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Site specific implementation of practices that alter the spatial/temporal distribution of grazing cattle to improve water quality of pasture streams in the Rathbun Lake watershed

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Abstract
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Keywords
Animal Science, Animal management and forage, Water quality quantity and management

Disciplines
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Principal Investigator:

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Budget:
$32,320 for year one
$2,340 for year two
$25,821 for year three

Q Do the physical characteristics of a pasture influence the effectiveness of practices intended to reduce the risk of nonpoint source pollution of pasture streams caused by congregation of cattle in and near streams?

ECOLOGY

A The major factors affecting congregation of cattle in and near pasture streams were the size and shape of the pasture.

Background

Vegetation can help prevent soil erosion and limit precipitation runoff, so maintenance of perennial vegetation on landscapes is a key to preventing pollution of surface water. However, some studies have shown greater sediment and phosphorus loading from pasturelands than other land uses. Vegetative ground cover presence and manure concentration are related to congregation of cattle within specific areas of pastures. This suggests that these problems may be managed through implementation of grazing practices that alter the location, frequency, duration and intensity of grazing. Management practices that utilize fencing provide the most direct method of excluding or limiting cattle access to pasture streams.

Cattle producers may be reluctant to assume the costs associated with construction and maintenance of fences, the need to develop alternative water sources, and the loss of forage associated with riparian buffers. While cost-share funding may be available from governmental agencies to construct fences, water systems, or stabilized access sites to protect quality of surface water resources, this funding is limited and needs to directed to areas where it would be most cost effective. Therefore, factors affecting congregation of cattle near pasture streams need to be quantified. While such information exists for western rangelands, Midwestern pastures are generally smaller, more homogeneous in terrain and botanical composition, and contain greater quantities of tall fescue, a grass species commonly associated with heat stress.

The objective of this project was to evaluate and demonstrate the effectiveness of site-specific Midwest management practices that alter the spatial/temporal distribution of grazing cattle in reducing the risk of nonpoint source pollution of streams in pastures with varying size, shape and shade distribution.

Approach and methods

In the first part of the project, GPS collars recorded locations of two to three cows per pasture at 10-minute intervals for five to 14 days on farms in the Rathbun Lake watershed in the spring, summer, and fall from 2007 through 2009. This study was conducted in conjunction with the ISU McNay Research Farm. In the second segment of the project, pregnant fall-calving Angus cows at the ISU Rhodes Research Farm

Cattle crossing at Rhodes Farm

grazed 10- or 30-acre cool-season grass pastures with 2.25 acres of each pasture within 110 feet of a bisecting stream. The investigators used continuous stocking with unrestricted stream access and no off-stream water, unrestricted stream access with off-stream water at 424 and 888 feet, respectively, or stream access restricted to a 16-foot stabilized gravel crossing. Pastures used for the two size treatments within a given stocking treatment were switched every two weeks from mid-May through mid-October 2010 and 2011. During each two-week period, GPS collars were attached to two to three cows per pasture to record cow location at 10-minute intervals.

Results and discussion

In Study 1, percentage of time that cows were in a stream or pond on five farms ranged from 2.8 percent in the spring to 4.2 percent in mid-summer. The percentage of time that cows were within 100 feet of a stream or pond was closely related to pasture size, increasing with decreasing pasture size in pastures ranging from 32 to 309 acres. In addition, the percentage of time that cows were within 100 feet of the streams increased to a lesser extent with increasing proportions of the total pasture area and shade within 100 feet of the stream or pond, but was not related to the percentage of tall fescue in the pastures.

In Study 2, cows in 10-acre pastures spent averages of 6.2 percent in-stream and 30.6 percent of the time in and within 110 feet of the stream if allowed unrestricted stream access. Increasing pasture size to 30 acres reduced the percentage of time within the stream by 52 percent and the percentage of time by 74 percent within 110 feet of the stream by between large compared to small pastures with unrestricted access. Restricting stream access to stabilized crossings reduced the proportion of time that cattle were in the stream by 78 and 69 percent in 10- and 30-acre pastures. Furthermore, restricting stream access to stabilized crossings reduced the proportion of time that cattle were within 110 feet of the stream by 68 and 72 percent in 10- and 30-acre pastures with restricted access compared to unrestricted access. While restricting stream access to stabilized crossings was effective in both small and large pastures, use of this practice had a larger effect in small pastures as the percentage of time that cows were in and near the stream was greater in small pastures in which cows had unrestricted stream access. Supplying off-stream water to cows did not reduce the percentage of time that cows were in or near the stream, regardless of pasture size.

