Microclimate Effects on the Temperature/Spatial Distribution of Beef Cows Grazing Cool-Season Grass Pastures by Different Management Practices (A Progress Report)

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Summary and Implications

Congregation of cattle near pasture streams increases fecal cover and decreases forage sward height and mass, thereby, increasing the risks of sediment, nutrients, and fecal pathogens entering the stream and impairing water quality. Restricting access to the streams to stabilized stream crossings or by providing alternative water sources away from the stream may decrease the amount of time that cattle spend near a stream and, thereby, reduce the risk of non-point source pollution. Six 30-acre cool-season grass pastures, bisected by a stream, were split into two blocks with three treatments per block. Treatments were: continuous stocking with unrestricted stream access (CSU), continuous stocking with access to the stream restricted to a 16-foot wide stabilized stream crossing (CSR), and rotational stocking (RS). Cattle spent a greater proportion of time in the stream in CSU pastures than other treatments in June ($P < 0.05$), August ($P < 0.05$), and September ($P < 0.10$). During May to July, and in September, cattle in CSU pastures spent a greater ($P < 0.05$) percentage of time within 110 feet of the stream than in CSR or RS pastures. Off-stream water had no effect on cattle distribution near the stream ($P > 0.10$) in a summer in which there was considerable precipitation resulting in some of natural off-stream water sources.

Introduction

Pastures have been cited as major contributors to sedimentation, phosphorus, and coliform loading of impaired surface water sources in Iowa. Restricting cattle access to streams through rotational stocking or stabilized stream crossings has the potential to reduce loading of these pollutants in pasture streams. In order to properly manage cattle grazing near streams, more research is needed to measure the effects of stocking treatments on the temporal/spatial distribution of cattle in pastures by considering environmental factors that cause cattle to congregate in areas near streams.

The objective of this study is to evaluate the relationships between environmental factors, grazing management, and off-stream water on the temporal/spatial distribution of cattle within pastures.

Materials and Methods

Six 30-acre pastures containing smooth bromegrass and reed canarygrass and bisected by a stream in central Iowa were stocked with 15 fall-calving Angus cows (mean weight, 1364 lbs.). Pastures were separated into two blocks with three treatments per block; continuous stocking with unrestricted stream access (CSU), continuous stocking with access to the stream restricted to a 16-foot wide stabilized stream crossing (CSR), or rotational stocking (RS). Cattle were not allowed to graze the riparian buffers (approximately 2.25 acres) on either side of the stabilized stream crossings in the CSR pastures. Pastures with RS were divided into 5 paddocks. Non-riparian paddocks were rotated when the cattle had grazed half of the live forage or after a maximum of 14 days. Grazing of riparian paddocks was limited a minimum height of 4 inches or a maximum of 4 days. Live forage mass was estimated with a falling plate meter (4.8 kg/m^2) at 24 random locations upon the cattle's entry and exit of each paddock.

A GPS collar was placed on one cow per pasture to record cow position every ten minutes for two weeks monthly from May through September. Locations of the cows in the pastures were determined on aerial maps of the pastures using ArcGIS version 9.2. Cattle positioning was analyzed as being in one of four zones on either side of the stream including: the stream (stream zone), 0 to 110 feet from the streambank (110 zone), between 110 and 220 feet from the streambank (220 zone), and greater than 220 feet from the streambank (upland zone).

To determine the effects of off-stream water on cow distribution, alternative water was supplied as rural water to tanks with floats on both sides of the stream at a minimum distance of 240 meters from the stream for one of the two weeks during each GPS tracking period. Phosphorus-free mineral was available ad libitum in feeders located near the alternative water sites continually.

Weather data were measured through a HOBO weather station using data loggers located near the center of the pastures. The weather station measured ambient and black globe temperatures, wind speed and direction, relative humidity, dew point, and precipitation. Precipitation was also measured using two rain gauges located on opposite ends of the pastures. Both rain gauges were measured on the day after any rain had fallen.

Distribution of the cattle was calculated as the proportion of total observations that cows were measured in each zone. The effects of grazing treatment were analyzed using the GLM procedure of SAS with treatment as the independent variable. The effects of off-stream water was analyzed using the GLM procedure of SAS for only pastures with the CSU and CSR treatments as distribution of cows in the RS pastures was dependent on management of the grazing system. The relationship between cattle distribution and microclimatic variables is currently being calculated as probabilities with the LOGISTIC procedure of SAS.

