J. Range Manage.
52:575–582 November 1999

Modification of cattle grazing distribution with dehydrated molasses supplement

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Abstract

A study was conducted in foothill rangelands during the fall to determine if livestock grazing distribution could be improved by strategic placement of dehydrated molasses supplement blocks (30% crude protein). Three pastures were categorized into inaccessible, easy, moderate, and difficult terrain. Moderate and difficult terrain was further divided into 27 to 55 ha subunits (n=32) and randomly assigned to control or supplement treatments. Every 7 to 10 days supplement and salt were moved; then the new supplement and control subunits were evaluated. Cattle use of the control and supplement subunits was compared by measuring forage utilization and fecal pat abundance both before supplement and salt placement and after removal. Measurements were collected near randomly selected sites within both control and supplement subunits. Salt was placed at half of the sites in both subunits while dehydrated molasses blocks were placed at sites only in the supplement subunit. Average daily supplement intake was lower (P<0.05) in the difficult terrain of 1 pasture (190 g) but ranged from 286 to 386 g in the other areas. Cattle consumed more (P<0.001) salt near supplement than in control areas. More (P=0.01) cattle were observed in areas with supplement (32 ± 8%) than in control areas (3 ± 2%). Increase in fecal pats was greater (P=0.01) in areas with supplement (3.3 ± 0.7 pats/100 m^2) than control areas (0.5 ± 0.5 pats/100 m^2) indicating greater use by cattle. Change in forage utilization was also greater (P>0.001) in areas with supplement (17 ± 2%) than in control areas (-1 ± 1%). For supplement areas, the increase in forage utilization was greater (P < 0.05) in moderate terrain than in difficult terrain. Results from this study suggest that cattle can be lured to underutilized rangeland by the strategic placement of dehydrated molasses supplement blocks.

Key Words: supplement, distribution, grazing, behavior, utilization

Resumen

Durante el otoño se condujó un estudio en pastizales de pie de montaña para determinar si la distribución del ganado podría ser mejorada mediante la colocación estratégica de bloques de melaza (30% de proteína cruda) como suplemento. En base a su facilidad de acceso, las áreas de tres potreros se categorizaron como: fácil, moderado, difícil e inaccesible. El terreno de acceso moderado y difícil posteriormente se dividió en subunidades de 27 a 55 ha (n=32), a cuales se les asignó aleatoriamente los tratamientos de suplementación y control. Cada 7 a 10 días el suplemento y la sal se movieron y las nuevas subunidades de suplemento y control fueron evaluadas. El uso por el ganado de las subunidades control y con suplemento se comparó mediante la medición de la utilización del forraje y la abundancia de materia fecal antes de colocar la sal y el suplemento y después de removerlos. Las mediciones se tomaron cerca de sitios seleccionados aleatoriamente en las subunidades control y con suplemento. La sal se colocó en la mitad de los sitios de ambas subunidades mientras que los bloques de melaza se colocaron solo en las subunidades asignadas con suplemento. El consumo diario promedio de suplemento fue bajo (190 g)(P<0.05) en el terreno de difícil acceso de uno de los potreros, pero varió de 286 a 386 g en otras áreas. El ganado consumió más sal (P< 0.001) cerca del suplemento que en las áreas control. Se observó más ganado en las áreas con suplemento (32 ± 8%) (P=0.01) que en las áreas control (3 ± 2%). El aumento de las deposiciones fecales fue mayor (P=0.01) en áreas con suplemento (3.3 ± 0.7 deposiciones/100 m^2) que en áreas control (0.5 ± 0.5 deposiciones/100 m^2), indicando un mayor uso de las áreas con suplemento. Los cambios en la utilización del forraje también fueron mayores (P>0.001) en las áreas con suplemento (17 ± 2%) que en las áreas control (-1 ± 1%). En las áreas con suplemento, el incremento en la utilización del forraje fue mayor (P< 0.05) en las subunidades de acceso moderado que en las de acceso difícil. Los resultados de este estudio sugieren que mediante la colocación estratégica de bloques de melaza el ganado puede ser atraído hacia áreas del pastizal subutilizadas.

Improving grazing distribution by livestock is an effective tool for improving watershed condition and reducing erosion (Kauffman and Krueger 1984). Spreading the use of rangeland forage across the landscape usually prevents the heavy utilization associated with concentrated grazing. Water developments, salting, fencing, fertilization, and riding can be used to improve grazing distribution (Cook 1966, Kauffman and Krueger 1984, Bailey and Rittenhouse 1989). These practices have been successfully used to prevent uneven grazing distribution; however, their use has been limited. Riding is labor-

Manuscript accepted 16 Jan. 1999.

intensive. Fertilization is expensive, and the benefits are short-term (Hooper et al. 1969). Water developments and fencing can be large capital expenses and may be impractical or cost-prohibitive.

