9.79	90.0	8.81	4.18	100.0	.98	.58
	419.71	50.3	210.99	100.00	90.2	167.41	100.00

Snow cover was 13.55% of ground

Table 1. Continued (Area III)

Species	Pounds per acre	Period 1 (4 days): Utilization at end of period	Period 1 (4 days): Amount consumed	Period 1 (4 days): Diet	Period 2 (4 days): Utilization at end of period	Period 2 (4 days): Amount consumed	Period 2 (4 days): Diet	Period 3 (4 days): Utilization at end of period	Period 3 (4 days): Amount consumed	Period 3 (4 days): Diet
		(%)	(lbs/A)	(%)	(%)	(lbs/A)	(%)	(%)	(lbs/A)	(%)
Poor condition range										
Ohy	15.28	75.0	11.46	13.46	98.6	3.61	5.10	100.0	.21	.34
Cst	130.29	2.0	2.60	3.05	35.2	43.12	60.86	65.2	39.09	63.56
Hja	55.76	50.0	27.88	32.74	65.0	8.36	11.80	86.2	11.82	19.22
Ela	62.21	64.0	39.81	46.74	88.7	15.37	21.70	99.4	6.66	10.83
Ska	12.67	27.0	3.42	4.01	30.0	.38	.54	59.4	3.72	6.05
	276.21	30.8	85.17	100.00	56.5	70.84	100.00	78.7	61.50	100.00
Good condition range										
Ohy	64.67	48.6	31.43	22.87	80.4	20.56	18.52	92.8	8.02	10.21
Cst	137.05	4.7	6.44	4.69	18.1	18.36	16.54	48.8	42.07	53.57
Hja	77.68	27.3	21.21	15.43	63.3	27.96	25.17	71.7	6.53	8.31
Ela	91.01	60.8	55.33	40.26	87.6	24.39	21.91	97.4	8.91	11.34
Alo	11.29	3.3	.37	.26	37.5	3.86	3.48	56.3	2.12	2.70
Ska	26.80	16.7	4.48	3.26	30.8	3.78	3.40	41.3	2.81	3.58
Sco	40.40	45.0	18.18	13.23	75.0	12.12	10.92	95.0	8.08	10.29
	448.90	30.6	137.44	100.00	55.4	111.03	100.00	72.8	78.54	100.00

Table 1. Continued (Area IV)

Species	Pounds per acre	Period 1 (5 days) Utilization at end of period			Period 2 (4 days) Utilization at end of period			Period 3 (4 days) Utilization at end of period		
		Utilization at end of period	Amount consumed	Diet	Utilization at end of period	Amount consumed	Diet	Utilization at end of period	Amount consumed	Diet
		(%)	(lbs/A)	(%)	(%)	(lbs/A)	(%)	(%)	(lbs/A)	(%)
Poor condition range										
Ela	69.96	96.4	67.44	56.82	99.4	2.10	3.93	99.8	.28	.33
Cst	80.14	4.0	3.21	2.70	27.0	18.43	34.47	55.0	22.44	26.18
Hja	89.47	22.0	19.68	16.58	56.2	30.60	57.22	96.0	35.61	41.55
Ohy	.65	91.5	.59	.50	95.0	.02	.04	98.7	.02	.02
Atr	79.33	35.0	27.77	23.40	37.5	1.98	3.70	71.7	27.13	31.65
Ska	.88	.0	.00	.00	39.0	.34	.64	65.0	.23	.27
	320.45	37.0	118.69	100.00	53.7	53.47	100.00	80.5	85.71	100.00
Good condition range										
Ela	157.94	64.3	101.56	59.35	76.0	18.48	22.64	99.2	36.64	30.83
Cst	17.47	5.4	.94	.55	25.0	3.42	4.19	40.0	2.62	2.20
Hja	167.12	25.7	42.95	25.09	50.5	41.45	50.79	89.5	65.18	54.84
Sco	26.61	12.9	3.43	2.00	58.8	12.21	14.96	97.2	10.22	8.60
Ohy	19.51	76.7	14.96	8.74	98.0	4.16	5.10	100.0	.39	.33
Atr	16.28	45.0	7.33	4.27	56.6	1.89	2.32	80.0	3.81	3.20
	404.93	42.3	171.17	100.00	62.4	81.61	100.00	91.8	118.86	100.00

Table 1. Continued (Area V and VI)

