Grazing Management Effects on Pathogen Loading of Midwestern Pasture Streams

J.R. Russell[1*], M.M. Haan[1], D.A. Bear[1], Y.-I. Cho[2], S.M. Ensley[2], K.-J. Yoon[2], N. A. Cornick[3]

Iowa State University Depts. of [1]Animal Science, [2]Veterinary Diagnostic and Production Animal Medicine, [3]Veterinary Microbiology and Preventive Medicine, Ames, IA

ABSTRACT

Loading of coliform bacteria in streams results from management practices that promote congregation of grazing cattle near pasture streams. The objective of this project is to quantify the effects of management practices that alter the distribution of beef cattle grazing in Midwestern pastures on loading of not only fecal coliforms, but also specific intestinal pathogens in streams. Water samples are being collected biweekly and after storm events from entry and exit sites of streams in 13 pastures on beef cow-calf farms in the Rathbun Lake watershed in southern Iowa and analyzed for fecal coliforms, *E. coli* O157:H7, bovine coronavirus, rotavirus, and enterovirus. Coliform and pathogen concentrations will be related to pasture characteristics, grazing management, and microclimatic data. To develop a model assessing risks of loading streams with pathogens from grazing cattle, the contributions of precipitation runoff and manure deposition to pathogen loading will be determined. Pathogen quantities in surface runoff from bimonthly rainfall simulations on bare and vegetated sites on stream banks will be measured in six pastures in the Willow Creek watershed in central Iowa grazed by rotational stocking or continuous stocking with full or restricted stream access. Temporal and spatial distribution of grazing cattle are being recorded with GPS collars in late spring, mid-summer, and early fall on five beef cow-calf farms in the Rathbun Lake watershed and monthly in the six pastures grazed in the Willow Creek watershed and related to their defecation patterns as affected by pasture characteristics, grazing management, and microclimatic data. The presence and concentrations of pathogens in feces are being measured from 90 cows and the amounts of feces excreted are being quantified with indigestible markers in 12 cows in the six pastures in the Willow Creek watershed.

IMPACT STATEMENT

Previous studies have suggested that manure deposition by grazing cattle in or near pasture streams results in loading of fecal coliform bacteria in surface water sources, indicating possible contamination with pathogenic intestinal bacteria and viruses. These problems are likely associated with poor grazing management and/or pasture conditions that promote frequent congregation of cattle in or near pasture streams. This project will quantify the effects of grazing management and/or pasture improvement practices that alter timing, frequency, duration and/or intensity of beef cattle grazing near pasture streams on the risk of pathogen loading of surface water sources in the Midwest.

INTRODUCTION

Livestock grazing has been shown to increase contamination of streams with fecal coliform and streptococcal bacteria in western rangelands and southern pastures. The presence of these bacteria may indicate the presence of other bacteria and viruses that are pathogens to livestock and/or humans.

Cattle grazing may cause pathogen loading of streams indirectly through its effects on the forage and soil or directly through manure deposition. Overgrazing, resulting from excessive stocking rates, or spot grazing, resulting from poor animal distribution across a pasture may increase pathogen loading in precipitation runoff associated with the loss of vegetation and increased soil compaction. While overland flow in pastures may contribute to pathogen loading during storm events, deposition of manure in or near streams pose a greater risk of intestinal pathogen loading.

ACKNOWLEDGEMENTS

This material is based upon work supported by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Award No. 2007-35102-18115. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view of the U.S. Department of Agriculture.

MATERIALS & METHODS

Rhodes Research Farm

Pastures

- Six 30-acre cool-season grass pastures
- Each bisected by a 642 foot stream segment
- Three grazing management treatments
  - Continuous stocking with unrestricted stream access (CSU)
  - Continuous stocking with stream access restricted to a 16-foot wide crushed rock crossing (CSR)
  - Five-paddock rotational stocking with one paddock in the riparian zone (RS)
    - 15 fall-calving Angus cows per pasture
    - Grazing mid-May through mid-October
    - Grazing treatments have been in use since the spring of 2005 and will continue through the duration of the study

Data collection

- Rainfall simulations
  - Simulator size: 1.0 x 0.5m^2 (Figure 1)
  - Simulation intensity: 7.1 cm·hr^{-1}
  - Simulation duration: 1.5 hours
  - 6 vegetated and 6 bare-ground sites along both stream banks in each pasture
  - 4 times per year (June, August, October, and the following April) in 2008 and 2009
  - Runoff samples analyzed for bacterial and viral content (see below)

Lake Rathbun Watershed

Pastures

- Thirteen pastures on twelve cooperating farms
- Pastures ranged in size from 7 to 265 acres with 948 to 5,511 feet streams reaches per pastures
- Streams drained watersheds of 624 to 13,986 acres

Data collection

- Producer Grazing Records
  - Number of cows, heifers, and bulls stocked in pastures
  - November, 2006 to November, 2007
- Water Sampling
  - May through November 2007 and March through November 2008 and 2009
  - Base flow samples collected twice per month upstream and down stream of each pasture
  - Storm flow samples collected following major storm event (one inch or greater rainfall in 24 hours) following a dry period (one month without a rainfall greater than one inch) upstream and down stream of each pasture
  - Samples stored on ice until analyzed.
- Water Analysis
  - Bacterial
    - Fecal Coliforms (Standard Methods for the Examination of Water and Wastewater, 9222A and 9225)
  - Viral (Reverse transcription-polymerase chain reaction techniques)
    - Bovine Corona Virus
    - Rotaviruses

Figure 1. Rainfall simulator.

RESULTS & DISCUSSION

Rhodes Research Farm

- Data collection will begin at the Rhodes site in the spring of 2008.
- Runoff and pathogen loads will be calculated on a weighted averages based on the proportion of vegetated and bare ground within each pasture.

Lake Rathbun Watershed

- Fecal coliforms concentrations in streams were generally low (<200 CFU/ 100 ml) during the 2007 sampling period with an occasional large spike in concentration across all sites (Figures 2 and 3).
- The majority of water samples were negative for viruses during the 2007 sampling period.
  - Four of the sites tested positive for Bovine Corona Virus at least one sampling period later in the season (September, October, November).

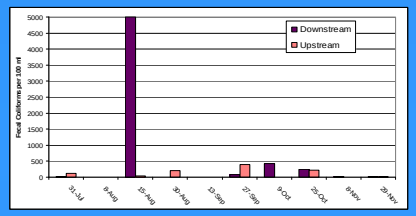

Figure 2. Fecal coliform concentrations in runoff from 1 of 13 sites during the 2007 grazing season.

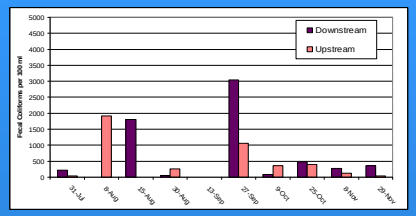

Figure 3. Fecal coliform concentrations in runoff from 1 of 13 sites during the 2007 grazing season.

For Additional information Contact:
Jim Russell
337 Kildee Hall
Ames, IA, 50011
515-294-4631
jrussell@iastate.edu