Strategic placement of supplement has been suggested as a tool for modifying grazing distribution (Vallentine 1990, Bailey et al. 1996); however, few studies have evaluated the effectiveness of supplement placement for improving grazing distribution. McDougald et al. (1989) found that use of riparian areas dropped dramatically when supplement feeding sites were moved to areas that were previously underutilized. Molasses-based supplements are highly palatable, and they potentially could be used to lure cattle to underutilized rangeland. Dehydrated molasses supplements are easy to deliver and can be placed and self-fed in rougher terrain more readily than liquid or dry supplements. This gives managers the potential to lure cattle to more rugged topography than is practical with other types of supplement. The goal of this study was to evaluate the effectiveness of strategic placement of dehydrated molasses supplements for modifying grazing distribution in moderate and difficult terrain as described elsewhere. Specifically, the objectives were to determine: (1) if dehydrated molasses supplements can be used to attract livestock to underutilized rangeland and thus modify grazing distribution of cattle during the fall, and (2), if cattle use of dehydrated molasses supplement is affected by the topography in which it is placed.

Methods

Study sites

Thackeray Ranch. From 8 Oct. 1997, to 17 Dec. 1997, a portion of the study was conducted at the Thackeray Ranch which is part of Northern Agricultural Research Center (NARC). The site is located approximately 25 km south of Havre, Mont., in the Bear Paws Mountains. The rangeland at the Thackeray Ranch is rugged and typical of Montana foothills. Uplands are dominated by rough fescue (*Festuca scabrella* Torr.) and Kentucky bluegrass (*Poa pratensis* L.) with some bluebunch wheatgrass (*Pseudoroegnaria spicata* [Pursh] A Love), while bottoms are dominated by Kentucky bluegrass. Two pastures (AI and Anderson) were used at this study site. The AI pasture (260 ha) was grazed from 8 Oct. 1997 to 4 Nov. 1997. Elevation in the AI pasture varied from 1,160 to 1,280 m, and in the Anderson pasture elevation varied from 1,070 to 1,220 m. The study was conducted in the Anderson pasture (325 ha) from 5 Nov. 1997 to 17 Dec. 1997.

Dana Ranch. The second portion of the study was conducted at the Dana Ranch located in foothills and mountain rangeland approximately 35 km south of Cascade, Montana. Vegetation is dominated by rough fescue and timothy (*Phleum pratense* L.) with some areas of Kentucky bluegrass. The study pasture contains roughly 4,900 ha, however, the study area was roughly 660 ha. Elevation in the pasture varies from 1,220 to 1,680 m, but the elevation in the study area varied from 1,490 to 1,680 m. The study was conducted in the Dana Ranch pasture from 6 Nov. 1997 to 13 Jan. 1998.

Stratification

Initially, pastures were stratified into 4 terrain categories (gentle, moderate, difficult and unusable) based on slope and distance to water. Areas identified as gentle terrain were located near water and unusable areas consisted of very steep slopes (over 40%). Acreage classified as gentle or unusable was excluded from the study. The remaining acreage was equally divided into moderate and difficult terrain. Rangeland classified as difficult contained steeper slopes or was located farther from water than the areas classified as moderate. Intermediate areas were categorized as moderate. The difficult, moderate, and gentle terrain categories were designed to reflect slight, light, and moderate grazing use, respectively, that was expected under traditional management. Moderate and difficult areas were then divided into subunits that were approximately equal in size. At the Thackeray Ranch, subunits in the AI pasture were approximately 27 ha; in the Anderson pasture, subunits were approximately 30 ha. Subunits were approximately 55 ha at the Dana Ranch.

Experimental Design

Treatments. For each pasture, grazing was divided into 2 or 3 periods. For the Thackeray Ranch periods lasted 14 days. There were 2 periods for the AI pasture and 3 periods for the Anderson pasture. For the Dana Ranch, there were 3 periods, and each period lasted 20 days. Within each period, 2 subunits within each terrain category (moderate and difficult) were randomly selected. Then 1 subunit of a terrain category was randomly selected as the area in which supplement would be placed. The other subunit was a control and did not receive any supplement. The design was such that a supplement and control subunit were simultaneously compared within a terrain category and both terrain categories were evaluated within a period. The order of which terrain categories were evaluated within a period (first or second 7- or 10-day interval) was randomized.

Supplement and salt placement. The dehydrated molasses supplement had a crude protein concentration of 30% (Table 1). Supplement was placed in steel barrels (113.4 kg/barrel) that were cut in half, 40 cm high. For the Thackeray Ranch, 5 sites were randomly selected within each of the supplement and control subunits (Fig. 1). Ten sites were randomly selected for supplement and control subunits at the Dana Ranch. Two supplement barrels were placed at each site of supplement subunits. At each of these sites, at least 1 barrel was full (113.4 kg) and the other was at least 1/2 full. This provided 1 barrel per 20 to 25 cows which is within the values recommended by the supplement manufac-

Table 1. Nutrient content and ingredients of the cooked molasses supplement used in the study.

Nutrient	Level
Crude protein	30.0%
Not more than 12.0 % equivalent crude protein from non-protein nitrogen	
Crude fat	4.0%
Crude fiber	2.5%

Ingredients:

Molasses products, animal fat (preserved with ethoxquin), plant protein products, animal protein products, processed by grain products, urea, monocalcium phosphate, dicalcium phosphate, calcium carbonate, magnesium oxide, sulfur, vitamin A acetate, D-activated animal sterol, vitamin E supplement, zinc sulfate, manganous oxide, ferrous sulfate, copper carbonate, calcium iodate, sodium selenite.