		Period 1 (5 days)			Period 2 (5 days)		
Species	Pounds per acre	Utilization at end of period	Amount consumed	Diet	Utilization at end of period	Amount consumed	Diet
		(%)	(lbs/A)	(%)	(%)	(lbs/A)	(%)
Area V							
Poor condition range							
Hja	55.76	40.5	22.58	39.60	86.1	25.43	49.62
Ela	16.63	98.8	16.43	28.81	99.4	.10	.20
Cst	89.32	10.6	9.47	16.61	38.2	24.65	48.11
Ska	.03	57.5	.02	.04	85.0	.01	.02
Scr	5.15	30.0	1.54	2.70	60.0	1.03	2.01
Ohy	7.07	98.7	6.98	12.24	99.0	.02	.04
	173.96	32.8	57.02	100.00	62.2	51.24	100.00
Good condition range							
Hja	70.12	79.2	55.54	37.62	96.4	12.06	15.83
Ela	81.75	70.5	57.63	39.04	99.8	23.95	31.44
Cst	75.11	7.0	5.26	3.56	40.4	25.09	32.95
Ska	2.88	53.3	1.54	1.04	66.3	.37	.48
Ohy	43.62	63.4	27.66	18.74	97.1	14.70	19.30
	273.48	54.0	147.63	100.00	81.8	76.17	100.00
Area VI							
Poor condition range							
Hja	157.44	35.6	56.05	51.54	70.0	54.16	94.86
Cst	54.07	24.4	13.19	12.13	26.0	.87	1.52
Ela	16.70	98.7	16.48	15.15	99.8	.18	.32
Ska	2.04	75.0	1.53	1.41	80.0	.10	.18
Sco	.92	98.0	.90	.83	100.0	.02	.04
Atr	22.89	90.0	20.60	18.94	97.7	1.76	3.08
	254.05	42.8	108.75	100.00	65.3	57.09	100.00
Good condition range							
Hja	85.21	29.2	24.88	14.08	79.7	43.03	76.50
Cst	23.73	2.9	.69	.39	27.3	5.79	10.30
Ela	154.56	95.1	146.99	83.21	98.9	5.87	10.44
Ska	2.15	90.0	1.94	1.10	99.0	.19	.34
Sco	3.65	58.8	2.15	1.22	96.0	1.36	2.42
Alo	2.27	.0	.00	.00	.0	.00	.00
	271.57	65.0	176.65	100.00	85.8	56.24	100.00

Table 1. Continued (Area VII)

Species	Pounds per acre	Period 1 (4 days) Utilization at end of period	Amount consumed	Diet	Period 2 (4 days) Utilization at end of period	Amount consumed	Diet
		(%)	(lbs/A)	(%)	(%)	(lbs/A)	(%)
Poor condition range							
Cst	144.12	3.4	4.90	7.30	39.0	51.31	96.86
Hja	8.45	97.8	8.26	12.31	99.6	.15	.28
Sco	1.27	95.0	1.20	1.78	99.5	.06	.11
Atr	45.54	96.3	43.86	65.32	98.8	1.14	2.15
Ohy	9.25	96.5	8.93	13.29	100.0	.32	.60
	208.63	32.2	67.15	100.00	57.6	52.98	100.00
Good condition range							
Cst	30.91	.5	.15	.08	23.5	7.11	3.81
Hja	72.08	16.8	12.11	6.48	56.7	28.76	15.42
Sco	258.70	49.2	127.28	68.28	30.9	82.01	43.96
Atr	62.98	50.0	31.49	23.61	60.6	6.68	3.58
Ohy	77.76	4.0	3.11	1.67	82.5	61.04	32.72
Alo	7.07	.0	.00	.00	1.7	.12	.06
Ska	4.15	.0	.00	.00	.0	.00	.00
Sgr	5.61	85.0	4.77	.00	100.0	.84	.45
	519.26	34.5	178.91	100.00	70.4	186.56	100.00

Table 1. Continued (Area VIII)

