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Effects of Movement and Activity Behavior in a Pasture System Compared to Time

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Summary with Implications

During the summer of 2016 seventeen cows were fitted with Global Positioning System (GPS) tracking collars to evaluate activity characteristics of cattle on rangelands. Data collected included daily distance traveled, average distance from water, daily time spent at water, daily area covered, and percent of day spent active (traveling or grazing). These variables were analyzed weekly to assess changes in behavior as time within pastures increased during three time periods of the growing season. Based on data collected from mid-May to mid-September, cattle showed little changes throughout the grazing season as to levels of activity through different periods of a 24-hour day. Daily patterns indicate that cattle are most active during mid-morning and evening hours. Periods of greatest inactivity occur during early morning hours and late afternoon prior to an evening grazing bout. Distance traveled showed a general downward trend as week within pasture progressed with the exception of the early grazed pasture. Average distance of cattle from water increased, and average time at water decreased at the end of the growing season. There were no statistical differences in activity levels or average area covered as time within a pasture increased. The greater distance traveled at the beginning of grazing on a pasture suggests that cattle are more selective in their grazing patterns and go to more grazing locations.

Introduction

Understanding how cattle graze, how far they travel, and where they select to graze or rest can help producers better understand how cattle behavior may influence grazing management on rangelands.

Manipulation of grazing behavior and distribution patterns can only happen if there is an understanding of current patterns. Global Positioning System (GPS) technology provides researchers with a tool to track cattle locations and grazing patterns. Advances in GPS technology create a consistent and accurate data source for individual animal locations over extended periods of a grazing season.

Cattle select locations on rangelands based on abiotic (e.g., topography) and biotic (e.g., forage quality) factors. Some of the most important drivers that influence cattle grazing locations are proximity to water, ease of travel, and amount of preferred forages. Producers and managers can improve distribution and grazing locations to more efficiently and uniformly utilize their forage resources by increasing water developments, fencing, mineral/salt/supplement placement, herding, or other distribution practices.

Understanding cattle grazing behavior is an important step in developing strategies to improve cattle grazing utilization, efficiency, and production. The objective of this study was to evaluate grazing behaviors of cattle as time progressed within pastures at different times during the growing season. It was hypothesized that daily distance traveled, area covered, and the amount of time cattle would be actively grazing would increase as time within the pasture increased because cattle would be required to seek out more areas to graze as the available forage decreased.

Table 1. Grazing periods, pasture attributes, and stocking rates and densities for herds of cattle grazing at the UNL Barta Brothers Ranch from mid-May to early-September 2016

	Grazing Period		
	Early	Middle	Late
Mean date in	17-May	15-Jun	19-Jul
Mean date out	15-Jun	19-Jul	1-Sep
Grazing, days	29.7 (1.8)	35.7 (3.3)	45.0 (1.5)
Pasture size, acre	133.4 (21.2)	132.6 (15.0)	170.0 (36.2)
Max water distance, miles	0.47 (0.09)	0.38 (0.03)	0.49 (0.12)
Mean slope, degrees	*21.6 (2.6)*	14.0 (3.8)	21.1 (4.7)
Mean elevation, feet	2599.1 (45.1)	2580.2 (24.2)	2595.5 (37.8)
Stocking rate, AUM/acre	0.72 (0.03)	0.76 (0.02)	0.82 (0.02)
Stocking density, AU/acre	0.72 (0.02)	0.72 (0.08)	0.58 (0.04)

() Indicates standard error

Procedure

Research was conducted at the University of Nebraska's Barta Brothers Ranch near Rose, NE in the eastern Nebraska Sandhills during the 2016 growing season. Common forage species were a mixture of warm- and cool-season grasses including needle- and-thread, little bluestem, prairie sandreed, kentucky bluegrass, scribner's panicum, sand dropseed, blue grama, and hairy grama. Seventeen cows with calves in 3 separate herds were fitted with GPS collars (i.e., 5 or 6 cows per herd). Herd sizes were 47 to 82 cow/calf pairs. Each herd was grazed on upland pastures in a 4-pasture deferred rotation from mid-May to mid-October. Rotations were planned so that the herds were typically moved to a new pasture within a few days of each other. Stocking rates on pastures varied from 0.72–0.82 (Animal Unit Months (;AUM/acre) with lower stocking rates in the early pasture because

Table 2. Distribution behavior results as time within grazing periods (early, middle, and late) progressed by week

