# Grazing Management of Beef Cows to Limit Non-point Source Pollution of Streams in Midwestern Pastures

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## Introduction

In 2006, the Iowa DNR identified 336 impaired water bodies in Iowa. The majority of these impairments are associated with elevated nutrient, sediment, or bacterial loads in streams and lakes. Poorly managed grazing of beef cattle in riparian areas may contribute to a reduction in quality of Midwest surface waters. However, research has shown that management practices that alter the timing, frequency, duration, and timing of grazing can reduce the impact of cattle on water sources.

If improperly managed, cattle grazing in riparian areas can result in two types of erosion within the stream channel. As cattle enter and leave a stream, mechanical breakdown of banks is caused by hoof action on the soil surface. Cattle grazing also removes vegetation from the soil surface leading to bank scour on vertical sides of the stream. Cattle may also reduce water quality by the deposition of nutrients and pathogens in their manure within or near streams.

Many concerns regarding livestock grazing are a result of uneven livestock distribution rather than inappropriate stocking rates. A variety of management practices have been proposed to alter cattle distribution patterns and reduce the associated damage to streams and riparian areas. Proposed practices have included exclusion of livestock grazing, alternative grazing schemes such as rotational stocking, management of riparian areas as special use paddocks, stabilized access sites, and off-stream salt and mineral supplementation and/or water sites.

## Rhodes Research Farm

Six 30-acre cool-season grass pastures, each bisected by a 642 foot stream segment, were grouped into 2 blocks and assigned one of three grazing management treatments. Treatments included: continuous stocking with unrestricted stream access (CSU), continuous stocking with stream access restricted to a 16-foot wide crossing (CSR), and 5-paddock rotational stocking with one paddock in the riparian zone (RS). Riparian paddocks in the RS treatment were stocked for a maximum of 4 days or until forage sward height decreased to a minimum of 4 inches. Each pasture was stocked with 15 fall-calving Angus cows from mid-May through mid-October in 2005, 2006, and 2007.

Cattle distribution patterns and behavior were monitored monthly throughout the grazing season by visual observation and GPS collars. Forage samples were clipped to determine forage mass and nutrient composition and the occurrence of bare ground and fecal cover were measured monthly. Stream bank erosion was measured monthly at 10 transects within each pasture.

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Cattle managed by CSU spent a greater proportion of their time in a pasture stream and within 110 feet of the stream than did cattle managed by either RS or CSR based on both GPS collar data and visual observations. But even in pastures with unrestricted stream access, cattle spent an average of 6.1% of their time within the stream.

In 2006, the presence of an off-stream water source decreased the proportion of time cattle spent within the stream by approximately half when cattle had unrestricted stream access. A similar effect was not observed in 2007, possibly because of differences in the presence of natural off-stream water sources associated with precipitation between the two years.

The proportion of bare ground along stream banks did not differ between grazing management treatments in most months. However, the proportions of bare ground within 110 feet of the stream in pastures with the CSU treatment were greater than the CSR or RS pastures in late summer of 2005 and 2006. Proportions of fecal-covered ground on stream banks in pastures with the CSU treatment were greater than CSR and RS pastures in mid-summer of each year. Forage masses within 110 feet of the stream in pastures with the CSR treatment were greater than the CSU pastures in late summer of each year.

No difference in net stream bank erosion has been observed between grazing management treatments in any year of the study.

**Lake Rathbun Watershed**

Thirteen pastures on twelve cooperating farms in the Rathbun Lake watershed were identified as appropriate for the project in the fall of 2006. Pastures ranged in size from 7 to 265 acres and had streams reaches of 948 to 5,511 feet that drained watersheds of 624 to 13,986 acres. Bi-monthly, from May through November, 2007, proportions of bare and manure-covered ground and the forage sward height and vegetation species were measured on both sides of the stream in each pasture. Streambank erosion was monitored on stream reaches in study pastures. Producers on cooperating farms record stocking rates in study pastures. On 5 cooperating farms 2 to 3 cattle were fitted with GPS collars to determine cattle distribution patterns three times throughout the 2007 grazing season.