Species	Pounds per acre	Period 1 (4 days) Utilization at end of period	Period 1 (4 days) Amount consumed	Period 1 (4 days) Diet	Period 2 (4 days) Utilization at end of period	Period 2 (4 days) Amount consumed	Period 2 (4 days) Diet
		(%)	(lbs/A)	(%)	(%)	(lbs/A)	(%)
Poor condition range							
Cst	103.49	12.1	12.52	12.11	34.1	22.77	68.12
Hja	15.51	74.4	11.54	11.16	91.6	2.67	7.99
Ohy	68.27	95.5	65.20	63.08	99.8	2.94	8.79
Sco	16.90	72.5	12.25	11.85	97.5	4.22	12.62
Ela	1.23	99.5	1.22	1.18	100.0	.01	.03
Alo	1.61	40.0	.64	.62	91.0	.82	2.45
	207100	49.9	103.37	100.00	66.1	33.43	100.00
Good condition range							
Cst	81.02	4.4	3.56	2.63	32.1	22.44	29.60
Hja	13.86	30.0	4.16	3.07	68.3	5.31	7.00
Ohy	21.96	94.4	20.73	15.30	99.3	1.08	1.42
Sco	125.88	57.0	71.75	52.94	94.0	46.58	61.41
Ela	35.90	98.4	35.32	26.06	99.6	.43	.57
	278.62	48.6	135.52	100.00	75.9	75.84	100.00

of period 2 (Table 1). Diets on the good condition range for the first period consisted mainly of needle-and-thread grass and Indian rice-grass. There was little change in the diet of the sheep on this area during the second period.

On area II galleta grass was the dominant plant on the poor range and winterfat was dominant on good range.

During period 1 on the poor range, 51 percent of the diet was galleta grass and 23.3 percent was winterfat. On the good range 53.4 percent of the diet was winterfat and 24 percent of the diet was galleta grass. During the second period on poor range, galleta grass made up 70.7 percent of the diet and winterfat accounted for only 17 percent. The winterfat consumed during the second period was primarily the result of a new supply made available from receding snow. The diet on good range during period 2 was composed of approximately 50 percent winterfat and 50 percent a mixture of grasses.

Trial III consisted of three, four-day periods. In the first period winterfat provided more than 40 percent of the diet on both sides of the fence. Galleta grass was more abundant on good range, but made up only one-half as much of the diet as compared to poor range. However, during the second period more than 60 percent of the diet on the poor range consisted of yellowbrush. This less desirable species contributed only 16.5 percent of the diet on good range during the same period.

At the completion of period 3, both good and poor ranges had received very heavy use with an average utilization of 73 and 79 percent respectively. Several of the more desirable species were utilized in excess of 90 percent. Yellowbrush which is normally unpalatable to sheep was utilized 49 percent on the good range and 65 percent on the poor range.

Trial IV was conducted in one five-day period and two four-day periods. The vegetation on the good area was composed largely of galleta grass and winterfat. Herbage on the poor range was comprised of nearly equal amounts of winterfat, big sagebrush, yellowbrush, and galleta grass.

Diets were similar on the good and poor ranges during period 1 with winterfat being the principal constituent. However, during period 2, yellowbrush and galleta grass comprised nearly 92 percent of the diet on the poor range while winterfat, needle-and-thread grass, and galleta grass composed the major portion of the diet on the good range.

The third period of trial IV resulted in very heavy grazing on both enclosures. All of the more palatable species were nearly 100 percent eaten which resulted in forced utilization of the less palatable species. Yellowbrush and big sagebrush made up 58 percent and galleta grass 41 percent of the diet on the poor range. Galleta grass was also the major species in the diet on the good range but winterfat made up about one-third of the diet while yellowbrush and big sagebrush each made up less than four percent.

Vegetation composition on the good and poor range of area V varied widely among species. Winterfat and Indian ricegrass were more abundant on good range and yellowbrush and galleta were more abundant on poor range. During the first period, diets were comparable except for a higher percentage of yellowbrush eaten on the poor range. During period 2, the diet from poor range was composed almost entirely of galleta grass and yellowbrush while on the good range the major portion of the diet was composed of winterfat and yellowbrush.

Vegetation differed considerably on the two condition classes of range on area VI. The poor range was primarily a galleta grass type and the good range was predominately winterfat. Over 80 percent of the diet in period 1 on the good enclosure was winterfat with galleta grass making up most of the remainder. The diet on the poor range was about one-half galleta grass and the remaining one-half was composed largely of winterfat, sagebrush and yellowbrush. During period 2, 95 percent of the diet on the poor range was galleta grass while only 75 percent of the diet from the good range was galleta grass.

