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Research Note

Method of Supplementation May Affect Cattle Grazing Patterns

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Abstract

Supplement placement can be used to manipulate livestock grazing patterns. The objective of this case study was to compare the effect of low-moisture blocks (LMB) and range cake (barley-based cylindrical cubes, 2 cm in diameter, and 2 to 8 cm long) supplementation on cattle grazing patterns in Montana foothill rangeland. One group of nonlactating cows ($n = 79$) was fed cake 3 times per week (1.8 kg · cow^{-1} · feeding^{-1}), and the other group ($n = 81$) had continuous access to LMB in separate pastures using a crossover design. Movement patterns of cows were recorded with global positioning system collars during four periods (2 wk · period^{-1}) during autumn. Range cake was fed on accessible areas, and LMB were placed in higher and steeper terrain. Intake of LMB averaged (mean ± SE) 318 ± 50 g · d^{-1}. Cows fed LMB (8.07° ± 0.20°) were observed on steeper slopes ($P = 0.08$) than cows fed range cake (6.96° ± 0.19°). Forage utilization decreased as slope increased to a greater degree when range cake was fed than when LMB was fed ($P = 0.001$). Cows spent more time ($P = 0.05$) within 100 m of LMB (274 ± 23 min · d^{-1}) than at range cake feeding sites (67 ± 24 min · d^{-1}). Strategic placement of LMB on high, steep terrain appears to be a more practical and effective approach than traditional hand-feeding range cake on intermediate terrain to improve uniformity of cattle grazing on rugged rangeland.

Resumen

La ubicación del suplemento puede ser usada para manipular los patrones de apacentamiento del ganado. El objetivo de este estudio de caso fue comparar el efecto de la suplementación con bloques de baja humedad (LMB) y la torta de pastizal (cilindros a base de cebada, 2 cm de diámetro y de 2 a 8 cm de largo) sobre los patrones de apacentamiento del ganado en un pastizal de piedemonte en Montana. Un grupo de vacas no lactantes ($n = 79$) fue alimentado con torta tres veces por semana (1.8 kg · vaca^{-1} · evento de suplementación^{-1}) y el otro grupo ($n = 81$) tuvo acceso continuo a los LMB en potreros separados usando un diseño cruzado. Los patrones de movimiento de las vacas se registraron usando collares y un sistema de posicionamiento global (GPS) durante cuatro periodos (2 semanas · periodo^{-1}) en otoño. La torta se suministró en áreas accesibles y los LMB fueron colocados en un terreno alto y con pendiente. El consumo de LMB promedio (media ± EE) 318 ± 50 g · d^{-1}. Las vacas alimentadas con LMB (8.07° ± 0.20°) se observaron en pendientes mayores que las alimentadas con torta (6.96° ± 0.19°). La utilización del forraje disminuyó conforme la pendiente aumentó, y esto ocurrió en mayor grado cuando se suplementó con torta que con LMB ($P = 0.001$). Las vacas pasaron mas tiempo ($P = 0.05$) dentro de un radio de 100 m de los LMB (274 ± 23 min · d^{-1}) que en los sitios suplementados con torta (67 ± 24 min · d^{-1}). La ubicación estratégica de LMB en terrenos altos con mucha pendiente parece ser un método más práctico y efectivo que la suplementación tradicional manual con torta en los terrenos intermedios para mejorar la uniformidad del apacentamiento del ganado en pastizales escabrosos.

Key Words: distribution, low-moisture blocks, range cake, utilization

INTRODUCTION

Supplements can be delivered to cattle on rangeland in a variety of forms. Range cake (2-cm-diameter cubes that are 2–8 cm long) can be hand-fed to cattle at various schedules (e.g., daily or 3 times per week). Protein supplements can also be self-fed using liquid, pressed block, and low-moisture block (LMB) delivery systems, which allow cattle continuous access to supplement.