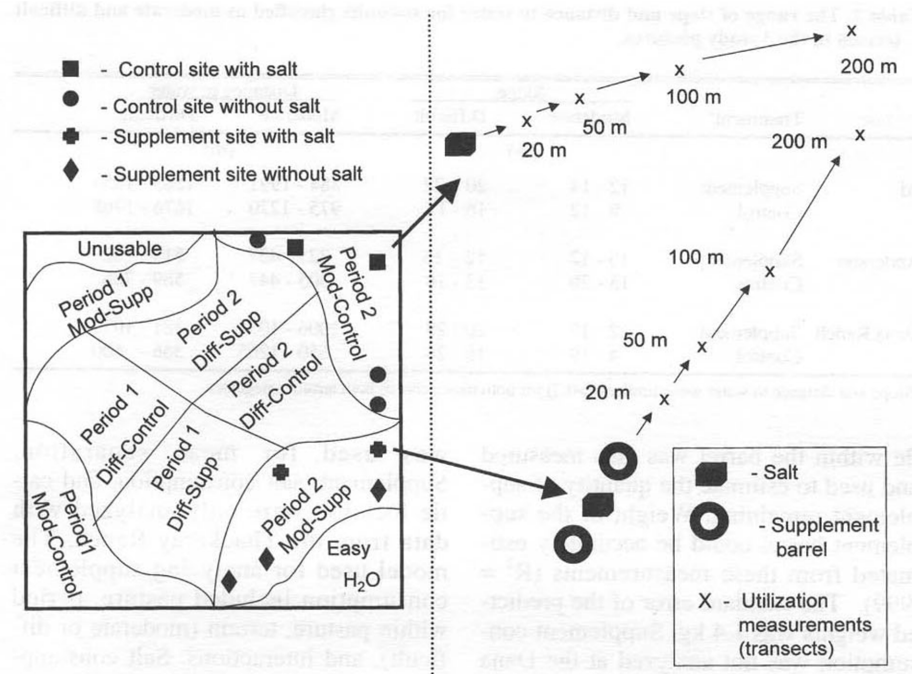

Fig. 1. Simplified diagram of the categorization of terrain, treatment allocation, utilization transect locations and supplement and salt placement. Initially, pastures were categorized as easy unusable, moderate and difficult based on slope and distance to water. Easy and unusable areas were not included in the study. Moderate and difficult areas were further divided into subunits. In this example, there are 4 subunits in moderate terrain and 4 subunits in difficult terrain. During each 14- or 20-day period, 2 randomly selected subunits in each terrain type (moderate and difficult) were evaluated. In each terrain type, one subunit was randomly assigned as a control with no supplement, and supplement was placed within the other subunit. These 2 subunits (same terrain type) were studied for 7 or 10 days. Forage utilization measurements were collected at distances of 20, 50, 100, and 200 m from the randomly selected sites within both control and supplement subunits. In this example, salt was available at 2 of the 5 sites within supplement and control subunits.

turer. In both the control and supplement subunits, white salt blocks (22.7 kg) were placed at some of the sites (2 of 5 sites at the Thackeray Ranch and 5 of 10 sites at the Dana Ranch). Sites that received salt were randomly selected. Supplement and salt in supplement subunits and salt in control subunits were moved every 7 days at the Thackeray Ranch and every 10 days at the Dana Ranch. Supplement and salt were only available at one supplement subunit and one control subunit (salt only) within a pasture at a time.

Cattle. The study at the Thackeray Ranch was conducted with 229 cows with Hereford and Tarentaise breeding. Cows began calving in mid-March, and finished by early May. Calves were weaned on 1 Oct. 1997. Cows and calves were first exposed to the dehydrated molasses supplement in early May 1997 for 1 week. For 2 weeks before the study, cattle had access to supplement in a separate pasture adjacent to the study areas. This preliminary training allowed cattle to become accustomed to the supplement and barrels. Approximately 1,200 Angus and Angus x Hereford cows grazed in the Dana Ranch pasture, but not all 1,200 cows were in the study area. Dana Ranch cattle were fed the dehydrated molasses supplement during the winter grazing season for 3 consecutive years before the study.

The day after placement of salt and supplement into new subunits, cattle at the Thackeray Ranch were herded to supplement and control subunits if animals had not already found the supplement. Approximately the same numbers of cattle were herded to the supplement and control subunits. The exact number herded to each subunit was recorded. Cattle were not drifted to subunits at the Dana Ranch.

Cattle were weighed and body condition was scored 7 days before the study (at weaning), after cattle were moved from the AI pasture (5 Nov. 1997) and again after cattle were removed from the Anderson pasture (20 Jan. 1998). Supplement was not provided to cattle in the Anderson pasture from 17 Dec. 1997, to 20 Jan. 1998. Body condition scores were based on a 1 to 9 scale, where 1 was emaciated and 9 was obese.