Area VII presented a wide contrast between good and poor ranges with the poor range side being a yellowbrush-big sagebrush type and the good range side a grass-big sagebrush type. During period 1 the sheep on the poor range ate much of the big sagebrush and what grass was available. Although yellowbrush was plentiful on poor range, it was only slightly utilized. Needle-and-thread grass and big sagebrush comprised over 90 percent of the diet on the good range during period 1.

During period 2, there was a marked difference between the diets on the good and poor ranges. Nearly 97 percent of the diet on poor range was yellowbrush and two percent big sagebrush with grass contributing less than one percent. With increased utilization on the good range, the diet contained a mixture of grasses and browse in about equal quantities (Table 1).

The poor condition range of area VIII was predominately yellowbrush while the good range contained mostly needle-and-thread grass with smaller amounts of winterfat and yellowbrush. Grasses composed about three-fourths of the diet on both range conditions during period 1, but during the second period, two-thirds of the diet on poor range was yellowbrush. During the same period on the good range nearly two-thirds of the diet was needle-and-thread grass with only 29 percent consisting of yellowbrush.

Chemical content of diet

The average nutrient content of the diets from eight study areas as determined by esophageal-fistula samples showed that diets from ranges in good condition were significantly higher in cellulose under both light and heavy use (Table 2). Diets from ranges in poor condition were higher in total protein, ash, other carbohydrates, and gross energy under both light and heavy grazing.

The changes in average chemical content of the diets with increased intensity of grazing can be attributed to changes in species composition, utilization of species and portion of individual plants eaten. After the more palatable species were nearly 100 percent utilized, the diet was drastically changed to less palatable species.

Increased utilization on both condition classes for the entire eight trials revealed that ether extract, total protein, cellulose, and gross energy decreased. Lignin and other carbohydrates were the only constituents that increased on good and poor range with increased utilization. The increase of lignin in the diet is due to forced use of more fibrous portions of the plant. Ash content of the diet decreased on poor condition ranges with increased use and increased on good ranges when utilization increased (Table 2).

The average total protein content of the diet was equal for good and poor ranges during the first period. During the second period there was a slight decline in total protein on good ranges but the noticeable

Table 2. Average chemical content of ingested material taken from esophageal-fistula samples and corrected for saliva contamination.

Condition	Trial	Period	Chemical composition						
			Ether extract	Total protein	Ash	Lignin	Cellulose	Other carbo-hydrates	Gross energy
			(Percent)						(kcal/lb)
Poor	I	1	3.2	10.4	11.2	10.4	20.2	44.6	1677
		2	3.6	10.0	3.9	14.3	21.7	46.4	1871
	Avg.		3.4	10.2	7.6	12.4	21.0	45.5	1774
Good	I	1	2.9	7.9	10.3	9.8	27.2	41.9	1654
		2	2.4	7.2	9.9	9.2	25.5	45.8	1719
	Avg.		2.6	7.6	10.1	9.5	26.4	43.8	1686
Poor	II	1	1.8	8.1	13.7	10.6	28.0	37.8	1682
		2	.7	7.8	17.5	11.1	20.0	42.9	1481
	Avg.		1.2	7.9	15.6	10.8	24.2	40.3	1584
Good	II	1	2.0	8.7	10.3	11.9	27.4	39.7	1696
		2	1.4	8.4	10.1	12.7	24.3	43.1	1686
	Avg.		1.7	8.6	10.2	12.3	25.8	41.4	1691
Poor	III	1	2.3	8.0	16.4	12.1	16.5	44.7	1560
		2	2.3	8.1	16.4	13.0	15.8	44.4	1598
		3	3.3	8.1	13.3	14.6	17.4	43.3	1691
	Avg.		2.6	8.1	15.4	13.2	16.6	44.1	1617
Good	III	1	3.2	9.1	9.6	11.4	21.1	45.6	1609
		2	3.7	8.0	8.3	12.0	22.4	45.6	1630
		3	2.5	7.5	11.9	12.9	21.6	43.6	1738
	Avg.		3.1	8.2	9.9	12.1	21.7	45.0	1659