Strategic placement of LMB can be used to improve the uniformity of grazing on rugged rangeland by luring cattle to underused areas (Bailey and Welling 1999). Hand-fed range cake could potentially change cattle grazing patterns, because animals readily come to an auditory signal associated with the supplement feeding (Schauer et al. 2005). Range cake requires more effort to feed in high and steep terrain than LMB because range cake is often fed 3 times per week (Huston et al. 2002), whereas a single placement of LMB will last up to 2 wk (Bailey and Welling 1999). The objective of this case study was to compare grazing patterns of cattle when supplemented by two commonly used practices: range cake fed 3 times per week in accessible terrain and LMB placed on steeper slopes at higher elevations.

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METHODS

Study Site

The study was conducted in the Anderson (329 ha) and Arches (258 ha) pastures of the Thackeray Ranch, which is located in

the Bear's Paw Mountains, 21 km south of Havre, Montana (lat 48°21′47″N; long 109°36′29″W). The Anderson and Arches pastures contain rugged terrain with an average slope of 8.8° and 10.5°, respectively. Elevation ranged from 1 056 to 1 230 m in Anderson and from 1 121 to 1 336 m in Arches. The average distance to water for the Anderson pasture was 716 m and 531 m for Arches. Pastures were dominated by Kentucky bluegrass (*Poa pratensis* L.), bluebunch wheatgrass (*Pseudoroegneria spicata* [Pursh] A Love), and rough fescue (*Festuca scabrella* Torr.). Soils were primarily shallow clays and gravelly loams.

Cattle

A total of 160 nonlactating, mature, crossbred cows were weighed 1 October 2002 and 2 January 2003. The study began on 17 October 2002 and ended on 20 December 2002. All cows had been exposed to LMB before this study, but they had not been exposed to range cake. Cows were randomly assigned to two treatment groups: supplementation with LMB ($n = 81$) or range cake ($n = 79$). During the interim between weaning (1 October 2002) and the beginning of the study, cows were fed their assigned supplements in separate pastures that were adjacent to the study pastures.

Feed

The range cake supplement was composed primarily of barley and grain byproducts, which was shaped into cylindrical cubes (2 cm in diameter and 2–8 cm long). Range cake contained 20% crude protein (CP). During the interim training period, cows were fed range cake 5 $d \cdot wk^{-1}$ at a rate of 0.9 $kg \cdot d^{-1}$ to familiarize them with the supplement and to train them to come to an audible signal, a vehicle horn. During the study, cows were fed 1.8 kg of range cake 3 times per week, on Monday, Wednesday, and Friday, at approximately 1100 hours. The LMB were fed ad libitum in half barrels (113.4 kg) at the manufacturer's recommended rate of one barrel for every 20–25 cows. The LMB contained 30% CP and is described in Bailey and Welling (2007). Two 22.7-kg white salt blocks (99.9% NaCl) were available for each treatment group.

Protocol

The study was divided into four consecutive 2-wk periods. During the first two periods, LMB was placed in one pasture and range cake in the other (randomly selected). During the next two periods, supplements and the associated cattle were moved to the other pasture in a crossover design. Before the study, two focal areas about 1 km apart were identified in each pasture and were used for both treatments. Focal areas were 40–45 m higher and on 3°–5° steeper slopes than range cake feeding sites. Average distances to water for focal areas and to range cake feeding sites were similar (within 210 m).

For the LMB treatment, four barrels were placed in a focal area for one period. New barrels were then placed in the other focal area in the same pasture for the next period, and previously placed barrels were removed. The order of placement of LMB in focal areas within a pasture was randomized. Barrels of LMB were located 40–50 m apart, and salt blocks were located 40–50 m from LMB. Cows were herded to the LMB on the day of placement.

The vehicle delivering range cake used two-track roads in accessible terrain (i.e., slopes $< 8°$). After driving to the location with the majority of cows, the vehicle horn was sounded, and cows were called to the vehicle. When the herd arrived, range cake was fed on the ground in a relatively straight line about 150 m long. Salt was available at one of the two focal areas in a pasture for 2 wk and then moved to the other focal area. The order was randomized. To simulate local management, cows in the range cake treatment were not herded to focal areas. Salt and LMB locations and range cake feeding sites (beginning, end, and midpoint) were recorded with a global positioning system (GPS) receiver (Trimble GeoExplorer, Sunnyvale, CA) capable of an accuracy of within 2 m.