Measurements

Stubble height, forage utilization, fecal pat abundance and standing crop were measured when supplement and salt were placed and again after they were removed. The change in these measurements was used to compare grazing use in supplement and control subunits. Since measurements were collected within a pasture for 2 or 3 periods, measurements recorded at supplement placement (in both supplement and control subunits) provided a baseline and subsequent measurements 7- or 10-days later allowed us to examine only the grazing impacts that occurred during interval between supplement placement and removal for that particular set of supplement and control subunits. Stubble height of 15 grass plants was measured along a transect at 2 m intervals beginning at 20 m from the randomly selected site. This process was repeated 3 more times along the same transect beginning at 50, 100, and 200 m from the randomly selected site (Fig. 1). Observers were trained to measure the 2 m intervals by steps so that the measurements could be collected in a reasonable amount of time. Stubble heights were converted to forage utilization levels using height-weight curves (Cook and Stubbendieck 1986). Ungrazed heights for each forage species were determined before cattle grazing when supplement was first placed in a pasture. Height-weight curves were developed for major species (Kentucky bluegrass, rough fescue and timothy) and published relationships (US Forest Service 1980) were used for other grasses (eg., bluebunch wheatgrass). Fecal pats were counted within an 100 m^2 plot located between 100 and 200 m from the site (1 x 100 m plot). Standing crop was measured at 50 and 100 m from the site using a 0.09 m^2 frame. Forbs were separated from grasses. Utilization, stubble height, standing crop and fecal pat abundance measurements were made along a transect which followed the contour and started at the nearest supplement barrel, salt or, in the case of control areas, the selected point (Fig. 1). The direction of the transect along the contour (eg., east or west) was randomized. At the Thackeray Ranch, all 5 sites were measured, but at the Dana Ranch, 6 randomly selected sites of the 10 available were measured.

Since this study was conducted during the fall and early winter in northern Montana, snow covered the ground during part of the study. Snow caused some difficulty in measuring fecal pat abundance and in measuring stubble heights and forage utilization. When necessary, observers removed the snow with their hands or feet to measure stubble heights. In most instances snow cover was less than 7 cm and fecal pats could be observed. During the last period at the Dana Ranch, snow cover was up to 15 cm in some areas, and fecal pat abundance and standing crop were not measured.

Crude protein concentration of grasses was determined by grinding clipped standing-crop samples (grass only) to pass through a 1 mm screen and was analyzed for nitrogen using a micro-Kjeldahl process. All grass samples from a subunit for a clipping date (before or after supplement placement) were pooled for nitrogen analyses.

Supplement consumption was determined by estimating the weight of each barrel before and after it was placed in a subunit, and then dividing the disappearance of supplement by the number of cows and the number of days between supplement placement and removal in a subunit. Measurements of the barrel were used to determine weight. The height (sides and center) of the supplement within the barrel was measured to determine the weight of supplement remaining in the barrel. The diameter of the center area used by cattle within the barrel was also measured and used to estimate the quantity of supplement remaining. Weight of the supplement barrel could be accurately estimated from these measurements (R^2 = .999). The standard error of the predicted weights was 1.4 kg. Supplement consumption was not analyzed at the Dana Ranch since the number of cattle in the study area could vary and since the study area comprised less than 15% of the pasture. Cattle at the Dana Ranch consumed over 90% of the supplement provided during the 10-day interval before additional supplement was placed in a new subunit.

The number of cattle in the current supplement and control subunits was counted weekly at the Thackeray Ranch. Observations were obtained between 1000 and 1400 hours on the 5th day after supplement was placed. Observers were on horseback and used maps to determine whether cattle were within the boundaries of the subunits.

Table 2. The range of slope and distance to water for subunits classified as moderate and difficult terrain in the 3 study pastures.

Pasture	Treatment[a]	Slope Moderate	Slope Difficult	Distance to water Moderate	Distance to water Difficult
		(%)		(m)	
AI	Supplement	12 - 14	20 – 27	884 - 1991	1585 - 1859
	Control	9 - 12	16 - 17	975 - 1270	1676 - 1768
Anderson	Supplement	10 - 17	12 – 16	223 - 457	518 - 762
	Control	15 - 20	13 - 18	305 - 447	589 - 785
Dana Ranch	Supplement	2 - 17	20 - 28	1006 - 1036	381 - 1077
	Control	4 - 19	15 - 24	650 - 1265	386 - 600

[a]Slope and distance to water were similar (P>0.2) for both treatments in both terrain categories.

Statistical Analyses

Data were analyzed by analysis of variance (SAS 1985) with 3 different models. Tukey's studentized range test was used for mean separation. Supplement, salt consumption, and cattle location were only analyzed with data from the Thackeray Ranch. The model used for analyzing supplement consumption included pasture, period within pasture, terrain (moderate or difficult), and interactions. Salt consumption, cattle observations, and forage quality were analyzed using a model that included treatment, pasture, period within pasture, terrain, and interactions. In both of these models, the residual was used as the error term for statistical tests since the residual consisted of variation among subunits.