The proportion of bare soil near the stream tended to increase as the proportion of reed canarygrass at vegetated sites decreased and the proportion of tall fescues at vegetated sites or the stocking rate increased. The proportion of manure- covered soil increased as the stocking rate and proportion of tall fescue at vegetated sites increased and the proportion of reed canarygrass at vegetated sites decreased.

Net stream bank erosion averaged 1.5 inches from November 2006 to September 2007 across the 13 study sites.

**Conclusions / Implications**

The proportion of time which cattle spend in or near pasture streams can be reduced by improved grazing management practices, such as, rotational stocking, improved access and crossing points, access to off-stream water sources, and placement of feed or mineral supplementation sites. By reducing the proportion of time cattle spend in or near stream the proportion of fecal covered and bare ground along and near stream banks can be reduced. However, following three years of grazing at the Rhodes Research Farm, no effect of grazing management has been observed on the amount of stream bank erosion.

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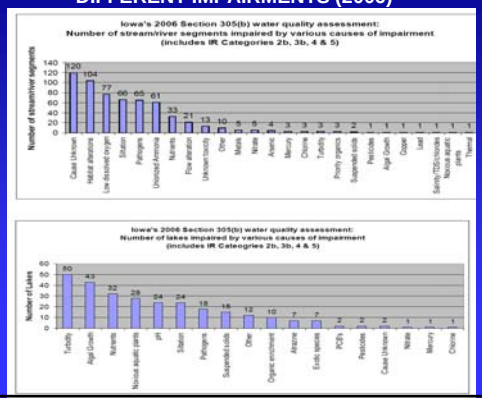
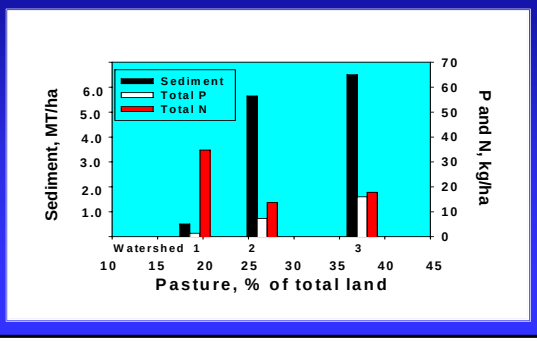
## IMPAIRED WATER SOURCES

- **Definition**
  - Any water source that can not meet the standards for its designated use for:
    - Drinking
    - Contact
    - Recreation
- **Extent**
  - 366 impaired water bodies in Iowa (2006)

## NUMBERS OF IOWA WATER SOURCES WITH DIFFERENT IMPAIRMENTS (2006)




## ANNUAL SEDIMENT, PHOSPHORUS, AND NITROGEN LOADING OF ROCK CREEK LAKE FROM TRIBUTARIES WITH DIFFERENT PROPORTIONS OF PASTURELAND (Downing et al., 2000)




## FACTORS CONTROLLING THE EFFECTS OF GRAZING ON WATER QUALITY

- Location of grazing
- Timing of grazing
- Intensity of grazing
- Length of grazing

## RHODES RESEARCH FARM

- 6 – 30 ac pastures
  - – Smooth Bromegrass
  - – Reed Canary grass
- 642 ft stream section bisected each pasture
- 15 Fall-calving Angus cows per pasture
  - – Mid-May to Mid-October
  - – 2005 (1428 lb) and 2006 (1271 lb)

