Effect of Range Condition on the Diet and Performance of Steers Grazing Native Sandhills Range in Nebraska

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Abstract

Two areas of native Sandhills range were used to determine the effect of range condition on the quality of diet and performance of grazing steers. Pasture 1 was in high good-excellent condition (75%), pasture 2 was in low good condition (58%). Pastures were stocked according to recommended rates. At the end of the grazing trial, utilization was full (54%) for both pastures. The grazing trial was continuous from June 1 to September 22, 1978. Three 2-year-old esophageal fistulated and 3 intact yearling steers were used in each pasture for diet and fecal collections during a 5-day-period once each month. Ten Hereford yearling steers were used to measure weight gains in each pasture. Diet samples were analyzed for in vitro organic matter digestibility (IVOMD) and crude protein (CP). Fecal production divided by indigestibility was used to predict intake. IVOMD was 58.6 and 63.4% and CP was 10.2 and 9.4% for pasture 1 and 2, respectively. Differences were not significant ($P<.05$). IVOMD and CP declined ($P<.01$) from period 1 through period 4 in both pastures. IVOMD decreased ($P<.05$) more during the grazing trial in pasture 1 (high good-excellent condition) than pasture 2 (low good condition). Organic matter intake (OMI) was lower ($P<.05$) for pasture 1 (74 g/kg $W^{.75}$) than for pasture 2 (83 g/kg $W^{.75}$). OMI was lower ($P<.05$) in period 4 than in previous periods. OMI was not different ($P>.05$) between fistulated and intact steers. Average daily gains (.78 and .72 kg) per day for pastures 1 and 2, respectively were not different ($P>.05$).

The Sandhills of Nebraska consist of about 12.5 million acres of rangeland. This is the largest expanse of grassland in the Great Plains and supports about 1.5 million cattle. Approximately 55% of the range in the Sandhills is in good to excellent condition, while the remaining 45% is classified as fair and poor condition (Bose 1977).

The purpose of range condition classification is to provide an estimate of the vegetation that is present on a given site compared to climax vegetation. This provides a basis for estimating trend, productivity, feasibility of range improvements and suggested stocking rates.

It is generally assumed that low condition range supports a higher percentage of plants that are low in nutritive content and forage production. If true, this could reduce the qualitative and quantitative intake of grazing animals, which in turn would affect their performance. Cook et al. (1965) stated that when good and poor condition ranges were grazed to comparable degrees of utilization, the nutrient content of diets collected via esophageal fistulas were not different. Lewis et al. (1977) conducted an 8-year study to compare the effect of range condition on steer gains when pastures were grazed to a comparable degree of utilization. They found that excellent condition ranges produced the most gain per ha (13.17 kg) but were intermediate in average daily gain (.77 kg); the good condition ranges were intermediate in gains produced per ha (11.80 kg) but had the highest average daily gain (.81 kg); the fair condition ranges were lowest in gain per ha (11.35 kg) and average daily gain (.72 kg).

The objectives of this study were to: (1) evaluate the effect of range condition on the qualitative and quantitative intake of yearling steers, (2) evaluate the effect of range condition on the performance of yearling steers, and (3) determine the effect of esophageal fistula on the quantitative intake of grazing steers.

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Methods and Procedures

Study Site Description

The study was conducted at the University of Nebraska Sandhills Agricultural Laboratory located 6 km northeast of Tryon, Nebraska. This area is within the 43 to 48 cm precipitation zone and consists primarily of range classified as a sands range site. Soils are predominately Valentine fine sands, which have internal drainage from adequate to excessive. Organic matter content was low, averaging about .81% and soil pH averaged approximately 6.8 (Burzlaff 1962).

Determination of range condition and initial stocking rates were based on procedures used by the Soil Conservation Service, U.S. Dep. Agr. for this area. Utilization was determined by placing wire enclosures in each pasture so that ocular judgements could be made on the differences in the amount of forage inside and outside enclosures.

The grazing trial was from June 1, 1978, through September 22, 1978. Rainfall from June through September was 13.16 cm. This was 7.62 cm below the average amount normally received during that time of year (Hergert 1980).

