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Impacts of Beef Cattle–Grazing Systems on Cattle Distribution and Streambank Erosion

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Abstract
Many of Iowa's surface waters contain high sediment and phosphorus(P) concentrations. It is recognized that overgrazing along pasture streams may result in soil erosion and manure deposition that contribute to P loading of pasture streams. Little research has evaluated the effects of grazing management on sediment and P loading of pasture streams in the Midwest, but grazing management is still generally considered to limit sediment and P loading of pasture streams. The objective of this study was to measure the effects of beef cattle– grazing systems on the spatial and temporal distribution patterns of cattle, the resulting impacts on selected pasture characteristics, and streambank erosion from pasture streams.

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Introduction

Many of Iowa's surface waters contain high sediment and phosphorus (P) concentrations. It is recognized that overgrazing along pasture streams may result in soil erosion and manure deposition that contribute to P loading of pasture streams. Little research has evaluated the effects of grazing management on sediment and P loading of pasture streams in the Midwest, but grazing management is still generally considered to limit sediment and P loading of pasture streams. The objective of this study was to measure the effects of beef cattle–grazing systems on the spatial and temporal distribution patterns of cattle, the resulting impacts on selected pasture characteristics, and streambank erosion from pasture streams.

Materials and Methods

Six 30-acre cool-season grass pastures, each bisected by a 642-ft stream segment, were grouped into two blocks and assigned one of three treatments: continuous stocking–unrestricted stream access (CSU); continuous stocking–restricted stream access to stabilized crossings (CSR); and rotational stocking (RS). Pastures were stocked with 15 fall-calving Angus cows (1,430 lb) from mid-May to mid-October 2005. Cattle distribution was determined by visual observation from 0600 to 1800 hours on two consecutive days during seven observation periods, five without off-stream water and two with off-stream water available in the CSU and CSR pastures during the grazing season. Off-stream water sources were located in the upland portion of the pastures. Cow herd location, number of cattle in the herd, and observed defecations and urinations were recorded at 10-minute intervals during observation days. Cattle locations were defined as within stream and 0 to 110 ft, 110 to 220 ft, and farther than 220 ft from the stream. Proportions of bare and manure-covered ground were measured monthly in open and congregation areas on the streambanks and at distances of 0 to 110 ft, 110 to 220 ft, and farther than 220 ft from the stream. Streambank erosion was measured at ten transects per pasture using erosion pins inserted at 39-in. intervals to the top of the streambanks. Pin lengths were measured monthly during the grazing season, and one month postgrazing to determine sediment erosion.

Results and Discussion

Cattle in CSR pastures spent a greater ($P<.05$) proportion of their time in the streambed compared with cattle managed by RS or CSR, as shown in Table 1. There was no effect of management treatment on the proportion of time that cattle spent in the remaining pasture locations. Month did not impact the proportion of time cattle spent in the streambed or within 110 ft of the streambed. The presence of an alternative water source did not alter cattle distribution patterns. Patterns of urination and defecation distribution were similar to cattle distribution patterns.

Bare soil, as a percent surface area, was more extensive ($P<.05$) on streambanks (40%) across all treatments than at other locations in pastures (6%). October was the only month in which there was more ($P<.05$) bare ground on the banks of the CSU (60%) than in either the RS (24%) or CSR (20%) pastures.

While no manure covered the ground surface on the bank or within 110 ft of the streambanks of CSR pastures and little manure covered the ground surface on the banks of RS pastures, there was little difference in the proportion of ground covered with manure at distances greater than 110 ft from the streambanks in June and August (treatment × zone, P<.05). In September and October, the proportion of ground surface covered with manure did not differ in any zone between CSU and RS pastures. However, in CSR pastures manure cover was greatest from 110 to 220 ft from the streambanks and was absent on the bank and from 0 to 110 ft from the streambanks in the riparian buffer (treatment × zone, P<.05). Manure cover did not exceed 3% of the ground surface in any treatment or month.

In September, greater (P<.05) net sediment erosion occurred from streambanks in the CSU pastures (0.98 in.) than from either the CSR (0.20 in.) or RS (0.12 in.) pastures, as shown in Table 2. Over the entire grazing season, net streambank erosion did not differ between grazing management treatments, averaging 2.13 in. These data indicate that the use of rotational stocking and the restriction of cattle to reinforced stream crossings are effective in reducing the proportion of time cattle spend in streams and riparian areas. The lack of treatment differences for streambank erosion, over the entire grazing season, was not surprising as much of the erosion occurred early in the grazing season and was likely related to past land management practices. It is believed that in subsequent years, treatment differences in streambank erosion will be observed.

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Table 1. Mean cattle distribution (% of total observed time) in relation to stream channel.

	Pasture Location[a]			
	Stream	110	220	Upland
RS[b]	0.87[d]	9.13	5.65	84.36
CSR	2.15[d]	0.78	11.02	86.07
CSU	5.72[c]	15.28	5.72	73.29

[a]Stream=in streambed; 110=0 to 110 ft from stream; 220=110 to 220 ft from stream; Upland=greater than 220 ft from stream.
[b]RS=rotational stocking; CSR=continuous stocking–restricted stream access; CSU=continuous stocking–unrestricted stream access.
[c,d]Means are significantly different at P<.05.

Table 2. Least squares means of net erosion and erosion in pastures with different grazing management.

	Month[a]						Grazing Season
	June	Jul	Aug	Sept	Oct	Nov	
	Net erosion, in.						
RS[b]	1.22	1.50	0.31	0.12[e]	0.28	-0.24	3.15
CSR	0.91	0.31	0.20	0.20[e]	0.08	-0.39	1.10
CSU	0.39	1.81	-0.04[c]	0.98[d]	-0.87	-0.24	2.05

[a]Analyzed by GLM using the changes occurring during the preceding winter as the covariant.
[b]RS=rotational stocking; CSR=continuous stocking–restricted stream access; CSU=continuous stocking–unrestricted stream access.
[c]Negative values represent soil deposition.
[de]Differences between means with different superscripts are significant, P<.05.