	Weeks							
	1	2	3	4	5	6	Linear	Quad
Distance traveled	miles · d^{-1}						*p-value*	
Early	2.40 (0.06)	2.20 (0.06)	2.04 (0.06)	2.23 (0.06)	-	-	0.04	0.03
Middle	2.22 (0.12)	2.20 (0.12)	2.09 (0.12)	1.97 (0.12)	1.95 (0.12)	-	0.04	0.91
Late	1.90 (0.12)	1.79 (0.12)	1.69 (0.06)	1.60 (0.06)	1.52 (0.12)	1.47 (0.12)	0.01	0.63
Average distance from water	miles							
Early	0.19 (0.03)	0.20 (0.03)	0.20 (0.03)	0.21 (0.03)	-	-	0.33	0.99
Middle	0.17 (0.02)	0.16 (0.02)	0.17 (0.02)	0.17 (0.02)	0.17 (0.02)	-	0.86	0.62
Late	0.17 (0.02)	0.18 (0.02)	0.19 (0.02)	0.21 (0.02)	0.21 (0.02)	0.21 (0.02)	0.05	0.31
Time at water	hours · d^{-1}							
Early	3.65 (1.1)	2.82 (1.1)	3.18 (1.1)	3.31 (1.1)	-	-	0.08	0.18
Middle	2.62 (0.4)	2.57 (0.4)	2.21 (0.4)	2.15 (0.4)	3.00 (0.5)	-	0.99	0.24
Late	4.69 (0.8)	4.58 (0.7)	3.76 (0.7)	2.73 (0.7)	1.99 (0.7)	2.05 (0.8)	0.01	0.85
Area covered	acres · d^{-1}							
Early	30.75 (5.68)	32.78 (5.68)	32.01 (5.68)	39.37 (5.68)	-	-	0.25	0.37
Middle	29.24 (4.69)	33.32 (4.45)	32.93 (3.95)	32.01 (4.45)	34.53 (5.43)	-	0.61	0.78
Late	34.33 (6.92)	41.30 (6.67)	40.11 (6.42)	36.04 (6.42)	34.23 (6.67)	39.94 (6.92)	0.97	0.86
Activity	hours · d^{-1}							
Early	11.38 (0.3)	11.94 (0.3)	12.06 (0.3)	11.92 (0.3)	-	-	0.30	0.25
Middle	10.67 (0.6)	10.60 (0.5)	10.85 (0.5)	11.22 (0.5)	11.48 (0.6)	-	0.30	0.65
Late	9.93 (0.8)	10.31 (0.7)	10.35 (0.7)	10.27 (0.7)	10.25 (0.7)	10.49 (0.8)	0.60	0.76

() indicates standard error.

of limited forage availability earlier in the growing season (Table 1).

Behavioral data were collected using Lotek 3300 GPS collars that recorded cow locations at 10-minute intervals. Battery life on the collars was sufficient to collect data through the first 3 pastures in the deferred rotation from mid-May to early September. These 3 pastures represented the three grazing periods in the study that are defined as early, middle, and late (Table 1). In addition to the recorded locations, the GPS collars tracked x- and y-axis movements of the collar and percent of the time when the cow's head was in down or upright positions. The sensor measurements were correlated with visual observations to estimate a cow's daily activity budgets. Collared cows were visually observed for 4.7 ± 0.6 hours and data from sensor measurements on the collars and the visual observations were used to create a model for active (grazing or walking) and non-active (resting, laying down, or standing) periods. The model used to correlate the sensor measurements with the visual observations accurately classified 80 to 85% of collar readings.

Distances traveled, average area covered, average distance cattle were from water, and time spent near water were determined in the spatial analysis program ArcGIS. Distance traveled was calculated by adding all distances between consecutive GPS points for a 24-hour day. Area covered was calculated using a minimum convex polygon procedure that determines the area between the outermost points recorded during the day.

A repeated measures analysis was used to test changes in behavior as time within the early, middle, and late pastures progressed. Diurnal activity patterns, or percent of the day that collared animals were active, was averaged for cattle on the early, middle, and late grazed pastures to evaluate when cattle were most active during the day.