Pasture 1 was a 60.7-ha pasture in high good-excellent condition (75%). The stocking rate was calculated to be .44 ha per animal per month. At the end of the grazing trial utilization was full (54%).

The predominant forage species were blue grama *(Bouteloua gracilis),* lead plant *(Amorpha canescens),* little bluestem *(Schizachyrium scoparium),* needleandthread *(Stipa comata),* prairie sandreed *(Calamovilfa longifolia),* land switchgrass *(Panicum virgatum).*

Pasture 2 was a 41.5-ha pasture adjacent to pasture 1. Range condition for this pasture was low good (58%) and the stocking rate was calculated to be .65 ha per animal per month. At the end of the grazing trial utilization was full (54%). The predominant grass species consisted of the same species as pasture 1 but included significant amounts of scribners panicum *(Panicum scribnerianum),* sixweeks fescue *(Festuca octaflora),* and western ragweed *(Ambrosia psilostachya).*

Sample Collection Procedures

Three 2-year-old esophageal fistulated steers were used for diet and fecal collection in each pasture. To increase the number of animals for estimating intake, three crossbred intact yearling steers were used for total fecal collections in each pasture.

Ten Hereford yearling steers were grazed in each pasture to measure weight gains during the grazing trial. Average weight at the beginning of the grazing trial was 250.3 kg.

Diet sampling and fecal collections using bags were made during a 5-day period once each month. The collection periods were June 5 through 9, July 3 through 7, July 31 through August 4, and August 31 through September 4.

Weigh periods for steers were 28, 28, 21, 22, and 14 days, respectively. Steers were weighed following an overnight removal from feed and water.

Diet samples were collected at approximately 6 a.m. each morning for about 45 minutes of grazing time. Screen bottom collection bags were used to allow drainage of excess saliva. Animals were not fasted prior to diet sampling. Fecal collections were made in the morning and evening, subsampled and composited into one fecal sample for each animal per day. All samples were ground through a 20-mesh screen in a Wiley Mill. Fecal samples from each steer were composited within each period, thus one sample per animal per period. Diet samples were not composited.

Diet and fecal samples were analyzed for both dry and organic matter content. Diet samples were also analyzed for crude protein (CP) (A.O.A.C. 1975). In vitro organic matter digestibility (IVOMD) of diet samples was determined using the Barnes (1969) revision of the Tilley and Terry (1963) procedure.

Intake, expressed on an organic matter basis, was determined using the following equation.

$$\text{kg organic matter intake (OMI)} = \frac{\text{kg fecal organic matter output}}{\text{\% indigestible diet organic matter}}$$

Data was analyzed using the general least squares model as presented by the Statistical Analysis System (SAS) (1979). A regression analysis was performed regressing actual weights of the Hereford steers on time for each pasture and then comparing the regression coefficients with a *t*-test (Steel and Torrie 1960).

Results and Discussion

Digestibility

In vitro organic matter digestibility was lower ($P<.05$) for pasture 1 (high good-excellent condition) than for pasture 2 (low good condition) (Fig. 1). Least square means and standard errors for IVOMD (%) were 58.6 ± 1.0 and 63.4 ± 1.0 for pastures 1 and 2, respectively. In contrast, Cook et al. (1962) found that digestibility was higher ($P<.05$) in diets of sheep grazing good condition range than poor condition range. They attributed this to a higher percent of grass species in diets from good condition range as compared to diets from poor condition range.

Increasing maturity of the forage was evident as combined IVOMD values of pastures 1 and 2 decreased ($P<.01$) from period 1 through period 4 (Table 1). Similar results were reported by Scales et al. (1971) using yearling cattle grazing Sandhills range in northeastern Colorado and by Streeter et al. (1968) in western Nebraska.

Table 1. Least square means by period for in vitro organic matter digestibility, crude protein, and organic matter intake (Summer, 1978, Sandhills Agricultural Laboratory).