Table 2. Continued

			Chemical composition						
Condition	Trial	Period	Ether extract	Total protein	Ash	Lignin	Cellulose	Other carbo-hydrates	Gross energy
			(Percent)						(kcal/lb)
Poor	IV	1	2.5	7.9	12.7	11.9	20.1	44.9	1679
		2	2.6	8.4	11.3	11.4	21.0	45.3	1761
		3	1.8	7.0	17.4	11.0	20.0	42.8	1575
	Avg.		2.3	7.8	13.8	11.4	20.4	44.3	1672
Good	IV	1	2.6	8.1	7.3	14.1	24.4	43.5	1790
		2	2.1	7.4	9.5	12.2	21.7	47.1	1716
		3	1.7	6.9	14.0	10.6	22.6	44.2	1588
	Avg.		2.1	7.5	10.3	12.3	22.9	44.9	1698
Poor	V	1	2.6	8.4	10.8	12.7	17.6	47.9	1726
		2	2.3	7.4	12.0	11.8	18.3	48.2	1686
	Avg.		2.4	7.9	11.4	12.2	18.0	48.1	1706
Good	V	1	2.1	8.8	8.7	12.1	19.3	49.0	1722
		2	1.6	7.4	8.1	12.5	20.3	50.1	1755
	Avg.		1.8	8.1	8.4	12.3	19.8	49.5	1738
Poor	VI	1	2.6	8.1	7.6	13.0	19.8	48.9	1838
		2	2.1	7.4	8.1	13.4	20.1	48.9	1738
	Avg.		2.4	7.8	7.8	13.2	20.0	48.9	1804
Good	VI	1	1.7	10.5	6.3	12.7	23.1	45.7	1749
		2	1.9	7.8	8.5	13.1	21.9	46.8	1806
	Avg.		1.8	9.2	7.4	12.9	22.5	46.4	1777

Table 2. Continued.

			Chemical composition						
Condition	Trial	Period	Ether extract	Total protein	Ash	Lignin	Cellulose	Other carbo-hydrates	Gross energy
					(Percent)				(kcal/lb)
Poor	VII	1	3.1	8.0	4.9	14.8	21.0	48.2	1926
		2	2.5	8.0	7.1	15.3	19.6	47.5	1810
	Avg.		2.8	8.0	6.0	15.0	20.3	47.9	1868
Good	VII	1	4.3	7.0	11.5	10.2	20.2	46.8	1738
		2	2.7	6.2	13.8	10.4	20.5	46.4	1651
	Avg.		3.5	6.6	12.6	10.3	20.4	46.6	1692
Poor	VIII	1	2.4	7.9	7.7	13.5	20.5	48.0	1769
		2	2.5	8.3	6.3	15.7	17.9	49.3	1856
	Avg.		2.4	8.1	7.0	14.6	19.2	48.6	1812
Good	VIII	1	2.7	7.0	8.1	12.5	22.1	47.6	1820
		2	2.2	7.6	7.8	13.6	24.7	44.1	1805
	Avg.		2.4	7.3	8.0	13.0	23.4	45.8	1813
Poor		1	2.6	8.4	10.6	12.4	20.5	45.6	1732
		2	2.3	8.2	10.3	13.2	19.3	46.6	1729
	Avg.		2.5	8.3	10.4	12.8	19.9	46.1	1731
Good		1	2.7	8.4	9.0	11.8	23.1	45.0	1722
		2	2.2	7.5	9.5	12.0	22.7	46.1	1721
	Avg.		2.4	8.0	9.2	11.9	22.9	45.6	1722

decrease in total protein on poor ranges under heavy grazing was significant at the five percent level (Table 3). Since browse species were more abundant on poor ranges than on good ranges, one would expect a higher total protein content in the diets on poor ranges. However, since the reverse was true it is assumed that heavier use on the more palatable species on poor ranges accounted for more coarse plant material in the diet which lowered the protein content of the material eaten.

Cellulose was significantly higher in the diets from good ranges than the diets from poor ranges under light and heavy grazing intensity (Table 3). This might be expected since grasses made up considerably more of the diet on good ranges. Grasses on desert winter ranges are higher than browse in cellulose and other carbohydrates while browse is higher than grasses in protein, ash and lignin (Cook _et al_. 1954).

Digestibility

The average digestibility of all nutrients in the diet was higher from the ranges in good condition than from ranges in poor condition.

The average digestibilities of total protein, cellulose and gross energy were significantly higher on the good ranges at the five percent level of probability (Table 5).

The digestibility of all nutrients in diets from poor ranges decreased with increased intensity of grazing. However, the digestibility of all nutrients except total protein in diets from good ranges increased with increased utilization (Table 4). The increased digestibility of cellulose and gross energy that was associated with more intensive grazing on good ranges might be attributed to the increased amount of grasses in the diets.

