2009

Effects of Stocking Rate and Botanical Composition on the Physical Characteristics of the Riparian Zones of Pastures (A Two-Year Progress Report)

Douglas Allen Bear
Iowa State University

James R. Russell
Iowa State University, jrussell@iastate.edu

Daniel G. Morrical
Iowa State University, morrical@iastate.edu

Mustafa Tufekcioglu
Iowa State University

Thomas M. Isenhart
Iowa State University, isenhart@iastate.edu

See last page for additional authors

Effects of Stocking Rate and Botanical Composition on the Physical Characteristics of the Riparian Zones of Pastures (A Two-Year Progress Report)

Abstract
Grazing management practices that allow cattle to congregate near pasture streams may result in the loss of vegetative cover and promote accumulation of manure near the streams, increasing the risk of nonpoint source pollution of the stream. The objective of this project was to evaluate the effects of stocking rate of pastures and the botanical composition of the pastures' riparian zone on the forage sward height and the proportions of bare and manure-covered ground along the banks of pasture streams.

Keywords
Animal Science, Natural Resource Ecology and Management

Disciplines
Agricultural Science | Agriculture | Ecology and Evolutionary Biology | Other Life Sciences

Authors
Douglas Allen Bear, James R. Russell, Daniel G. Morrical, Mustafa Tufekcioglu, Thomas M. Isenhart, and John L. Kovar

Effects of Stocking Rate and Botanical Composition on the Physical Characteristics of the Riparian Zones of Pastures (A Two-Year Progress Report)

Douglas Bear, research assistant
Jim Russell, professor
Dan Morrical, professor
Department of Animal Science
Mustafa Tufekcioglu, research assistant
Thomas Isenhart, associate professor
Department of Natural Resource Ecology and Management
John Kovar, soil scientist
USDA National Soil Tilth Laboratory

Introduction

Grazing management practices that allow cattle to congregate near pasture streams may result in the loss of vegetative cover and promote accumulation of manure near the streams, increasing the risk of nonpoint source pollution of the stream.

The objective of this project was to evaluate the effects of stocking rate of pastures and the botanical composition of the pastures' riparian zone on the forage sward height and the proportions of bare and manure-covered ground along the banks of pasture streams.

Materials and Methods

Thirteen pastures, ranging from 7 to 265 acres, on 12 cooperating farms in the Rathbun Lake watershed were used. Producers of these operations recorded the number of cows, heifers, and bulls stocked in these pastures as they entered and left the pasture from November 2006 to November 2008.

Bi-monthly, from May through November, proportions of bare and manure-covered ground and the forage sward height and species were measured on both sides of the stream at up to 30 locations at 100 ft intervals along the stream in each pasture. Proportions of bare and manure-covered ground were measured perpendicular to the stream by a 50-ft line, beginning at the edge of the stream. Sward height was measured with a falling plate meter (8.8 lb/yd^2) and vegetation species was identified at the mid-point of the line.

Differences in the proportions of bare and manure-covered ground, forage sward height, and the proportion of each vegetative species between farms were analyzed. Regression and stepwise multiple regression equations were calculated.

Results and Discussion

Stocking rate. The period stocking rate per stream length was highly related to the forage sward height measured approximately 25 ft from the stream. In stepwise multiple regressions, sward heights in the riparian zone decreased as the proportions of tall fescue, bluegrass, and annual stocking rate of cow-days/acre increased and as the percentage of legumes decreased (r^2=0.56).

Bare soil. Bare soil proportions along the stream banks did not differ between sampling intervals, but did differ by farms. Proportion of bare soil along the banks was only weakly related to the period stocking rate per stream length. In stepwise multiple regressions, bare soil decreased as reed canarygrass and sedge increased, and annual stocking rate of cow-days/ft of stream reach decreased. These variables accounted for 43 percent of the variation in the proportion of bare soil. Because annual stocking rate accounted for only 3 percent of the 43 percent variation, natural factors like stream flow and rainfall may have larger effects on bare soil adjacent to streams than cattle traffic.

Manure-covered soil. The proportion of manure-covered soil within 50 ft of the stream increased as the period stocking rate per acre increased (Table 1). In multiple stepwise regressions, the proportion of manure-covered ground increased as the period stocking rate of cow-days per acre and proportions of bluegrass and tall fescue increased and as proportions of broadleaf weeds and weed grasses decreased. These variables accounted for 57 percent of the variation in manure-covered soil and may represent effects of stocking rate of areas with the most commonly grazed species.

Vegetation species. Mean sward height across sampling intervals decreased from July to November implying that stream banks may be more susceptible to erosion from precipitation run-off over the winter (Table 1). Farms with the least proportion of tall fescue, but highest proportion of reed canarygrass also had the least amount of bare soil in the riparian areas. These factors may provide a critical understanding of vegetative species that may help decrease the percentage of bare soil in riparian areas of pastures. Variations in species prevalence may imply that cattle are selecting more palatable vegetative species early in the growing season and decreasing the sward height late in the grazing season, which allows more aggressive vegetative species to take over the riparian areas of pastures.

Results imply that increasing stocking rate will result in decreases in sward height and increases in manure cover in riparian zones. However, the effects of stocking rate on the proportion of bare soil adjacent to streams are small.

Acknowledgements

The authors would like to thank the cooperating producers and the personnel in the Rathbun Land and Water Alliance for their assistance with this project. The material in this report is based on the work supported by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Award No. 2006-51130-03700. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the U. S. Department of Agriculture.

Table 1. Average sward height (cm) of forage and proportion of manure-covered ground 25 feet from the stream in 13 pastures in the Rathbun Lake watershed across sampling intervals.

Pasture	Months							
	Average sward height (cm) of forage				Average proportion of manure-cover ground			
	May	July	September	November	May	July	September	November
1	8.0	8.0	4.7	2.0	1.57^{a}	0.83^{b}	0.45^{b}	1.67^{a}
2	12.4^{a}	11.3^{ab}	4.9^{bc}	2.0^{c}	0.73	0.49	0.41	0.62
3	21.5^{b}	43.3^{a}	16.0^{bc}	10.3^{c}	0.02	0.00	0.00	0.00
4	17.9^{a}	21.2^{a}	14.9^{a}	5.9^{b}	1.08^{a}	0.63^{ab}	0.05^{b}	1.15^{a}
5	7.8	8.2	5.3	2.3	0.44	0.45	0.18	0.48
6	8.9^{a}	6.5^{ab}	4.6^{ab}	1.1^{b}	0.16	0.28	0.02	0.63
7	13.3^{a}	6.1^{b}	2.8^{b}	1.0^{b}	0.38^{b}	1.71^{a}	1.20^{a}	1.63^{a}
8	4.3^{b}	11.7^{a}	5.3^{ab}	2.5^{b}	1.19^{a}	0.20^{c}	0.55^{bc}	0.95^{ab}
9	12.1^{b}	21.8^{a}	19.4^{a}	8.3^{b}	0.57	0.08	0.00	0.31
10	16.1^{a}	4.9^{b}	1.9^{b}	1.2^{b}	0.19	0.73	0.33	0.48
11	2.7	4.8	2.4	1.1	1.44^{a}	1.25^{ab}	0.97^{ab}	0.63^{b}
12	2.9	5.8	6.7	2.4	0.81	0.76	0.47	0.69
13	20.7^{b}	40.6^{a}	24.8^{b}	10.0^{c}	0.01	0.00	0.00	0.00

^{a,b,c}Within a row, least squares means without a common superscript differ ($P < 0.05$).