For fecal pat abundance, standing crop, forage utilization, and stubble height, data were analyzed as changes in measurements from supplement placement until removal. The statistical model for these variables included treatment, pasture, period within pasture, terrain, presence of salt, and interactions. The variation among subunits (treatment x pasture x period within pasture x terrain interaction) rather than the residual was used as the error term for evaluating treatment, pasture and period with pasture effects since each subunit had 5 or 6 observations (1 observation per site). The residual was only used to examine if the presence or absence of salt affected grazing use.

Data collected from each subunit were also averaged and analyzed. Results were similar to those using data from all sites so they were not presented. Initially, the number of cattle herded to study sites was used as a covariate in analyses of Thackeray Ranch data. The number of cattle herded to study sites did not contribute to the analyses (P>0.1) and was not included in further analyses.

Table 3. Summary of weekly weather conditions at the Thackeray Ranch during the study.

Pasture	Dates*	Period	Terrain	Temperature High	Temperature Low	Wind Speed Average	Wind Speed Maximum
				(°C)		(km/hr)	
AI	10/22 to 10/28	2	Moderate	9.5	-2.8	6.3	44.1
	10/29 to 11/4		Difficult	12.6	1.8	10.8	56.6
Anderson	11/5 to 11/11	1	Moderate	9.9	-7.2	1.4	25.6
	11/12 to 11/18		Difficult	3.7	-8.1	5.3	31.1
	11/19 to 11/25	2	Moderate	6.1	-5.2	6.3	43.3
	11/26 to 12/2		Difficult	8.6	-2.8	6.4	46.0
	12/3 to 12/9	3	Difficult	2.8	-13.2	1.0	24.8
	12/10 to 12/16		Moderate	8.1	-0.8	17.5	53.3

*Weather data were not available during the first two weeks of the study (Period 1).

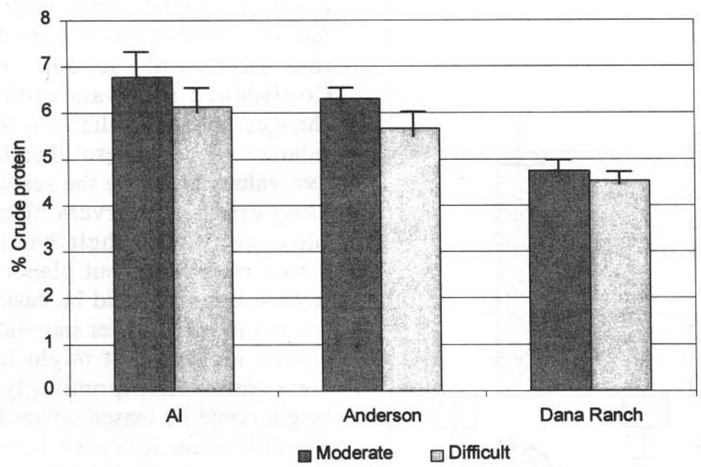

Fig. 2. Crude protein concentration within moderate and difficult terrain in the AI, Anderson and Dana Ranch pastures.

Results and Discussion

Environmental Conditions

Pastures varied in topography (Table 2), but subunits assigned to treatments within a terrain category were similar (P>0.2). Distance to water was greatest for the AI pasture. Terrain in the AI and Dana Ranch pastures was steeper than in the Anderson pasture.

Weather conditions during the study were relatively mild for northern Montana in the fall (Table 3). Daily high temperatures were usually above freezing and daily low temperatures were usually below freezing.

Crude protein concentration of grasses at the Dana Ranch was lower ($P<0.05$) than the AI and Anderson pastures of the Thackeray Ranch (Fig. 2). Crude protein content of grasses was higher ($P = 0.03$) in moderate terrain (5.9%) than in the difficult terrain (5.4%). Difficult terrain was typically grazed lighter than moderate terrain, and may have contained more decadent forage material. Crude protein concentration of grasses did not change ($P = 0.18$) during the interval between supplement placement and removal.

Supplement Intake

Average individual supplement intake at the Thackeray Ranch varied from 154 to 386 g/day (Fig. 3). Supplement consumption was lower ($P = 0.03$) in the AI pasture (286 g/day) than in the Anderson pasture (336 g/day) where terrain was gentler and sites were closer to water (Table 2). The interaction between pasture and terrain was important ($P = 0.003$) for supplement consumption. In the AI pasture, supplement consumption was (191 g/day) in the difficult terrain and 386 g/day in moderate terrain. In the Anderson pasture, supplement consumption was 318 and 359 g/day in moderate and difficult terrain categories, respectively. Overall, supplement consumption each week was consistent (286 to 386 g/day) except in the difficult terrain of the AI pasture where supplement consumption was lower (154 and 222 g/day).