Results and Discussion

Grazing Treatment

Cattle spent a greater proportion of time in the streams of CSU pastures than other treatments in the months of June and August ($P < 0.05$) and September ($P < 0.10$; Fig. 1). Cattle in CSU pastures spent 0.8 to 4.8% of their time within the stream compared to cattle in CSR pastures that spent less the 0.5% of their time in the stream in any month. Similarly, cattle in CSU pastures spent a greater ($P < 0.05$) proportion of time in the 110 zone than cattle in CSR and RS pastures from May to July and in September ($P < 0.10$; Fig. 2). The low proportion of time that cattle in the RS pastures were within 110 feet of the stream resulted from the way the grazing system was managed. Periods of stocking the riparian paddock and recording GPS positions never occurred at the same time. Based on the proportion of days that the cows in the RS pastures were in the riparian paddock, cows in RS pastures were within 110 feet of the stream for 0, 0, 3.2, 9.7, and 6.7, and 0% of the days in May, June, July, August, September, and October, respectively.

As a result of spending more time within the stream and 110 zone of the pastures, cattle in CSU pastures spent less time in the upland zone than CSR pastures in May and June ($P < 0.05$), and September ($P < 0.10$), and than the RS pastures in June ($P < 0.05$).

Off-stream Water

Allowing cattle access to off-stream water did not affect ($P > 0.10$) the proportion of time that cattle spent near the stream in any month (Data not shown). Lack of the effects of off-stream water may have resulted from cool weather conditions or the availability of natural off-stream water sources that occurred this grazing season. Over the six months of grazing, 29.9 inches of rain fell at the research location, compared to the annual average of 32.2 inches. Average temperatures for May, June, July, August, and September were 58, 69, 72, 69, and 63^{o}F compared to the 100-year averages of 60, 70, 76, 72, and 60^{o}F, respectively.

Microclimate Effects

The high proportion of time that cattle in CSU pastures spent in the stream or 110 zone in July might be expected because of seasonally high temperatures. However, the lower proportions of time that cattle in these pastures were in or near the stream in August seem incongruous with this relationship.

Weather data for the time periods that GPS collars were placed on the cattle is being analyzed. Weather conditions will be matched to each interval that the GPS collar recorded a position and cow distribution will be analyzed as probabilities with each microclimatic variable and index.

Conclusion

This study has illustrated that using rotational stocking and restricting stream access through the use of stabilized stream crossings can reduce the amount of time that cattle spend near or in pasture streams. Microclimate weather data will continue to give us valuable information on factors that lead cattle to congregate near streams.

Acknowledgements

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Figure 1. Mean proportions of time that cattle spent in the stream of pastures with continuous stocking with unrestricted stream access (CSU), continuous stocking with restricted stream access (CSR), or rotational stocking (RS) during the 2008 grazing season. a = differences between CSU and CSR, b = differences between CSU and RS, c= difference between CSR and RS, ($P < 0.10$).