Table 3. Analysis of variance for chemical content of fistulae samples presented in Table 2.

		Mean squares						
Source	D.F.	Ether extract	Total protein	Ash	Lignin	Cellulose	Other carbo-hydrates	Gross energy
Total	31							
Condition (C)	1	.01	.81	11.0	6.00	72.0**	3	2,196
Trials (T)	7	1.25	.92	17.0	3.14	18.0*	24*	72,759
T x C error (a)	7	.47	1.65	21.0	4.57	4.0	3	25,071
Period (P)	1	.91*	2.26*	.0	3.00*	5.0	9*	106
C x P	1	.08	1.02	2.0	1.00	1.0	0	22
T x P error (b) T x C x P	14	.15	.29	3.3	.71	3.4	2	23,678

* Significant or approaching significance at the 5 percent level.
** Significant at the 1 percent level.

Table 4. Average digestibility of desert range forage from grazing trials on adjacent poor and good range as displayed by fence-line contrasts.

Condition	Trial	Period	Consumption	Percent digestibility: Ether extract	Percent digestibility: Total protein	Percent digestibility: Cellulose	Percent digestibility: Other carbohydrates	Percent digestibility: Gross energy	Digestible protein	Metabolizable energy
			(lbs/day)						(percent)	(kcal/lb)
Poor	I	1	3.17	11.5	56.6	48.0	61.8	36.9	5.9	477
		2	2.21	19.1	35.4	27.0	46.2	22.7	3.5	275
	Avg.		2.69	15.3	46.0	37.5	54.0	29.8	4.7	376
Good	I	1	3.10	-16.8	45.9	61.9	57.1	34.6	3.6	424
		2	3.20	14.1	40.8	62.8	63.3	43.1	2.9	584
	Avg.		3.15	- 1.4	43.4	62.4	60.2	38.8	3.2	504
Poor	II	1	2.50	-11.6	36.0	61.0	48.2	37.3	2.9	460
		2	2.65	-70.5	38.2	59.3	59.2	37.2	2.9	392
	Avg.		2.58	-41.0	37.1	60.2	53.7	37.2	2.9	426
Good	II	1	3.58	15.4	43.3	59.6	53.0	36.5	3.8	472
		2	3.41	- 1.7	41.1	49.2	60.6	36.8	3.5	470
	Avg.		3.50	6.8	42.2	54.4	56.8	36.6	3.6	471
Poor	III	1	2.96	14.7	27.4	26.9	55.2	27.7	2.2	291
		2	3.08	5.8	24.0	27.6	55.9	27.6	1.9	101
		3	2.75	35.5	26.2	34.2	45.0	26.1	2.1	269
	Avg.		2.93	18.7	25.9	29.6	52.0	27.1	2.0	220
Good	III	1	3.76	38.4	43.9	44.9	64.2	35.6	4.0	425
		2	3.74	51.9	34.8	34.6	63.7	34.3	2.8	412
		3	3.02	34.2	30.0	43.3	58.8	33.6	2.2	418
	Avg.		3.51	41.5	36.2	40.9	62.2	34.5	3.0	418

Table 4. Continued.

Condition	Trial	Period	Consumption	Percent digestibility: Ether extract	Total protein	Cellulose	Other carbohydrates	Gross energy	Digestible protein	Metabolizable energy
			(lbs/day)						(percent)	(kcal/lb)
Poor	IV	1	2.84	35.0	39.3	40.2	63.5	38.3	3.1	461
		2	2.85	41.1	38.8	44.8	63.4	39.3	3.3	506
		3	2.77	8.6	32.0	49.7	55.4	31.4	2.2	319
	Avg.		2.82	28.2	36.7	44.9	60.8	36.3	2.9	429
Good	IV	1	2.95	19.3	39.8	38.6	62.9	33.6	3.2	435
		2	3.22	32.7	44.9	41.8	68.0	39.6	3.3	514
		3	2.99	31.1	41.5	46.3	57.5	36.0	2.9	370
	Avg.		3.05	27.7	42.1	42.2	62.8	36.4	3.1	440
Poor	V	1	2.20	10.4	28.1	23.2	60.8	18.7	2.4	141
		2	2.53	26.9	40.1	42.7	55.0	30.6	3.0	335
	Avg.		2.36	18.6	34.1	33.0	57.9	24.6	2.7	238
Good	V	1	3.02	8.3	43.2	31.9	57.5	27.7	3.8	325
		2	3.11	1.6	42.9	40.1	58.6	34.1	2.0	432
	Avg.		3.06	5.0	43.0	36.0	58.0	30.9	2.9	378
Poor	VI	1	2.79	24.1	33.4	38.9	60.8	36.6	2.7	481
		2	2.33	23.6	24.4	37.0	58.0	30.5	1.8	350
	Avg.		2.56	23.8	28.9	38.0	59.4	33.6	2.2	416
Good	VI	1	3.62	-1.7	51.0	39.2	34.7	35.3	5.4	480
		2	3.71	25.5	44.6	48.9	57.8	38.8	3.5	497
	Avg.		3.66	11.9	47.8	44.0	46.2	37.0	4.4	488