Period	IVOMD	CP	OMI
	%	% of OM	g/kg $W^{.75}$
1. June 5 – 9	66.9[a]	13.5[b]	77.8[b]
2. July 3 – 7	62.2	9.3	78.7
3. July 31 – Aug 4	62.7	8.2	82.8
4. Aug.31– Sept 4	52.1	8.1	74.0
$s\ \bar{x}$	1.4	.2	2.0

[a]Means within a column are cubic ($P<.05$)
[b]Means within a column are quadratic ($P<.05$).

In vitro organic matter digestibility for pasture 1 decreased from period 1 through period 4; however, IVOMD for pasture 2 remained relatively constant from period 1 to period 2, increasing in period 3, and then decreasing in period 4 (Fig 1). This interaction was significant ($P<.01$). Because diet samples were not analyzed for botanical composition, it was difficult to determine if a species preference by cattle caused this pasture by period interaction. In vitro organic matter digestibility for pasture 1 probably declined because of late summer temperatures (Van Soest et al. 1978), advancing maturity (Scales et al. 1971, Smith et al. 1968, Streeter 1966, Ventura et al. 1975) and the lack of forage regrowth due to the absence of later summer precipitation.

In pasture 2, sixweeks fescue was the predominant cool-season grass in low areas which also received the heaviest grazing use. Visual observations of grazing cattle indicated that this species was consumed until late June, when it matured and dried up, after which animals began consuming mostly warm-season grasses. References were not found that evaluated the forage quality trend of sixweeks fescue. However, Cook and Harris (1952) conducted a summer grazing trial on a foothill site of northwestern Utah to compare the forage quality trend of cheatgrass *(Bromus tectorum)* to crested wheatgrass *(Agropyron desertorum)*. They found that throughout the grazing season crested wheatgrass was higher than cheatgrass in total digestible nutrients, but lower in other carbohydrates. Another study by Cook and Harris (1968) revealed that cheatgrass may be deficient in digestible energy for grazing sheep after the end of May. Also, throughout the grazing season crested wheatgrass furnished considerably more digestible energy than cheatgrass.

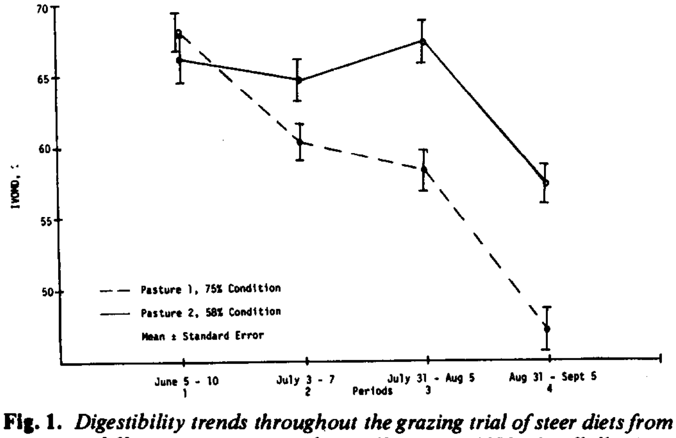

Fig. 1. *Digestibility trends throughout the grazing trial of steer diets from ranges differing in range condition (Summer, 1978, Sandhills Agricultural Laboratory).*

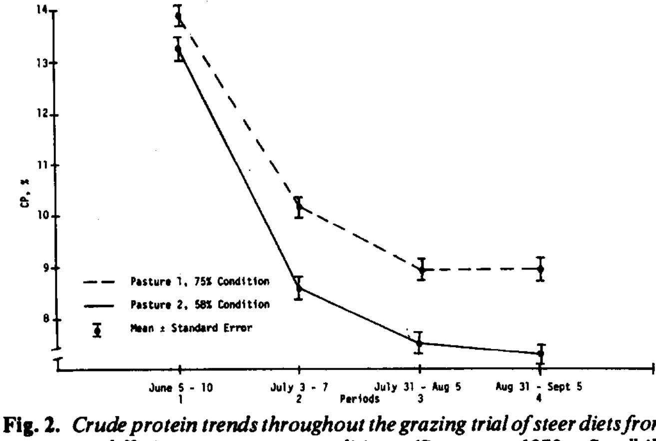

Fig. 2. *Crude protein trends throughout the grazing trial of steer diets from ranges differing in range condition (Summer, 1978, Sandhills Agricultural Laboratory).*

