

Effect of Range Condition and Utilization on Nutritive Intake of Sheep on Summer Ranges

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Highlight

Total protein, ash, lignin, and other carbohydrates were somewhat higher in forage from poor ranges while ether extract, cellulose, and gross energy were slightly higher in forage from good ranges. The digestibilities of cellulose, other carbohydrates, and gross energy in forage from both good and poor ranges decreased with heavier utilization.

The mountainous ranges of the West are commonly grazed from about June 15 until September 15. These summer ranges display various stages of range condition with respect to their full potential as forage producing lands. The productivity of these ranges

greatly affects the economy of the livestock industry since they produce marketable animals. It is frequently stated that ranges in poor condition produce poorer animal gains than ranges in good condition. This assumes that ranges in poor condition provide lower nutritive levels than do ranges in good condition or that animals eat less on poor ranges.

Little work has been done to determine the nutritive content and digestibility of forage consumed on ranges in different conditions, or the effect of grazing intensity upon the nutritive content and digestibility of for-

age consumed on mountainous summer ranges.

Cook et al. (1953, 1962) and Piper et al. (1959) found that the nutrient intake on desert ranges decreased with increasing intensity of grazing. This was a result of both reduced daily consumption and decreased digestibility of the nutrients ingested. It was found that the nutrient content in herbage on poor range was as desirable and was as highly digested as the nutrient content in herbage on good range when comparable degrees of utilization were made on both condition classes.

Renner and Johnson (1942) and Hutchings (1954) stated that poor ranges produced greater numbers of plants low in nutritive value than good ranges. Gobel and Cook (1960), however, found that most species that were abundant on poor desert ranges were as nutritious as the species found on good ranges.

The present study was done on typical mountainous summer range between 6,000 and 7,000 feet elevation in northern Utah on the Cache National Forest. The annual precipitation averages about 22 inches with about one-fourth of it coming during the winter months. Maximum temperatures of 80 degrees F. are reached during the summer. Frost occurs frequently in late June and again during the latter part of August and September.

Methods and Procedures

Five study areas were selected where existing fences marked obvious differences in range condition on opposite sides (Figure 1). The study areas were predominately sagebrush grass intermixed with mountain brush and aspen types. In all cases the adjacent sides represented poor and good range condition as classified by the procedures outlined by the U. S. Forest Service (1962).

The areas to be grazed were fenced with equal quantities of herbage on both the poor and the good side. Enough forage was enclosed in each paddock to furnish feed for a 3-day adjustment period and two consecutive 6-day digestion trails for 7 wether sheep and 4 esophageal fistulated sheep. The first six days represented light use and the second six days represented moderate to heavy use. The first area was grazed starting about June 8 and the fifth was grazed starting about September 1 each year during the three-year study period (1960-1962). The areas were grazed in the same order each year.

Herbage production and diets were calculated by the method used by Edlefsen et al. (1960).

Fourteen paired wether sheep were equipped with harnesses and bags for collecting feces. In addition, eight paired sheep equipped with esophageal-fistula cannulae were used to collect



Figure 1. A fence line contrast in a sagebrush-grass type showing good range condition on left and poor range condition on right.

forage samples. At the beginning of each trial one sheep of each pair was assigned to good or poor ranges at random. All fourteen wether sheep used for fecal collections were weighed on and off each study area.

The chemical analyses of the forage samples collected from fistulated sheep were corrected for ash and phosphorus content of the saliva by the procedure outlined by Cook (1964).

Fecal collections were begun 24 hours after the first forage collections were made, and were terminated 24 hours after the last forage collections for each period on each area. Fecal collection bags were emptied twice daily. At the end of each 6-day period, collections of both feces and forage were composited for chemical analysis.

The total daily forage intake and digestibility coefficients were determined by the lignin-ratio technique (Cook et al., 1951).

Results and Discussion

Production, Utilization and Diets.—A total of 16 grasses, 33 forbs and 11 browse species were

found on the 5 areas studied during the years 1960-62. Slightly less total herbage was produced on good range than on poor range (Table 1).

Good range produced more grass than poor range but utilization of grasses was higher on poor range. However, grass made up slightly more of the diet on good range (Table 1). The production of forbs was higher on poor range but utilization of forbs was higher on good range. As a result, good and poor range had about equal amounts of forbs in the diet. Production and utilization of browse were slightly higher on poor ranges and thus, the browse was higher in the diet of sheep grazing poor ranges.

Percentages of grass and forbs increased in the diet with increased intensity of grazing, but browse decreased (Table 1).

Chemical Content of Diet.—Ether extract constituents in the diet were significantly higher ($P < .05$) on good ranges than on poor ranges (Table 2). There were significant differences in percent ether extract consumed among years and among areas. But there was no significant dif-

Table 1. Average production, utilization and diet from good and poor range conditions on summer ranges when grazed at two intensities during three successive years (1960-62) from June 8 to September 10.