Cattle Tracking

Four to eight randomly selected cows from each group were tracked using Lotek GPS 2200 collars (Newmarket, Canada) at 10-min intervals for 2-wk periods. Collars were placed on another set of randomly selected cows during the next period. Over the entire study, 23 cows in the LMB and 22 cows from range cake treatment were tracked for the full 2-wk periods.

Geographic coordinates obtained from collared cows were differentially corrected so that the accuracy was within 7 m (Moen et al. 1997). The average distance traveled per day was calculated by summing distances between successive recorded locations of each cow. Elevation, slope, distance to supplement, and minimum distance to water were calculated for each recorded location using a US Geological Survey digital elevation model and then averaged for each cow. Visits to LMB were defined as collared-cow locations that were within 10 m of barrels (Bailey and Welling 2007).

Forage Utilization Measurements

At the end of the second and fourth periods, forage utilization was measured at 100 transects spaced evenly across each pasture. Pastures were divided into 100 × 100 m grid cells, and utilization measurements were collected in one of three cells. Transect locations within cells were randomly selected. Height–weight relationships and stubble heights (Cook and Stubbendieck 1986) were used to estimate the utilization of 20 palatable perennial grass plants along each 40-m transect, which were later averaged together.

Range Cake Waste

In dry conditions, the area within 4 m of where cake was fed was carefully examined 24–72 h after feeding. Unused range cake cubes were counted, dried, and weighed. A similar approach was used if it snowed. The weight of the wasted cake was calculated by multiplying the number of observed cubes by the average weight of cubes collected during dry conditions. Evidence of the range cake was visible after snowmelt, even after deterioration of the cube.

Statistical Analyses

Focal areas within a pasture during a period ($n = 8$) were used as the experimental unit for telemetry data to increase the number of experimental units from four to eight and provide some quantification of the inherent variation and potential experimental error. It could be argued that pasture, rather than focal area

Table 1. Least-square means of terrain use, time spent within 100 m of water, and daily distance traveled by collared cows that were self-fed low-moisture blocks (LMB) and hand-fed range cake (error df = 2).

Item	LMB	SE	Range cake	SE	*P* value
Slope, °	8.07	0.19	6.96	0.20	0.08
Elevation, m	1 177	4	1 164	4	0.13
Distance from water, m	642	19	689	19	0.22
Time spent within 100 m of water, $h \cdot d^{-1}$	2.4	0.1	2.9	0.1	0.11
Distance traveled, $km \cdot d^{-1}$	4.26	0.23	5.08	0.23	0.14

within pastures, was the true experimental unit. To reduce the dependency between measurements obtained from the two focal areas within each pasture, we tracked different randomly selected cows during each period, and focal areas within a pasture were located about 1 km apart. However, this article is best considered as a case study because of the potential of pseudoreplication (focal areas rather than pastures as experimental units).

A mixed model (Littell et al. 1996) was used to analyze tracking data, which included treatment (LMB or range cake), pasture, month (first two periods or second two periods), and focal area within a pasture as fixed effects. Focal area by treatment interaction (df = 2) was considered a random effect and was used as the error term.

For forage utilization data, the analysis of covariance included treatment, pasture, slope, elevation, distance to water, and the interactions between treatment and terrain attributes (slope, elevation, and distance from water). Interactions between treatment and terrain attributes were used to determine whether treatment affected how cows grazed different topography and various areas of the pastures.

RESULTS

Standing Crop

Grass standing crop at the beginning of the study was $1\,240 \pm 160$ $kg \cdot ha^{-1}$ (mean ± SE) in the Anderson pasture and $1\,000 \pm 170$ $kg \cdot ha^{-1}$ in the Arches pasture. Forb standing crop was 150 ± 70 $kg \cdot ha^{-1}$ in the Anderson pasture and 460 ± 120 $kg \cdot ha^{-1}$ in Arches.