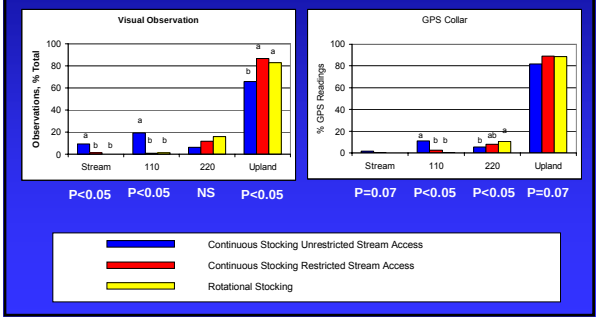
## STREAM CROSSING

Fall 2004

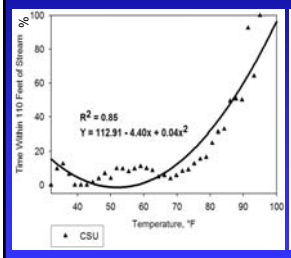
Fall 2006

Summer 2007

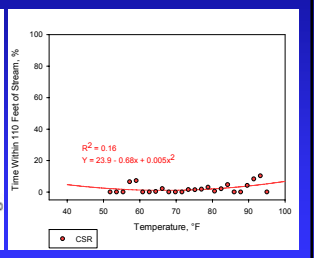
## MEAN CATTLE DISTRIBUTION WITH GPS COLLARS OR VISUAL OBSERVATION (2006)




## EFFECT OF TEMPERATURE ON THE TIME CATTLE SPEND WITHIN 110 FEET OF A PASTURE STREAM

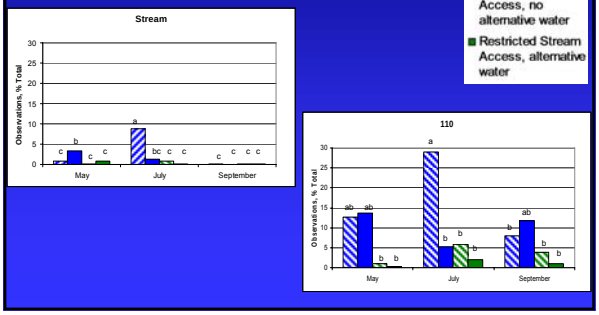



Continuous Stocking, Unrestricted Stream Access

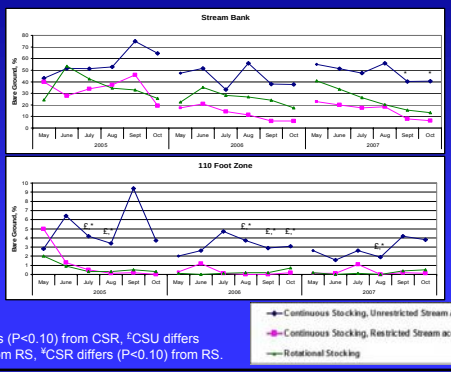



Continuous Stocking, Restricted Stream Access

## EFFECTS OF OFF-STREAM WATER SOURCES ON PROPORTION OF TIME CATTLE ARE IN OR WITHIN 110 FEET OF STREAM BY MONTH (GPS, 2006)

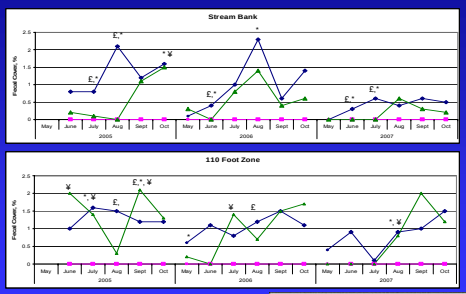



## PROPORTION OF BARE GROUND ON STREAM BANKS AND WITHIN 110 FEET OF STREAMS




*CSU Differs (P<0.10) from CSR, ᴱCSU differs (P<0.10) from RS, ᵡCSR differs (P<0.10) from RS.

## PROPORTION OF FECAL COVERED GROUND ON STREAM BANKS AND WITHIN 110 FEET OF STREAMS




*CSU Differs (P<0.10) from CSR, £CSU differs (P<0.10) from RS, ¥CSR differs (P<0.10) from RS.