Range condition	Class of forage	Production	Period 1		Period 2	
			Util.	Diet	Util.	Diet
		lb/A	———(Percent)———			
Good	Grass	293	10.2	22.8	25.6	33.1
	Forbs	305	11.9	27.8	29.5	39.3
	Browse	693	9.3	49.1	14.7	27.6
	Total and Average	1291	10.1	100.0	22.7	100.0
Poor	Grass	230	14.0	21.9	35.1	28.9
	Forbs	381	10.1	26.3	27.7	40.0
	Browse	776	9.9	52.0	16.6	31.3
	Total and Average	1387	10.6	100.0	20.7	100.0
Average	Grass	261	12.1	22.4	30.4	31.0
	Forbs	343	11.0	27.1	28.6	39.7
	Browse	735	9.6	50.6	15.7	29.0
	Total and Average	1339	10.4	100.0	21.7	100.0

ference between grazing intensities.

A highly significant decrease ($P < .01$) in the percentage of total protein in the diet was associated with increased intensity of utilization on both good and poor ranges during all three years of study (Table 2). This was believed to result from increased consumption of coarser portions of the plant with heavier grazing. Total protein in the diet was slightly higher on poor range than on good range during all three years but the difference was not statistically significant. This was no doubt a result of more browse in the diet on poor

range, browse being higher in protein than grasses or forbs.

There was a highly significant increase in the ash content of forage as utilization increased. This may have resulted from a change in parts of the plants consumed and to more dirt adhering to the lower portion of the plants.

The percentage of lignin in the diet was somewhat higher under heavy utilization on both good and poor range. Increased consumption of coarser parts of the plants could account for this.

The percent cellulose was significantly higher ($P < .05$) in the sheep's diet on good ranges com-

pared to those on poor ranges (Table 2). This could be a result of having more grass in the diet on good range since grasses are higher in this constituent than are forbs or browse (Table 1). The other carbohydrate fraction was slightly higher in poor range than in good range diets. Percent cellulose in the diet increased with increased grazing intensity on both good and poor range but the percent of other carbohydrates decreased.

Gross energy in the diet was somewhat higher on good range than on poor range and, like ether extract, total protein, and other carbohydrates, it decreased in the diet as utilization increased.

The effect of intensity of grazing upon cellulose, other carbohydrates, and gross energy in the diet was not statistically significant ($P < .05$). Neither range condition nor intensity of grazing had any significant effect on the content of phosphorus in the diet (Table 2).

Digestibility and Nutritive Intake.—The digestibility of ether extract constituents was significantly affected ($P < .05$) by range condition. The average digestibility of ether extract material on good range was 2.3 percent and on poor ranges, -14.7 percent. This difference can be explained only on the basis of the actual material making up the

Table 2. Average chemical content of ingested material from fence line contrasts on mountainous summer range that displayed good and poor condition. Data from five separate areas grazed at two intensities, each year for three years (1960-62); dry matter basis.

Range Condition	Grazing period	Ether extract	Total protein	Ash	Lignin	Cellulose	Other carbohydrates	Phosphorus	Gross energy
		———	———	———	(Percent)	———	———	———	(kcal/lb)
Good	1	3.7	12.0	11.2	10.1	21.8	41.5	0.30	1954.5
	2	3.7	11.4	11.6	10.4	22.2	40.8	0.30	1945.1
	Average	3.7	11.7	11.4	10.2	22.0	41.2	0.30	1949.8
Poor	1	3.5	13.0	11.6	10.2	19.7	42.4	0.30	1941.6
	2	3.1	11.9	12.2	10.8	20.2	41.8	0.29	1929.7
	Average	3.3	12.4	11.9	10.5	19.9	42.1	0.30	1935.7
Average	1	3.6	12.5	11.4	10.0	20.8	42.0	0.30	1948.1
	2	3.4	11.6	11.9	10.6	21.2	41.3	0.29	1937.4

ether extract content of ingested forage on poor and good ranges. It might be attributable to the two browse species (*Chrysothamnus viscidiflorus* and *Purshia tridentata*) which differed materially in the diet on poor and good range (Table 1). The material included in the ether extract fraction for each of the two species could be markedly different.

The digestibility of the protein in the diets differed significantly among years and among the five areas within years. The digestibility coefficient for protein was somewhat higher on poor range than on good range. This difference was not statistically significant, however. The interaction between range condition and intensity of use had a significant effect on the digestibility of protein. On good range the digestibility of the protein in the diet increased slightly the second period, while on poor range the digestibility decreased during the second period (Table 3).

Percent digestible protein was higher in forage consumed from poor range compared to forage from good range, and it decreased as intensity of utilization increased on both poor and good range (Table 3). These differences between range conditions and intensity of use approached statistical significance at the 5 percent level of probability.

The digestibility of cellulose was significantly higher in forage from good ranges compared to that from poor ranges, and it decreased significantly with heavier utilization on both good and poor range.

The digestibility of "other carbohydrates" decreased significantly ($P < .05$) with heavier utilization but was not affected by range condition.

The digestibilities of gross energy and dry matter were somewhat lower for forage from poor ranges than for forage from good ranges. Digestibility coefficients for these constituents decreased slightly with heavier utilization on both good and poor range condition (Table 3). These differences were not of sufficient magnitude to be statistically significant.