Supplement Intake

Intake of LMB was 318 ± 50 $g \cdot d^{-1}$, whereas range cake was fed at a rate of 769 $g \cdot d^{-1}$. Cows fed LMB (13 ± 2 $g \cdot d^{-1}$) consumed more ($P = 0.04$) salt than cows fed range cake (4 ± 2 $g \cdot d^{-1}$).

Cow Weights

Cows fed LMB gained 0.41 ± 0.3 $kg \cdot d^{-1}$. Cows fed range cake gained 0.39 ± 0.3 $kg \cdot d^{-1}$.

Terrain Use

Cows fed LMB used steeper slopes ($P = 0.08$) than cows fed range cake. Telemetry data also provided some evidence that cows fed LMB used higher elevations ($P = 0.13$) and spent less ($P = 0.11$) time within 100 m of water than cows fed range cake (Table 1).

To evaluate the degree that cows remained near supplement, we examined the time that collared cows spent within 100 m of supplement placement sites. Cows spent more time ($P = 0.05$) within 100 m of LMB than at range cake placement sites. The least-square means for time spent within 100 m of LMB and range cake feeding sites were 274 ± 23 and 67 ± 24 $min \cdot d^{-1}$, respectively. When cows were initially fed range cake (0–24 h after feeding), they spent an average of 94 min within 100 m of the feeding site (Fig. 1). Most of the time (64%), cows went to another location to graze after leaving the range cake feeding site, and 36% of the time cows went to water. Cows sometimes returned 24–48 h after feeding and spent an average of 32 min within 100 m of where range cake was fed.

Cows remained within 10 m of LMB (a visit) for 57 ± 11 $min \cdot d^{-1}$. Cows visited LMB on $40\% \pm 5\%$ of the days evaluated, or about once every 2.5 d. Only 2 of 24 collared cows (8%) did not visit LMB. Similarly, four of the 79 cows (5%) consistently came where the range cake was fed, but they were never observed consuming cubes. They stood 10–20 m from the cake placement line, whereas other cows searched and consumed cubes.

Forage Utilization

Forage utilization increased by an average of 5 percentage points during a month (two periods). Forage utilization was not

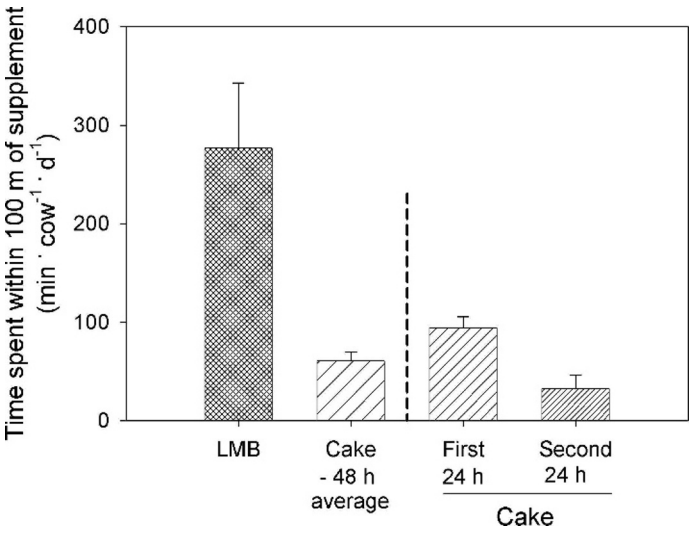

Figure 1. Time spent within 100 m of low-moisture block (LMB) and range cake (cake) feeding sites by cows with global positioning system collars. Range cake was fed 3 times per week at different locations within accessible terrain, whereas LMB was continuously available in higher and steeper terrain. Times spent within 100 m of range cake feeding sites are presented for the first and second 24 h following feeding and for the average of the 48 h following feeding.