Crude Protein

Crude protein was higher ($P<.05$) for pasture 1 (high good-excellent condition) than for pasture 2 (low condition) (Fig. 2). Least square means and standard errors for CP (%) were 10.2 ± and 9.4 ± 2 for pastures 1 and 2, respectively. Likewise, Goebel and Cook (1960) reported that protein content of clipped forage samples was higher ($P<.05$) from good condition range than poor condition range.

Cook and Harris (1952) compared the protein content of cheatgrass to crested wheatgrass. They found that at comparable growth stages crested wheatgrass was higher ($P<.05$) in total protein than cheatgrass. Another study by Cook and Harris (1968) showed that after May cheatgrass was deficient in digestible protein for grazing sheep, while crested wheatgrass provided considerably more digestible protein throughout the growing season.

Increasing maturity of the forage was evident as combined CP values of pastures 1 and 2 decreased ($P<.01$) from period 1 through period 4 (Fig. 2). Likewise, Scales et al. (1971) found that crude protein declined from 16% in May to 6.2% in November. Similar results were reported by Smith et al. (1968) and Rosiere et al. (1975). Streeter et al. (1968) attributed the decrease in nitrogen content of steer diets to a continual decline in nitrogen content of forage species consumed throughout the summer grazing season.

Crude protein for pastures 1 and 2 decreased from period 1 through period 4, such that a pasture by period interaction did not exist ($P>.05$) (Fig. 2). Crude protein probably declined because of late summer temperatures (Van Soest et al. 1978), advancing maturity (Scales et al. 1971, Smith et al. 1968, Streeter et al. 1968) and the lack of forage regrowth due to the absence of late summer precipitation.

Intake

Organic matter intake was lower ($P<.05$) for pasture 1 (high good-excellent condition) than for pasture 2 (low good condition) (Fig. 3), because IVOMD was lower for pasture 1 than pasture (Fig. 1). Least square means and standard errors for OMI of pastures 1 and 2 were 74.0 ± 2.6 and 83.0 ± 2.5 g/kg $W^{.75}$, respectively.

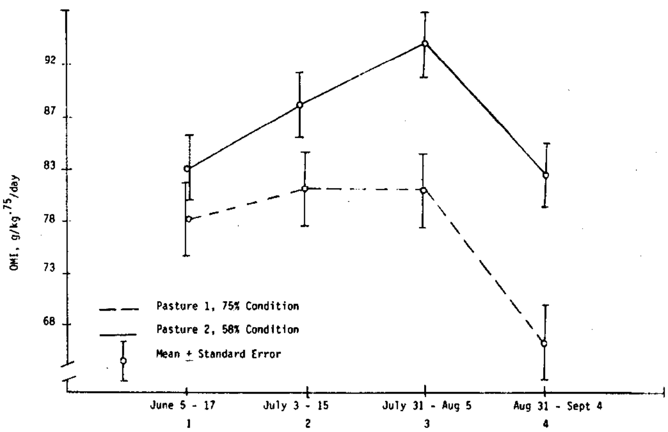

Fig. 3. *Intake trends throughout the grazing trial of steers grazing ranges differing in range condition (Summer, 1978, Sandhills Agricultural Laboratory).*

The combined OMI values for both pastures remained stable from period 1 to period 2, increasing in period 3 and then declining in period 4 (Table 1, Fig. 3). The change from period to period was significant ($P<.05$). The increase of OMI during period 3 is due to the increase of IVOMD for pasture 2 during period 3 (Fig. 1). In period 4 OMI declined due to the decline of IVOMD (Table 1, Fig. 1).