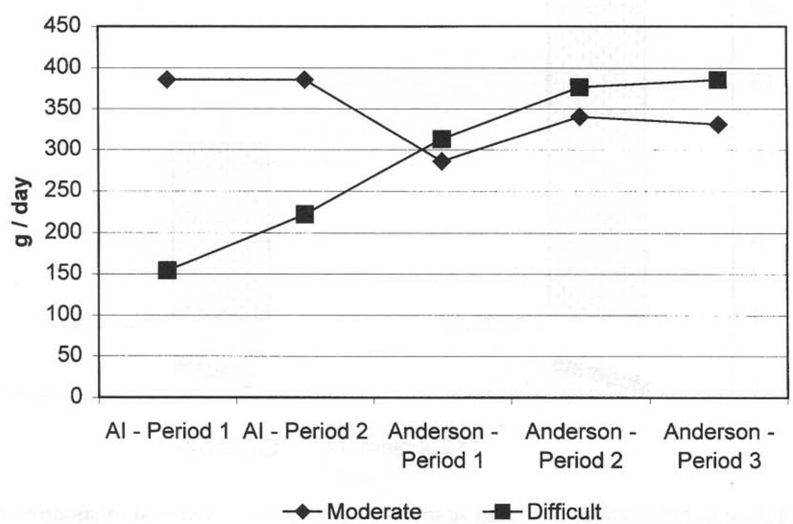

Fig. 3. Average individual intake of dehydrated molasses supplement during periods 1 and 2 in the AI pasture and periods 1, 2, and 3 in the Anderson pasture.

Salt Consumption

Average individual salt consumption was higher ($P = 0.02$) in the Anderson pasture (8 g/day) than in the AI pasture (4 g/day) where the terrain was steeper and subunits were further from water (Table 2). Salt consumption was higher ($P = 0.001$) in subunits with supplement (11 g/day) than in control areas (2 g/day). Cattle apparently consumed salt while they were at sites with supplement. Casual observations suggested that cattle consumed salt while other animals were consuming supplement. They were apparently waiting for access to the supplement.

Cattle Weight Change

Cattle generally maintained weight from the beginning of the study until they were moved from the Thackeray Ranch on 15 January 1998. Total weight change from Oct. to Jan. was 0.1 kg. While in the AI pasture, cattle gained a total of 9.2 kg or 0.3 kg/day, but cattle lost weight in the Anderson pasture (9.1 kg or -0.1 kg/day). Cattle were provided supplement for only the first 55% of the time they were in the Anderson pasture. Cattle weight gains were greatest for cows in lower body condition. For each unit decrease in body condition score before the study, weight gain was increased by 0.2 kg/day in the AI pasture and 0.1 kg/day in the Anderson pasture. In addition, younger cows often gained more weight than older cows, especially in the AI pasture.

Cow Location

A greater percentage of cattle at the Thackeray Ranch were observed (P =

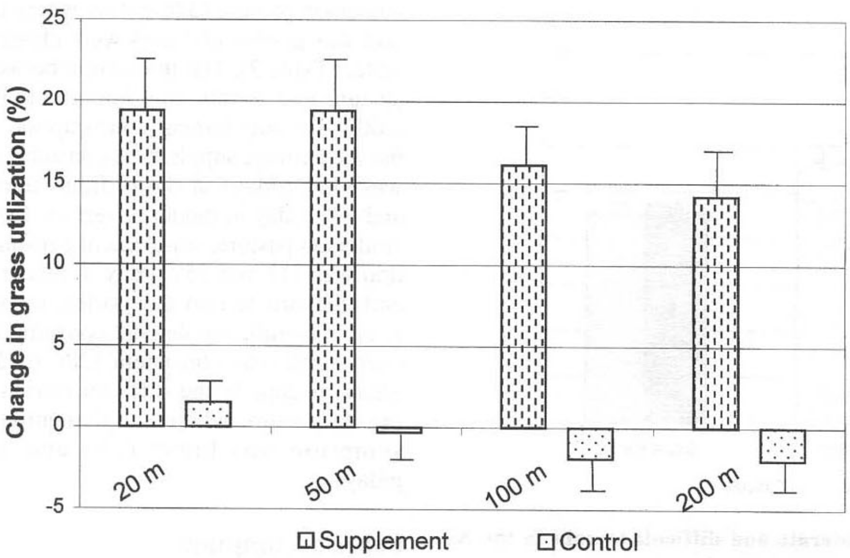

Fig. 4. Change in grass utilization from supplement placement to removal in subunits with supplement and in control subunits at distances of 20, 50, 100, and 200 m from supplement or control sites.

0.04) in subunits with supplement (31.9% of herd) than in subunits without supplement (3.4% of herd). The number of cattle observed in moderate and difficult terrain were similar (P = 0.14). Cattle observations in the AI and Anderson pastures were also similar (P = 0.57). Supplement effectively lured cattle to areas of moderate and difficult terrain, at least from 1000 to 1400 hours (local time) when observations were collected.