The total digestible nutrients and digestible energy in the diets compared rather closely with the digestibility of dry matter. All three were somewhat lower in diets on poor ranges than in diets on good ranges and all three decreased with increased utilization.

Daily Intake.—A highly significant difference ($P < .01$) was observed in the average daily forage intake among the three years. The average daily dry matter intake per wether sheep was 3.34, 2.25, and 2.76 pounds for 1960, 1961, and 1962, respec-

tively. The forage in 1960 and 1962 remained green longer and as a result was more palatable over a longer period. Differences in the characteristics of forage growth are believed to be the major factor accounting for the difference in daily intake among years. There was a significant difference ($P < .05$) in average daily intake among the different areas. This was a result of many factors such as species composition, stage of plant growth, and weather conditions. Neither range condition nor intensity of grazing had a significant effect on daily intake, but the interaction effect between range condition and intensity of grazing approached significance ($P < .05$). The daily intake of forage increased slightly with heavier utilization on good range, but on poor range the daily intake decreased slightly with heavier utilization.

Weight Changes.—During 1960 the experimental sheep weighing approximately 120 pounds to start gained 54 pounds on good range areas and 37 pounds on poor range areas from June 10 until September 6. During the summer of 1961 sheep weighing approximately 152 pounds gained 13 pounds on good range but lost 3 pounds on poor range. Sheep weighing 138 pounds gained a total of 14 pounds on good range and 17 pounds on

Table 3. Average daily intake of dry matter and digestibility of chemical constituents in forage consumed from adjacent good and poor range grazed at two intensities. Data collected over 3 years (1960-62) at five locations each year.

Range condition	Grazing period	Digestibility						Dry matter	TDN	Dig. protein	Digestible energy
		Daily intake	Ether extract	Total protein	Cellulose	Other carbohydrates	Gross energy				
		(lbs)	— — — — —	(Percent)		— — — — —		— Percent —		(Kcal/lb.)	
Good	1	2.8	2.1	44.2	56.7	74.2	49.1	52.6	48.7	5.4	956.7
	2	3.0	2.5	44.5	55.4	72.3	48.0	52.1	47.5	5.1	930.8
	Average	2.9	2.3	44.4	56.1	73.3	48.5	52.4	48.1	5.3	943.7
Poor	1	2.7	−14.2	46.5	55.5	75.4	48.0	52.3	49.0	6.2	932.3
	2	2.6	−15.2	44.7	51.6	71.2	46.9	50.1	45.0	5.5	903.3
	Average	2.7	−14.7	45.6	52.5	73.3	47.5	51.2	47.0	5.9	917.8
Average	1	2.8	−6.0	45.3	56.1	74.8	48.5	52.2	48.9	5.8	944.5
	2	2.8	−6.4	44.6	53.5	71.7	47.4	51.1	46.3	5.3	917.1

poor range during the summer grazing season of 1962.

Summary and Conclusions

During three summers from 1960 to 1962 a study was conducted on mountainous summer ranges of northern Utah to determine the effect of range condition and intensity of grazing upon the daily intake, nutritive content, and digestibility of the grazing sheep's diet.

Five areas displaying fence-line contrasts of good and poor range condition were selected and fenced so that each side included equal amounts of herbage. Seven wethers equipped with fecal collecting bags and four sheep equipped with esophageal-fistula cannulae were grazed on each side of the fence. Each paddock was grazed for two 6-day periods; the first represented light use, and the second represented moderate to heavy use. The first area was grazed during the middle part of June each year and the fifth area was grazed during the first part of September. Daily intake and digestibility were determined by the lignin-ratio technique.

Ranges in poor condition produced slightly more total herbage than adjacent ranges in good condition. Good ranges produced more grass but utilization of grasses was higher on adjacent poor ranges. Both production and utilization of browse were greater on poor ranges than on good ranges.

Grass and forbs increased in the diet with increased utilization, but browse decreased in the diet as degree of range utilization increased.

Total protein, other carbohydrates, and gross energy in the diet decreased with increased grazing intensity; whereas, ash, cellulose, and lignin contents increased. These trends were more pronounced on poor range than on good range. Total protein, ash, lignin, and other carbohydrates were somewhat higher in forage from poor ranges, while ether extract, cellulose, and gross energy were slightly higher in forage from good ranges. This was believed a result of more browse being included in the diet on poor ranges and the grass content being higher in the diet on good ranges. Browse, in general, are higher in protein, ash, and lignin, and grasses are higher in cellulose.

The average digestibilities of cellulose, other carbohydrates, and gross energy in forage from both good and poor ranges decreased with heavier utilization. On good range the digestibility of total protein was not affected by increased utilization, but on poor range it decreased significantly.

Total digestible nutrients in the forage decreased on both good and poor ranges with increased utilization, but the decrease was much less on good range.

Daily forage intake increased slightly during the second grazing period on good range but decreased somewhat during the second period on poor range. Range condition had no significant influence on daily intake.

Wether sheep weighing about 135 pounds at the beginning of

the trials gained an average of 28 pounds for the summer grazing season on good range and only 17 pounds on poor range.

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