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Impacts of Intensive Rotational Grazing on Stream Ecology and Water Quality

(A study sponsored by The Agricultural Ecosystems Research Project of Wisconsin.)

Management of shoreline areas on farms has become a major focus of nonpoint pollution control efforts. In general, the tendency in agricultural shoreland management has been to encourage the establishment of vegetative filter strips, which take land out of production and require maintenance of fencing and vegetation by the landowner. Rotational grazing can encourage sod development and help stabilize erosive streambanks. It may be an attractive compromise between complete exclusion of livestock from riparian areas and more traditional grazing systems, which historically been associated with water pollution and degradation of these environmentally sensitive areas.

The goals of this study are to evaluate two potential management options for riparian areas on livestock farms: ungrazed vegetative filter strips and rotationally grazed pasture, and compare them with riparian areas that are continuously grazed. We hope to identify rotational grazing management techniques which are likely to maintain suitable habitat for healthy aquatic and riparian wildlife communities while allowing use of riparian areas by the farmer.

The research is being conducted on spring-fed trout streams on 19 farms in Green, Dane, Iowa, Grant, Richland, Vernon, LaCrosse, Trempealeau, and Buffalo Counties in Wisconsin's 5 "driftless" areas. Study sites include 5 rotational farms, 5 continuously grazed riparian areas, 5 grassy buffer strips, and 4 buffer strips that have been allowed to grow up into trees. Buffer strips are bounded on both sides by cropland. The study focuses on five general areas of investigation:
1) fish and aquatic insect communities and habitat, 2) streambank stability and soil erosion, 3) forage production and grazing management, 4) riparian and streambank plant communities, and 5) inventory of wildlife communities inhabiting riparian areas.

We are evaluating fish communities using a technique called electroshocking, in which the fish are temporarily stunned by an electric current. They float to the surface where they can be netted, identified, measured, and returned to the water. Aquatic insects, which make up an important part of the diet of many fish species are also collected and identified. We will use information about the fish and insect populations of the streams to tell us about the overall health of the watershed. Stream bank slope, length, and sod cover were measured to determine the soil erosion potential of different management options. Forage production and vegetation structure have been monitored over the course of the grazing season. Forage samples were collected to determine yield and nutritional quality. Wildlife species groups being studied include birds, amphibians, and small mammals. Together, the data collected will give us a sense of how best to manage riparian areas to protect natural resources and promote health game and fish populations as well as allow profitable use of riparian pastures by farmers.

We have completed two seasons of a 2 to 3 year study. Preliminary first year data analysis suggests that fish and aquatic invertebrate communities respond to broad, watershed scale effects, whereas terrestrial wildlife are responding to local land use differences. Stream habitat quality was similar at rotational and grassy bufferstrip sites, but fish communities appeared to respond more positively to bufferstrips than to rotational grazing.

(Continued on page 7.)

Inside this Issue

New York and Michigan.....p.2

Ohio and Ontario.....p. 3

Wisconsin and the Basin.....p. 4

Farmer's Corner.....p. 5

Pastures are Clean and Green.....p. 6

(Continued from page 1.)

Continuous pastures had generally poor habitat quality and poor fish communities. Aquatic insect data analysis is incomplete, but at this stage, the biggest difference seen is between woody bufferstrips (best) and all grassy treatments. Terrestrial wildlife groups responded differently to the stream habitats. Amphibians were present in greater numbers at rotational and continuous pasture sites than at grassy bufferstrip sites. In contrast, small mammals appear to prefer grassy bufferstrips over either rotational or continuous pastures. Both rotational and continuous pastures supported more diverse bird communities than grassy bufferstrips. Riparian bird communities were more diverse than those of adjacent upland pastures. Further data collection is needed to clarify these differences.

Vegetation management created very different forage production, terrestrial habitat, and stream bank structure for the treatments. As expected, rotational pastures had greater forage availability and better forage quality than continuous pastures. Grassy bufferstrips had tall rank vegetation dominated by reed canarygrass. Few forbs or legumes were present, except within 10 feet of the stream. These sites tended to have the steepest bank slopes (due to channelization), but also the lowest level of bare ground on the bank slope. Rotational and continuous pastures had less steeply sloping banks, but more bare ground. Rotational pastures had better sod cover than continuous pasture on the stream banks, but not as good as bufferstrips. Compared to bufferstrips, both pasture types had more diverse plant communities which included grasses, legumes, and forbs (wild flowers).

All data reported in this summary is preliminary. Data for 1997 is in the process of being analyzed. A final report will be available after the completion of the study. For more information contact: Laura Paine, U.W. Agronomy Department, 1575 Linden Dr., Madison, WI 53706. E-mail: lkpaine@facstaff.wisc.edu or telephone 608-262-6203.

Appropriate Technology Transfer for Rural Areas (ATTRA)

ATTRA is a non-profit organization funded by USDA at the University of Arkansas, Fayetteville. Publications available of interest to graziers include, Sustainable Chicken Production, Meeting the Nutritional Needs of Ruminants on Pasture, Grass-Based and Seasonal Dairying and Rotational Grazing.

The publications are free. Copies can be obtained by contacting ATTRA at 1-800-346-9140.

(Continued from page 6.)

Groundwater Quality. Much more nitrate is lost in groundwater than in surface runoff. Most of this nitrogen movement to groundwater occurs during the winter months. During the summer months, the growing forage uses soil moisture and precipitation and little is available to move be low the root zone. In the winter months plants have very little growth and most water runs off or infiltrates. It is during this time that nitrogen moves through the root zone. In the third pasture system, with its fairly high rate of N fertilizer, the nitrate-N levels in the groundwater exceeded 10 ppm after five years. (Even higher levels were measured in the groundwater under the winter feeding area of the second pasture system described because over 300 lbs of N were brought in as hay.) With the change to a legume-grass mixture in the third pasture system, the nitrate-N levels in the groundwater dropped to less than 10 ppm in the winter rotational areas and to less than 3 ppm in the summer rotational areas. Using legumes rather than nitrogen fertilizer resulted in 30-80% reduction in nitrate losses by the second year, but the herd size was reduced from 35 to 25 cows to reflect a reduction in the amount of forage produced.

Conclusions and Recommendations. The results show that grazing systems on medium textured soils in this region, when well managed, produce surface runoff and groundwater of very acceptable quality. Unfertilized pastures often have better water quality than ungrazed woodlands. Fencing livestock from streams will reduce soil erosion on the stream banks as well as improving water quality. Nitrogen applications should not be made on saturated soils where runoff is likely to occur with the next rainfall event. Legumes should be the primary source of N for pastures with nitrogen applications restricted to strategic timing to overcome summer slump or stockpile in the autumn. Nitrogen application levels should be kept to 100 lbs per acre each year taking into account manure, purchased fertilizer, and legume contributions.

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1948 Yearbook of Agriculture

"Grass" was the title of the 1948 Yearbook of Agriculture published by the United Stated Department of Agriculture. It's subtitle was, "Grass in the Nation's Life." The entire book, almost 900 pages was devoted to all aspects of grassland agriculture.