Table 2. Least-squares constants and regression coefficients from the analysis of covariance of factors affecting changes in forage use over 1 mo (two 2-wk periods). LMB indicates low-moisture blocks.

Parameter		Estimate	SE	*P* value
Intercept	—	15.4	3.9	0.001
Treatment	LMB	3.3	4.8	0.5
	Range cake	0.0		
Pasture	Anderson	−5.6	1.8	0.002
	Arches	0.0		
Elevation		−0.01	0.04	0.87
Elevation × treatment	LMB	−0.06	0.05	0.19
	Range cake	0.0		
Distance to water		0.01	0.01	0.30
Distance to water × treatment	LMB	−0.01	0.01	0.07
	Range cake	0.0		
Slope		−1.07	0.20	0.001
Slope × treatment	LMB	0.96	0.27	0.001
	Range cake	0.0		

related to elevation ($P = 0.87$) or distance to water ($P = 0.30$), but forage utilization decreased ($P < 0.001$) with steeper slopes (Table 2). The slope-by-treatment interaction ($P < 0.001$) clearly showed that steep slopes affected forage utilization to a lesser degree with LMB than with range cake.

Range Cake Waste

At three of the seven feeding sites, no evidence of unused range cake cubes was observed. Cows wasted 29 ± 13 g · feeding^{-1} of range cake. Wasted cubes were usually in fecal material.

DISCUSSION

Terrain Use

LMB was placed in higher and steeper terrain than range cake feeding sites to simulate typical management in the area. LMB can be placed in rougher terrain than range cake because LMB can provide supplement for roughly 2 wk. Producers typically feed range cake near two-track roads in gentle or intermediate terrain because additional vehicle maintenance and depreciation occurs when supplement is transported to rugged topography. Collared cows fed LMB used steeper slopes than cows fed range cake. Telemetry data also provided some evidence that strategic placement of LMB increased utilization of higher elevations and decreased time spent near water. These analyses were based on only eight experimental units because this type of study is difficult to replicate. Management-scale herds and pasture sizes are required. Although results must be viewed as a case study, the experimental units reflect pastures sizes and herd sizes that are common to the area.

Similar to Mueggler (1965), forage utilization was lower on steep slopes than on gentle slopes when range cake was fed, but utilization was similar on gentle and steep slopes with LMB. These data agree with the telemetry data and suggest that strategic placement of LMB increased grazing of steep slopes that typically receive less use.

Schauer et al. (2005) found that protein supplementation and the frequency of feeding did not affect cattle grazing patterns when range cake was consistently fed at water. Cattle distribution as affected by supplement delivery method (continuously available or self fed), consistency of feeding locations, and terrain where supplement is placed deserves further study.

Supplement Use

Cattle use of LMB in this study was similar to the levels observed by Bailey and Welling (2007), where only 4% of cows were not observed within 10 m of LMB. Even though cows were hand-fed and all animals came to the truck when called, 5% of cows did not consume range cake. Based on anecdotal observations, some cows appear very adept at locating and consuming range cake cubes, whereas others consistently follow the truck or the person feeding the cake. A formal study measuring individual variation in intake of hand-fed supplements under range conditions appears warranted.

Cows spent more time within 100 m of LMB than within 100 m of range cake feeding sites (Fig. 1). The incentive to return to range feed cake feeding sites was less than at LMB placement sites. Range cake feeding locations varied, and cows consumed virtually all cubes within 60 min of feeding. Cows appeared to be more sensitive to the feeding truck than to a specific location. Anecdotal observations noted that cows began to travel to the feed truck when it first entered the pasture. As soon as cows heard the horn, they began to travel rapidly to the truck, often trotting or running. Minimal changes in behavior of cows supplemented with LMB were noted when the truck horn sounded.

MANAGEMENT IMPLICATIONS

Strategic placement of LMB in rough terrain is a more practical and effective approach to improve uniform cattle-grazing distribution than feeding range cake in accessible terrain based on the results of this case study.

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