Forage Utilization and Stubble Height

The change in forage utilization was greater (P<0.05) in subunits with supplement than in subunits without supplement. Forage use was greater at distances of 20, 50, 100, and 200 m from supplement barrels than at corresponding distances from control sites (Fig. 4). For subunits with supplement, change in forage utilization was greater (P<0.05) in moderate terrain than in difficult terrain (Fig. 5). Changes in stubble height followed the same pattern as forage utilization. Stubble height was reduced by a greater amount (P<0.05) in subunits with supplement than in control areas. Cattle did not restrict grazing to areas adjacent to supplement barrels. Initially, we expected a concentric ring pattern of forage use to form with heavier use near the barrels; however, cattle appeared to graze areas within 200 m of supplement, and perhaps further, somewhat evenly. McDougald et al. (1989) also found that cattle grazed near areas with supplement. In their study, supplement placement in underutilized rangeland reduced cattle grazing in riparian areas. Martin and Ward (1973) concluded that placement of meal-salt supplement in areas previously used lightly increased the utilization of perennial grasses.

In control areas, changes in forage utilization and stubble height were sometimes negative. Obviously, this was the result of sampling error and/or an artifact of snowfall that occurred between the first and second readings. Confidence intervals around mean changes in grass utilization for control subunits included zero; therefore negative values could be the result of sampling errors. Observers also brushed snow away with their hands or feet before measuring, but plants with low stubble heights would be easier to miss and not measured after snowfall. Thus, a nearby higher plant might have been measured. Correspondingly, stubble height could be biased upward, and forage utilization would be biased downward. This potential bias should not affect any conclusions drawn from the study since any bias would equally impact supplement and control treatments. We also converted all negative changes in forage utilization and stubble height to zero and analyzed the data using the same statistical model. Results using such transformed data were similar to those with untransformed data.

Fecal Pat Abundance

The increase in fecal pat abundance was greater (P = 0.009) in subunits with supplement (3.3 pats/100 m^2) than in control areas (0.5 pats/100 m^2). Fecal pat abundance increased at a greater rate

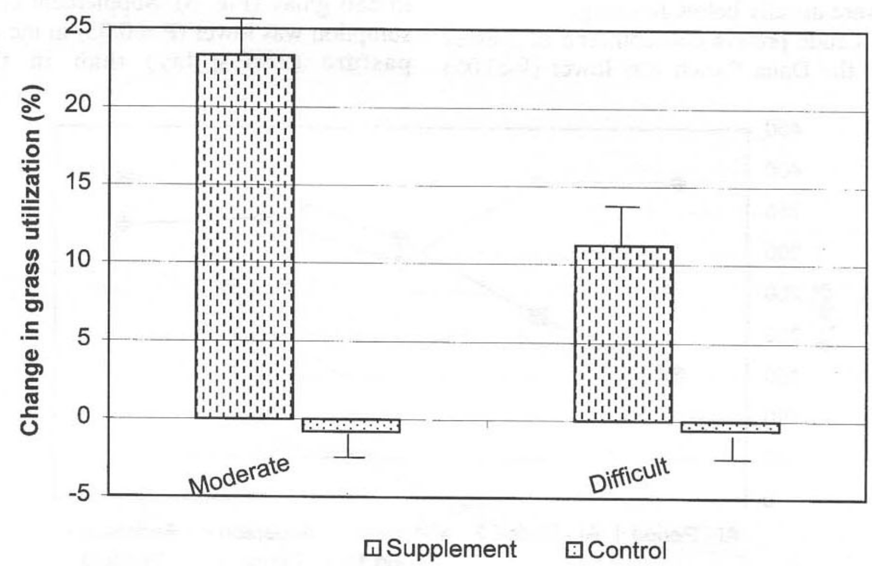

Fig. 5. Change in grass utilization from supplement placement to removal in subunits with and without supplement in moderate and difficult terrain. Values in the figure are averages of measurements collected at 20, 50, 100, and 200 m from supplement and control sites.

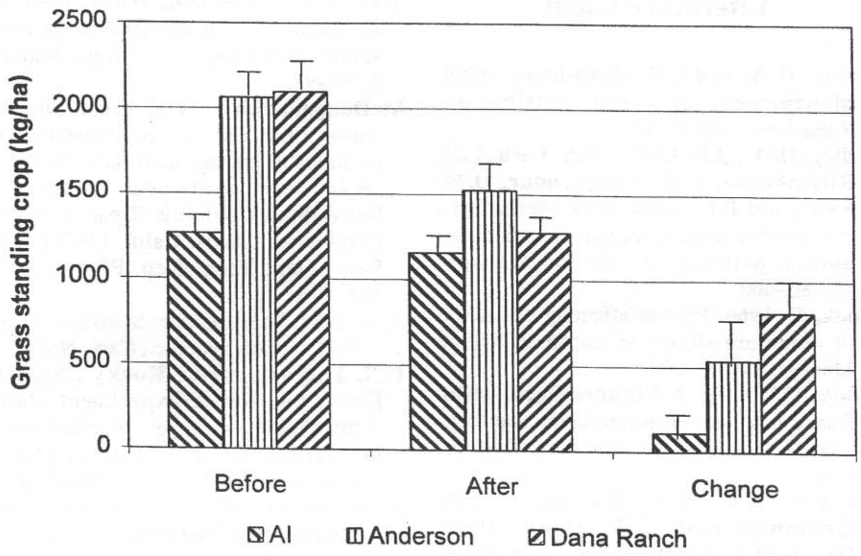

Fig. 6. Standing crop of grass in the AI, Anderson and Dana Ranch pastures before supplement placement and after removal.