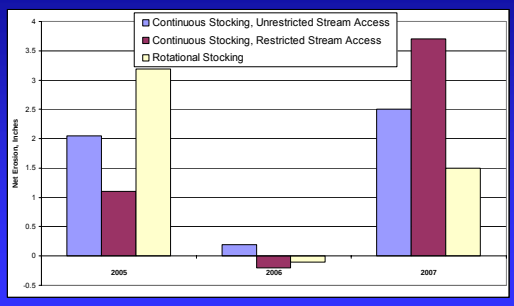
## STREAM BANK EROSION

Continuous Stocking, Restricted Stream Access

Rotational Stocking

Continuous Stocking, Unrestricted Stream Access

## STREAM BANK EROSION




**Negative values in 2006 indicate net deposition.**

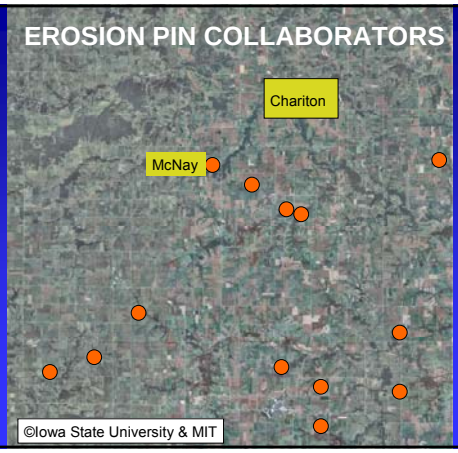
## LAKE RATHBUN WATERSHED

- To quantify the effects of pasture management on potential sediment and phosphorus loading of surface waters from stream bank erosion and manure deposition
- To evaluate the effects of botanical composition, grazing management, and climate on temporal and spatial distribution of cows

## STREAM BANK EROSION

- Erosion Pins on 13 sites
- Bare ground and fecal cover
  - 50' string with beads every 6''
  - Measure streams every 100' along bank
  - % Bare or Manure cover
  - Grass Characteristics, Sward Height

## EROSION PIN COLLABORATORS



## EROSION PINS IN THE FIELD

## WATER SAMPLING / PATHOGEN STUDY

- Collecting Water Samples at 13 sites
- Pathogens in Stream?
- Collecting every 2 wks
- Two samples: Upstream & Downstream
- Analyzed for viruses and bacteria by ISU Veterinary Diagnostics Lab
  - BVD, Coronovirus, e coli HO157, Fecal Coliforms

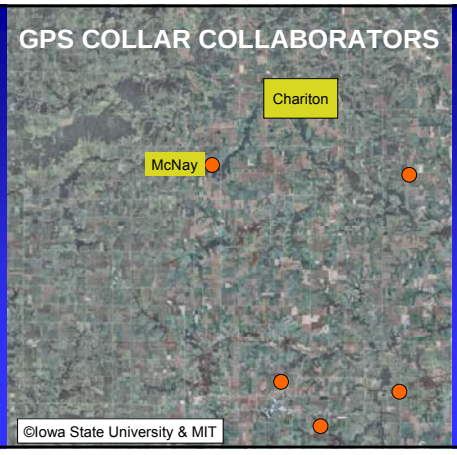
## CATTLE DISTRIBUTION: MATERIALS AND METHODS

- 5 Collaborators
- Outer Boundaries – GPS
- Grid and Field Lines
- Grass Characteristics in squares
  - Center and 4 other recordings
  - F, RC, BR, BG, OG, W
- Riparian Shade
- **What factors influence cattle distribution?**