Likewise, Scales et al. (1971) found that dry matter intake of steers increased from 52 g/kg $W^{.75}$ in July and then declined to 39 g/kg $W^{.75}$ in November. In contrast, Smith et al. (1968) and Streeter (1966) reported that dry matter intakes were highest in late summer. Streeter (1966) explained that the combination of increased digestiblity and dry matter content of consumed forage resulted in an increase of forage consumption.

Organic matter intake for pasture 1 remained stable from period 1 to period 3 and then declined in period 4 (Fig. 3). However, for pasture 2, OMI increased from period 1 to period 3 and declined in period 4 (Fig. 3). But this interaction was not significant ($P>.05$).

Esophageal Fistulated vs Intact Animals

The esophageal fistula has been widely used to collect forage samples for many years. This technique allows researchers to obtain representative forage samples, actually consumed by the animal, for chemical analysis.

Organic matter intake of the esophageal fistulated steers was not different ($P>.05$) from the intact steers (Fig. 4). Least square means for OMI for both types of animals were 78 g/kg $W^{.75}$.

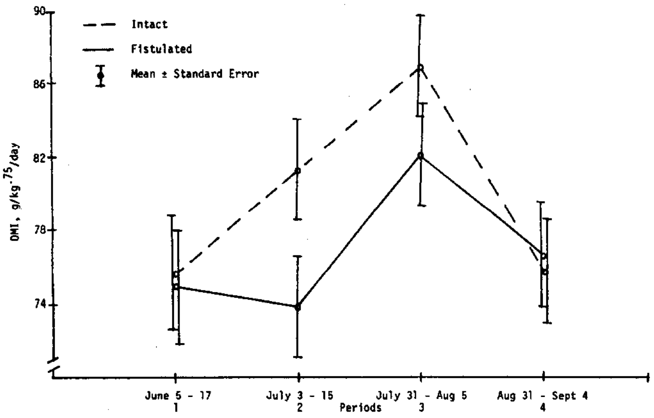

Fig. 4. *Intake trends of fistulated and intact steers throughout the grazing trial (Summer, 1978, Sandhills Agricultural Laboratory).*

Organic matter intake of the fistulated and intact animals was not ($P>.05$) affected by pastures. In pasture 1, least square means for the fistulated and intact animals were 71 and 77 g/kg $W^{.75}$, respectively. In pasture 2, least square means for the fistulated and intact animals were 85 and 80 g/kg $W^{.75}$, respectively. However, the pasture by type of animal interaction was not significant ($P<.05$).

Organic matter intake of fistulated and intact animals increased from period 1 through period 3 and decreased during period 4. This period by type of animal interaction was not significant ($P>.05$) (Fig. 4). It appears that the esophageal fistula did not affect intake.

Weight Gains of Grazing Steer Calves

There was no difference ($P<.05$) in average daily gain between steers grazing pastures 1 and 2. Steers in pasture 1 gained .78 kg per day, while steers in pasture 2 gained .72 kg per day. Regression of steer weights over time with regression coefficients and standard

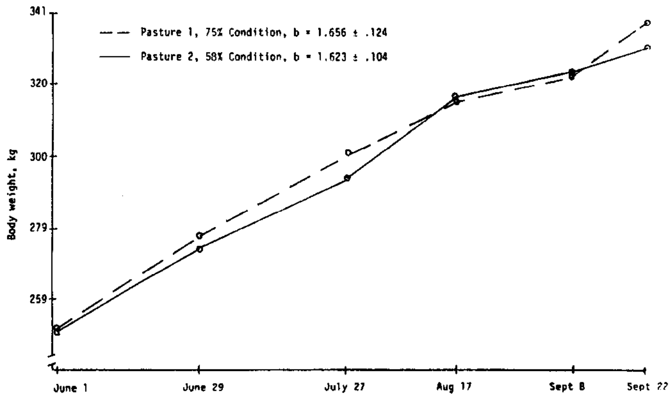

Fig. 5. *Weights of yearling steers throughout the grazing trial from ranges differing in range condition (Summer, 1978, Sandhills Agricultural Laboratory).*

errors for pastures 1 and 2 is shown in Figure 5. Since forage quality of steer diets was similra and forage availability was not a factor, the weight gains of the steers were not different.

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