Table 4. Continued.

				Percent digestibility						
Condition	Trial	Period	Consumption	Ether extract	Total protein	Cellulose	Other carbohydrates	Gross energy	Digestible protein	Metabolizable energy
			(lbs/day)						(percent)	(kcal/lb)
Poor	VII	1	2.35	24.5	33.8	40.9	59.3	33.8	2.7	409
		2	2.37	31.4	39.3	33.8	53.4	29.1	3.1	289
	Avg.		2.36	28.0	36.6	37.4	56.4	31.4	2.9	349
Good	VII	1	2.67	39.2	37.0	52.5	66.3	38.8	2.6	518
		2	2.36	16.2	31.8	54.2	66.2	39.0	2.0	465
	Avg.		2.52	27.7	34.4	53.4	66.2	38.9	2.3	492
Poor	VIII	1	2.52	44.5	38.8	44.9	58.6	35.8	3.1	469
		2	2.28	43.0	38.7	11.9	64.7	35.1	3.2	472
	Avg.		2.40	43.8	38.8	28.4	61.6	35.4	3.2	470
Good	VIII	1	2.56	29.8	29.9	44.9	60.4	36.6	2.1	593
		2	2.61	34.8	42.6	50.9	69.0	43.2	2.8	600
	Avg.		2.58	32.3	36.2	47.9	64.5	39.9	2.4	596
Poor		1	2.67	19.1	36.7	40.5	58.5	33.1	3.1	399
		2	2.54	15.0	34.9	35.5	57.0	31.5	2.8	340
	Avg.		2.60	17.0	35.8	38.0	57.8	32.3	3.0	370
Good		1	3.16	16.5	41.8	46.7	57.0	34.8	3.6	459
		2	3.17	21.9	40.4	47.8	63.4	38.6	2.8	497
	Avg.		3.16	19.2	41.1	47.2	60.2	36.7	3.2	478

Table 5. Analysis of variance for daily consumption, digestibility, and intake of protein and metabolizable energy for data presented in Table 4.

			Percent digestibility						
		Mean squares							
Source	D.F.	Pounds eaten per day	Ether extract	Total protein	Cellulose	Other carbohydrates	Gross energy	Percent digestible protein	Metabolizable energy
Total	156								
Condition (C)	1	2.52**	34	227*	714*	49	155*	.41	73,536*
Trials (T)	7	.409	1,405	51	257	63	47	.83	21,978*
T x C error (a)	7	.129	462	65	112	51	16	1.40	3,675
Period (P)	1	.03	4	19	30	47	9	2.00*	364
C x P	1	.04	179	87	44	125*	59*	.36	14,533
T x P error (b) T x C x P	14	.05	234	31	81	31	17	.44	5,068
Among individuals	126	.62	418	115	241	97	56	.00	0

* Significant or approaching significance at the 5 percent level.
** Significant at the 1 percent level.

The amount of metabolizable energy in the diet was significantly greater on good ranges compared to poor ranges during both light and heavy grazing. There was 29 percent more metabolizable energy available in the diet of sheep on good range than those on poor range (Table 4).

Daily intake

The average air dry forage consumed daily by the grazing animals on good condition ranges was significantly greater under all intensities of use than daily intake by animals on poor ranges. Increased intensity of use definitely resulted in a decrease in daily intake on the poor condition range but had no noticeable effect upon the daily intake of sheep grazing good ranges.

The average daily consumption for sheep on good ranges was 0.56 of a pound greater than for sheep on poor range which was significant at the one percent level (Table 5).