Conclusions

The major project conclusion is that the size and shape of pastures is the primary factor controlling the congregation of cattle in and near pasture streams, and the smaller the pasture, the greater the need for more intense management. The effects of pasture size and shape on cow distribution supersede other possible factors such as shade distribution or the proportion of tall fescue in the pastures. As congregation of cattle will increase the percentage of bare and manure-covered ground while reducing forage height, the risks of nonpoint source pollution of pastures is considerably greater in small, narrow pastures than in large, wide pastures. Therefore, more restrictive management practices that use fencing (i.e., vegetative buffers or riparian paddocks)

will be more effective at reducing the risks of nonpoint source pollution of streams in small pastures than large pastures. This experiment highlighted the effects of restricting stream access to stabilized crossings. These restrictions reduced the time that cattle were present in the stream and riparian zones in both large and small pastures by comparable proportions. However, the cattle spent much more time in the stream and riparian zones in small pastures than large pastures when provided unrestricted stream access, resulting in greater impacts of restricted access in small pastures.

While some studies in the literature have shown that providing water off-stream would reduce congregation of cattle near pasture streams, this practice proved ineffective in altering distribution of grazing cattle in either large or small pastures. While the reasons for the lack of efficacy in this experiment are unclear, the fact that providing off-stream water was ineffective in altering distribution of grazing cattle means that this practice might be effective only under specific conditions. It likely should not be recommended for altering cow distribution unless it can be combined with another restrictive practice, such as riparian buffers or rotational grazing.

The probability of cattle presence in shade is highly related to ambient temperature regardless of grazing management. However, riparian shade became the major source of shade at high temperatures in small pastures. In large pastures, shade in the upland areas of the pastures was the major source of shade, even at high ambient temperatures.

Impact of results

Maintaining perennial vegetation is a key to preventing sediment and nutrient loading of waterways in Iowa. However, previous studies have implicated pasturelands as major sources of sediment and phosphorus in water resources. Some states now require implementation of riparian buffers in all pastures to reduce nonpoint source pollution. However, the economic cost of placing and maintaining fences, providing alternative water, and the loss of grazing land in riparian buffers make grasslands a less attractive crop alternative to farmers. Even if the costs of fencing and water systems are shared with government programs, the funding available for such programs is limited. It would be beneficial to target these practices to sites where implementation would be most cost effective.

Results of this project demonstrated the predominant role of pasture size and shape on the congregation of grazing cattle in and near pasture streams. In addition, the results demonstrated that restricting stream access of grazing cattle to stabilized crossings was more effective in small than large pastures. This project showed that the most cost-effective approach to limit the risks of nonpoint source pollution from direct manure deposition or precipitation runoff in pasture streams would be to target more restrictive management practices. Thus, the most cost-effective approach to keeping pasture streams clean is to control the access of cattle to streams in small, narrow pastures. Use of ungrazed or flash-grazed riparian buffers is one approach to limit access of cattle to streams. However, it should be emphasized that use of riparian buffers is

not the only restrictive approach that could reduce the risk of nonpoint source pollution in pasture streams. Merely providing limited stream access in a riparian paddock of a rotational grazing system in which grazing was limited to four days or a residual forage height of 4 inches per rotation was as effective at controlling the risks of nonpoint source pollution of pasture streams as were vegetative buffers with stabilized stream access sites as shown in previous research.

It is anticipated that the results of this project will be used by producers and technical service providers in the USDA-NRCS, Cooperative Extension Service, and the Iowa Department of Natural Resources. They have information to implement the most cost-effective pasture management practices to limit risks of nonpoint source pollution of streams based on the physical characteristics including size, shape, and shade distribution and stocking rates of individual pastures. Thus, cost-sharing of funds to limit nonpoint source pollution should be used in pastures with physical characteristics that promote congregation of cattle near pasture streams. Through such management, water quality of Iowa streams could be improved by 1) controlling the loading of nonpoint source pollutants from pastures with physical characteristics that promote cattle congregation near streams and 2) not providing an incentive for conversion of large pastures from grass to row crop production where cattle infrequently congregate near streams.

Education and outreach

Two refereed journal articles are underway, and five abstracts already have been published, as well as three summaries in the ISU Animal Industry Reports for 2010, 2011, and 2012. Results from the project were shared at six events (conference and field days) in Iowa and three out-of-state meetings.

Leveraged funds

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