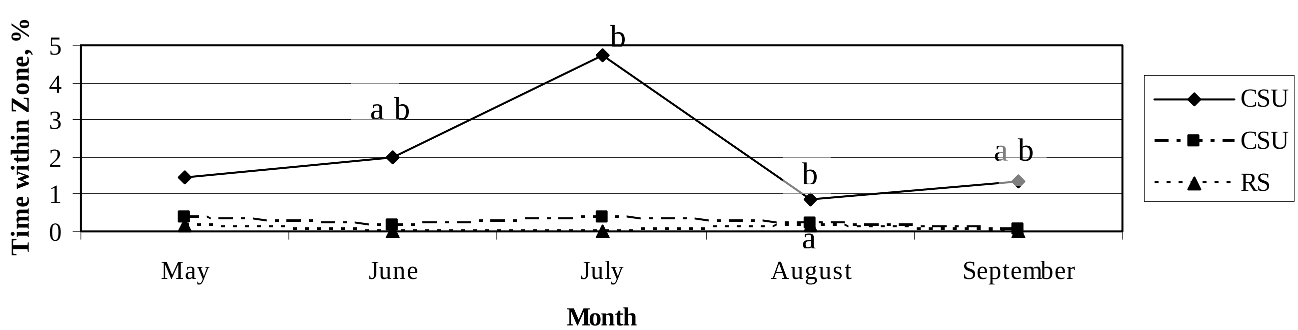

Figure 2. Mean proportions of time that cattle spent within the 110 foot zone of pastures with continuous stocking with unrestricted stream access (CSU), continuous stocking with restricted stream access (CSR), or rotational stocking (RS) during the 2008 grazing season. a = differences between CSU and CSR, b = differences between CSU and RS, c= difference between CSR and RS, (P < 0.10).

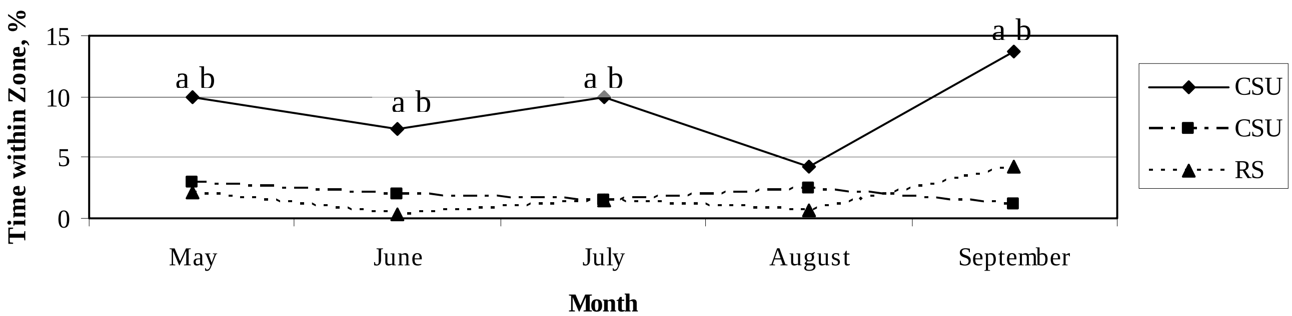

Figure 3. Mean proportions of time that cattle spent with the 220 foot zone of pastures with continuous stocking with unrestricted stream access (CSU), continuous stocking with restricted stream access (CSR), or rotational stocking (RS) during the 2008 grazing season. a = differences between CSU and CSR, b = differences between CSU and RS, c= difference between CSR and RS, (P < 0.10).

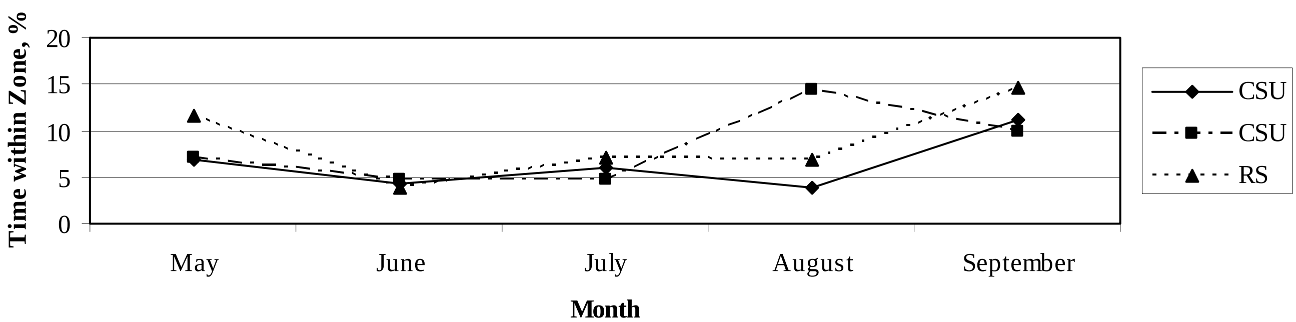

Figure 4. Mean proportions of time that cattle spent in the upland zone of pastures with continuous stocking with unrestricted stream access (CSU), continuous stocking with restricted stream access (CSR), or rotational stocking (RS) during the 2008 grazing season. a = differences between CSU and CSR, b = differences between CSU and RS, c= difference between CSR and RS, (P < 0.10).