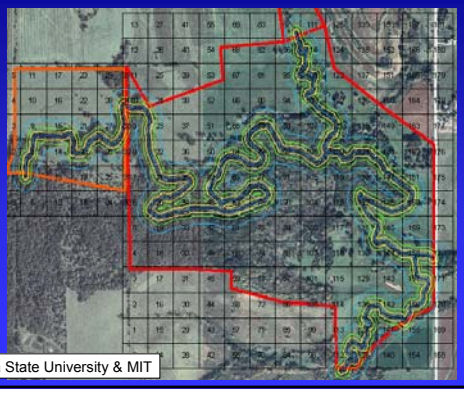
## GRASS CHARACTERISTICS

- Tall Fescue
- Reed Canary
- Bromegrass
- Bluegrass
- Orchard Grass
- Weeds

## GPS COLLAR COLLABORATORS



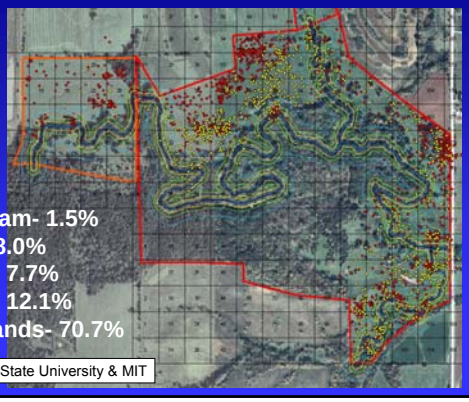

## MCNAY RESEARCH FARM



## GPS COLLARS

- 5 Collaborating Farms
- 2 – 3 Collars / site
- Records intervals of 10 mins.
- On 2 weeks
- Spring, Summer, Fall seasons

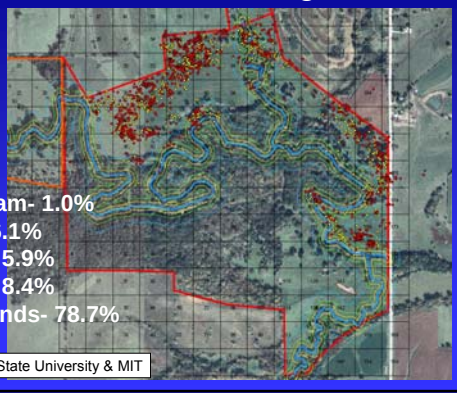
## MCNAY FARM – MAY 2007



**Stream- 1.5%**
**50- 8.0%**
**100- 7.7%**
**200- 12.1%**
**Uplands- 70.7%**



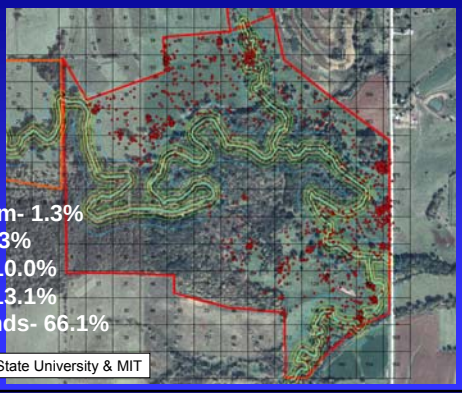
## MCNAY FARM – August 2007



**Stream- 1.0%**
**50- 6.1%**
**100- 5.9%**
**200- 8.4%**
**Uplands- 78.7%**



## MCNAY FARM – October 2007



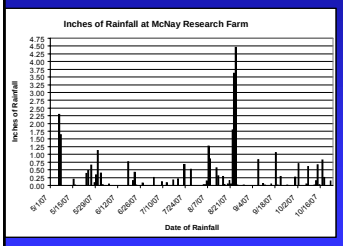
**Stream- 1.3%**
**50- 9.3%**
**100- 10.0%**
**200- 13.1%**
**Uplands- 66.1%**