Results

During the early grazed pasture, daily distance cattle traveled exhibited a quadratic response (i.e., $P < 0.05$) with distances decreasing in the first 3 weeks, but increasing in the final week that cattle were in the pastures (Table 2). Daily distance traveled decreased linearly as time within pasture increased during the middle and late grazing pastures (Table 2). Increased travel in the final week on the early pasture may support the hypothesis that cattle needed to travel more because less forage was available as cool season biomass decreased and warm season biomass had yet to reach full production potential in early June. With the exception of the cattle on the early pasture, cattle exhibited the opposite response of what we originally hypothesized with distance traveled decreasing as time within pasture increased. This response could be due to cattle's spatial memory. As time progressed, cattle may have develop a mental map of a pasture including preferred forage locations. Understanding these locations allowed cattle to be more efficient with their movements. Another explanation is a reduction in selectivity of foraging in cattle as the time within a pasture progresses. Reduction in selectivity could be due to utilization of preferred forages in the first few

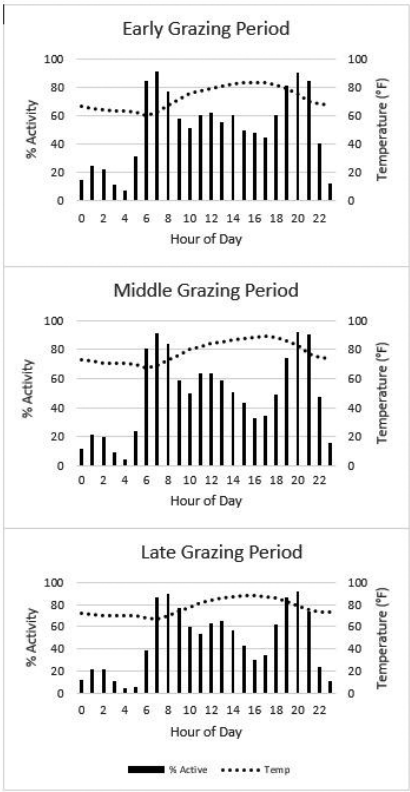

Figure 1. Daily activity levels and temperatures for early, middle, and late grazing periods; % Active represents % of hour spent in activity (traveling or grazing), grazing periods represent pastures grazed in the early part of the summer (17 May – 15 June), middle part of the summer (15 May – 19 July), and late part of the summer (19 July – 1 Sept.)

weeks that cattle are turned out on pastures.

Cattle behavior in the late pasture support the hypothesis that cattle would be farther from water as time within the pasture progressed. Cattle grazing in the late pasture showed a general trend of being further from water and spending less time at water as time within the pastures progressed (Table 2). However, the early and middle pastures showed no statistical differences for distance cattle were from water and time spent at water. Increases in distance traveled from water and time spent at water for cattle in the late pasture could be the result of cattle seeking out areas farther from water as forage closer to water became depleted. Only seeing this in later grazing pastures may be the result of more uniform pasture quality later in the growing season and a decreased selectivity in foraging as the season progresses.

No differences were observed in average area covered as it related to time within a pasture (Table 2). However, the daily distance travel decreased. This suggests that there may be less selectivity of foraging because cattle were making direct travel routes to preferred foraging areas rather than a more sinuous travel pattern to many different grazing locations. This could have also been the reason cattle spent less time at water and had farther average distances from water during the late pasture.

No differences were observed in activity levels as time within a pasture increased for all grazing periods (Table 2). Diurnal activity was relatively consistent throughout the grazing periods (Figure 1). Little variation in activity regardless of time of season or time within a pasture could stem from bovine physiology. Regardless of conditions, cattle need a certain amount of time during the day dedicated to grazing andrest and rumination. Grazing at appropriate stocking rates in the study did not seem to influence this amount of time as time within the pastures increased. According to these results, roughly half of a 24-hour day is spent in rest (including rumination) and half in activity (mostly grazing) (Table 2).

Based on averages of all collared animals for the duration of the study, a consistent activity pattern emerged for activity levels in a 24-hour period (Figure 1). More specifically, starting from midnight until 5 A.M., cattle demonstrated their lowest levels of activity with no period exceeding 25% of the time when cattle were active. This early morning period of inactivity can mostly be attributed to traditional night bedding of cattle. The periods from 6–9 A.M. represent one of two peaks in activity during a 24-hour period with a spike of 90% activity at 7 A.M. Activity levels generally decline after 9 A.M. to levels between 50–60%, until late afternoon (3–5 P.M.) when activity dipped to between 35–45%. A second activity peak typically occurred between 6 and 10 P.M. After 10 P.M. activity declined.

In conclusion, grazing activity of cattle and area covered by cattle in a pasture stayed consistent throughout the growing season, but distance traveled tended to decrease as time within the pasture increased. Cattle in this study tended to spend less time at water and traveled farther distances from water toward the end of the growing season, but not during the early and middle part of the growing season. Cattle activity was greatest at mid-morning and late evening, and lowest at night and during mid-afternoon. While more research is needed to better understand the dynamics of cattle as time progresses on pastures, the decreased travel suggests that cattle will typically search out fewer places as time within the pasture increases. This could affect grazing utilization if cattle are only on pastures for a short time and take only a portion of the yearly allotted forage.

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