(P = 0.06) in the AI pasture (3.6 pats/ 100 m^2) than in the Dana Ranch pasture (0.3 pats/ 100 m^2). The Anderson pasture was intermediate. The increase in fecal pat abundance observed in areas with supplement followed the same pattern as the cattle location data, forage utilization, and stubble height data. Cattle spent more time in subunits with supplement than in corresponding subunits without supplement.

Forage Standing Crop

Grass standing crop was greater (P = 0.07) in the Anderson and Dana Ranch pastures than the AI pasture when subunits were first measured; however, after the second measurement, there were no differences (P>0.1) among pastures (Fig. 6). Apparently, pastures were grazed to approximately the same levels after supplement was provided. As expected, grass standing crop in supplement and control subunits was similar (P = 0.91) for the first measurement, but after the second measurement grass abundance was greater (P = 0.06) in the control areas (Fig. 7). The difference in standing crop between supplement and control subunits after supplement removal suggests that cattle grazed more in areas with supplement. The actual change in grass standing crop before and after supplement was similar (P = 0.15) for the supplement and control supplements. Standing crop measurements were highly variable and as a result, differences in mean values between treatments were not always statistically significant. Yet, mean values for standing crop of grass followed the same pattern as cow location, forage utilization, stubble height, and fecal pat abundance data. Cattle appeared to graze more grass in subunits with supplement than in corresponding subunits without supplement.

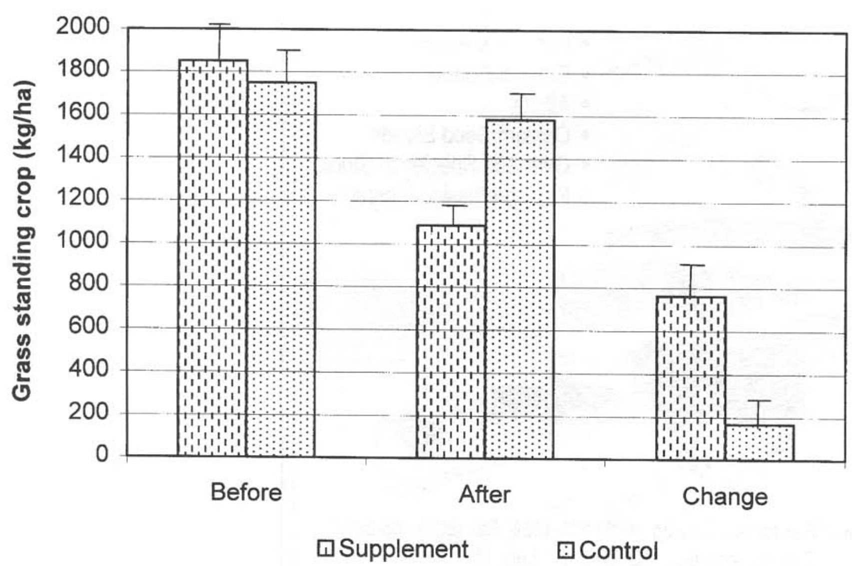

Fig. 7. Change in the standing crop of grass before supplement placement and after removal in subunits with and without supplement (control).

Effect of Salt on Grazing Use

The presence of salt had virtually no effect on forage utilization, fecal pat abundance or standing crop. Changes in forage utilization and stubble height at sites with salt were similar (P>0.36) to sites without salt at distances of 20, 50, 100 and 200 m from the site. Changes in fecal pat abundance at sites with salt were also similar (P = 0. 84) to those without salt. In addition, the presence or absence of salt did not affect (P>0.12) any of the standing crop measurements. Although cattle consumed more salt at sites with supplement, cattle did not spend more time grazing at sites with salt than at those without.

Conclusions

Consumption of dehydrated molasses supplement was relatively consistent except in the difficult terrain of 1 pasture where consumption was lower. Cattle consumed more salt where supplement was provided, but salt placement did not affect where cattle grazed in this study. More cattle were observed in areas with supplement than in similar control areas. Fecal pat abundance measurements also showed that cattle spent more time in areas with supplement. Forage utilization and stubble height measurements showed that cattle grazed grasses more heavily in areas 20 to 200 m from supplement than in corresponding control areas. Supplement placement was more effective for increasing grazing use in moderate terrain than in difficult terrain. Clipping analyses also suggested that cattle grazed more in areas with supplement, although results were more variable. Overall, cattle consuming supplement maintained weight during the study, but weather conditions were relatively mild. Initially, cattle gained weight. Cattle in thinner body condition gained more weight than cattle in a better body condition.

Results from this study suggest that placing dehydrated molasses supplement in underutilized rangeland can improve uniformity of grazing by beef cows in foothills rangeland during the fall and early winter. Although it may be more effective in moderate terrain, strategic placement of dehydrated molasses supplement is expected to increase cattle use of rangeland that is steep and/or distant from water. In this study, supplement was placed in smaller sections of pastures and was moved every 7 to 10 days. If supplement is initially spread throughout the complete pasture or if supplement is not moved regularly, this approach may not be effective.

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