## WEATHER STATIONS

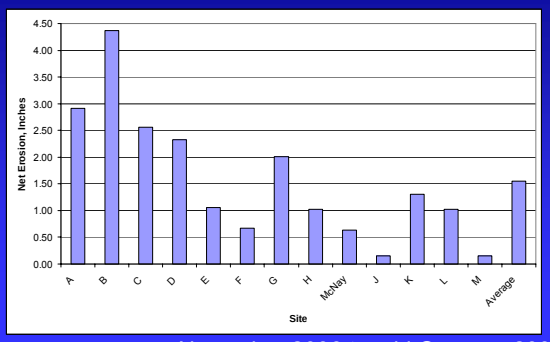
- Rainfall
- Temperature - °C & °F
- Dew Point
- Relative Humidity
- Wind Speed and Direction
- Blackglobe Temp
- Heat Loss Index

## MCNAY RAINFALL



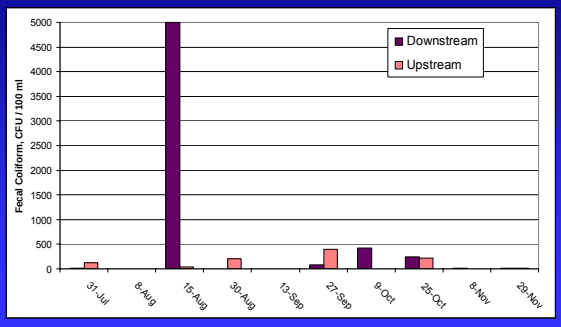

| | Rainfall, inches |
|---|---|
| May | 7.25 |
| June | 1.90 |
| July | 2.06 |
| August | 13.68 |
| September | 2.60 |
| October | 3.44 |

## STREAM BANK EROSION




November 2006 to mid-Summer 2007

## FECAL COLIFORM




2000 – 2006 75% of stream water samples had ≤ 380 *E. Coli* per 100 ml.
Water Fact Sheet 2007-8. 2007. Iowa's Water Ambient Monitoring Program. Iowa DNR

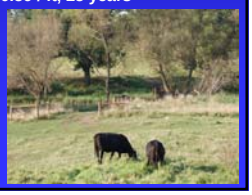
## EFFECTS OF GRAZING MANAGEMENT AND OFF-STREAM WATER ON P EXCRETION IN OR WITHIN 110 FEET OF A PASTURE STREAM

| Grazing System | Off-Stream Water | P Excretion, g·cow$^{-1}$·d$^{-1}$ | | |
|---|---|---|---|---|
| | | Total | In Stream | 110 Foot Zone |
| Continuous Unrestricted[b] | - | 50.9 | 1.6 | 8.4 |
| Continuous Restricted[b] | - | 51.4 | 0.2 | 1.9 |
| Continuous Unrestricted[b] | + | 50.9 | 0.8 | 5.2 |
| Continuous Restricted[b] | + | 51.4 | 0.1 | 0.6 |
| Rotational[c] | + | 43.9 | -- | 2.5 |

[a]Pregnant fall-calving cows receiving no P supplementation.
[b]Calculated with proportion of time using GPS collars.
[c]Calculated with proportion of days in riparian paddock.

## COSTS OF MANAGEMENT TO ALTER COW DISTRIBUTION IN PASTURES

- Stream crossings
  - Installation - $4,347 + Labor for 16' x 80'
  - Longevity???
- Off-stream water
  - Pipe, Water Tanks, Installation, Hydrants - $2.30 / ft
- Fencing
  - High-tensile, 5 strands, electric - $0.70 / ft, 25 years
  - High-tensile, 2 strands, electric – $0.59 / ft, 25 years



## CONCLUSIONS

- Research at the Rhodes Research Farm shows:
  - Cattle distribution in or near streams can be reduced through improved grazing management.
    - Rotational stocking
    - Improved access and crossing points
    - Off-stream water sources
    - Placement of feed or mineral supplementation sites
    - and, possibly, alterations in shade
- Effects of these practices on farms in the Rathbun Lake watershed
  - ???????
- Effects of grazing management on stream bank erosion and pathogens
  - ???????



## QUESTIONS???

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• Leopold Center for Sustainable Agriculture

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