CONCLUSIONS

Desert ranges in good condition produced considerably more herbage per acre than adjacent ranges in poor condition. The percentage of more palatable species was consistantly higher on ranges in good condition than ranges in poor condition.

A greater proportion of more palatable plants on the good condition ranges generally encouraged greater use upon more species. As a result, the daily intake of herbage on the good ranges was significantly greater than the daily intake on ranges in poor condition.

The species composition of the diets on the good ranges compared to poor ranges were more nearly alike during period 1 than during period 2. This is attributed to the selection of the more palatable plants on both areas under light use. After the more palatable plants were nearly 100 percent eaten on the poor ranges, the diets were restricted in some cases to a single, less desirable species.

The study revealed that the relative abundance of browse and grasses on good and poor ranges was not necessarily an indication of the relative proportion of each forage class in the diet. When some of the less palatable browse species were present in limited quantities on good range, utilization on these less desirable species was considerably higher than on poor range where these species were plentiful. Apparently sheep prefer a variety of plants and eat sparce species for a change.

The cellulose content of the diet was considerably greater on ranges in good condition, during all intensities of grazing. There were no significant differences in other chemical constituents in the diets as a result of range condition.

Intensity of grazing had a marked effect on nutrient content of the diet. Ether extract, total protein, cellulose, and gross energy decreased in percentage on both good and poor condition ranges with increased intensity of use. Lignin and other carbohydrates increased in percentage on both condition classes with increased use.

Condition of the range significantly affected the digestibility of nutrients in the diets. The average digestibility of all nutrients in diets from good ranges was higher than digestibility coefficients of nutrients in the diets from poor ranges. In addition, there was a reduction in digestibility of all nutrients from poor ranges under increased use while the digestibility of all nutrients in diets, except protein, showed a slight increase with increased use on ranges in good condition.

Also of major importance was the significantly greater amount of metabolizable energy in the diet from good ranges compared to poor ranges.

SUMMARY

A study was conducted in southwestern Utah during the winter grazing season of 1957 and 1958 to determine the effect of range condition upon the production, nutritive intake, and digestibility of desert range forage.

Eight separate trials were conducted on desert range areas displaying fence-line contrasts of good and poor range conditions.

Areas containing equal herbage were fenced on each side of the fence. Three sheep with esophageal fistula and five wethers equipped with fecal collecting bags were grazed simultaneously on each enclosure.

Each trial was divided into two or three periods, of equal duration, the first period representing light use, and the second and third representing heavy use. Samples of injested material from fistulated sheep and fecal samples for each wether were composited at the termination of each period for chemical analysis. Digestibility coefficients and daily intake were calculated by the lignin-ratio technique.

Ranges in good condition produced more herbage than ranges in poor condition.

The relative abundance of browse and grasses on the ranges was not found in the diet in the same relative proportions.

Utilization was generally lighter on poor ranges compared to good ranges. Also, the daily forage intake was markedly less on poor ranges than on good ranges.

The cellulose content in diets from good ranges was significantly higher than diets from poor ranges. Other constituents were not greatly affected by range condition.

Digestibility of all nutrients was less on poor ranges than on good ranges. As intensity of grazing increased, the digestibility of nutrients in the diets decreased on poor ranges while increased intensity had no appreciable effect upon the digestibility of nutrients on good ranges.

It was concluded that range condition had a significant effect upon herbage production, daily consumption by sheep and digestibility of forage from desert ranges. Poor condition adversely affected all these factors.

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APPENDIX

Table 6. A list of scientific and common names of important range plants found in the area where this study was conducted.

Scientific name	Common name	Symbol
Grasses		
Aristida longiseta	Three-awn grass	Alo
Hilaria jamesii	Galleta grass	Hja
Oryzopsis hymenoides	Indian ricegrass	Ohy
Sitanion hystrix	Squirreltail grass	Shy
Sporobolus cryptandrus	Sand dropseed grass	Scr
Stipa comata	Needle-and-thread grass	Sco
Browse		
Artemisia tridentata	Big sagebrush	Atr
Chrysothamnus stenophyllus	Yellowbrush	Cst
Eurotia lanata	Winterfat or white sage	Ela
Gutierrezia sarothrae	Snakeweed	Gsa
Forbs		
Salsola Kali var. tenuifolia	Russian thistle	Ska
Sphaeralcea grossulariaefolia	Globemallow	Sgr