2015

Enhancing botanical composition, wildlife habitat and carbon sequestration of pastures in south central Iowa through soil disturbance by mob grazing of beef cattle

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

Harris J. Sellers
Iowa State University, sellers@iastate.edu

Stephen Barnhart
Iowa State University, sbarnhar@iastate.edu

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

Helga Offenburger
Iowa Department of Natural Resources

Enhancing botanical composition, wildlife habitat and carbon sequestration of pastures in south central Iowa through soil disturbance by mob grazing of beef cattle

Abstract
As Iowa pastures continue to be dominated by cool-season grass species, strategic integration of a single mob-grazing event into pasture management offers a tool to simultaneously increase productivity of pastures and to improve grassland wildlife habitat through increased biodiversity. However, the success of the maneuver depends on climate, soil and landscape.

Keywords
Animal Science, Animal management and forage, Soils and agronomy, Wildlife and recreation

Disciplines
Agronomy and Crop Sciences | Meat Science | Natural Resources and Conservation | Soil Science

LEOPOLD CENTER
FOR SUSTAINABLE AGRICULTURE

Enhancing botanical composition, wildlife habitat, and carbon sequestration of pastures in south central Iowa through soil disturbance by mob grazing of beef cattle

Abstract: As Iowa pastures continue to be dominated by cool-season grass species, strategic integration of a single mob-grazing event into pasture management offers a tool to simultaneously increase productivity of pastures and to improve grassland wildlife habitat through increased biodiversity. However, the success of the maneuver depends on climate, soil and landscape.

Principal Investigator:

James Russell
Animal Science

Co-investigators:
Harris J. Sellers
ISU Extension
Chariton, IA

Stephen Barnhart
Agronomy

Daniel Morrical
Animal Science
Iowa State University

Helga Offenburger
Iowa Department of Natural Resources--Private Lands
Chariton, IA

Budget:
$47,697 for year one
$48,362 for year two
$49,854 for year three

Q Can strategic short-term use of mob grazing be used to enhance ecological services from pastures or ungrazed grass lands?

ECOLOGY

A A single-mob grazing event significantly enhanced the botanical composition of either a pasture for grazing or ungrazed grassland for wildlife habitat. However, these responses were largely affected by soil moisture and land use history of the location as mob grazing was more effective at altering the botanical composition under high soil moisture levels on soils that did not have a history of cultivation.

Background

The low biodiversity of grasslands in south central Iowa results in low productivity for grazing livestock and loss of ecological services such as wildlife habitat, carbon sequestration and maintenance of water quality. The lack of plant diversity likely results from selective grazing in pastures and not enough disturbance in the plant community in non-grazed grasslands. However, the addition of grazing at high stocking densities for short durations may reduce the competition from dominant cool-season grasses and allow establishment of less competitive plants such as legumes and annual species. Increasing diversity of plant communities has the potential to increase the productivity and nutritional value of grasslands for livestock production, increase carbon sequestration and enhance wildlife habitat particularly for ground-nesting birds.

The addition of grazing to grasslands not currently grazed (lands enrolled in government contracts such as the Conservation Reserve Program or purchased for recreational activities) would increase the land available to cattle producers for grazing. This would allow cattle producers to better manage their own pastures. Although disturbance of plant communities to enhance plant community diversity may provide many benefits, high stocking densities may negatively impact soil physical characteristics.

The objectives of this project are to:

- Evaluate the effectiveness of the strategic use of mob-grazing to improve the botanical composition of the forage for grazing cattle, wildlife habitat, carbon sequestration and water infiltration in pastures in south central Iowa.
- Quantify the effects of stocking density as affected by the frequency of movement of mob-grazing and subsequent management on the botanical composition, wildlife habitat, carbon sequestration and water infiltration in pastures in south central Iowa.

Cows grazing by rotational stocking paddocks two years after early-spring mob stocking. (Photo by Justin Bisinger.)

Approach and methods

To determine the effects of grazing at the high or moderate stocking densities on plant community and soil characteristics, two pre-existing south-central Iowa sites of mixed cool-season grass and legume pastures; one without (site 1; S1) and one with (site 2; S2) warm-season grasses were each divided into three pastures with five paddocks/pastures. Within each pasture, five treatments were randomly assigned to separate paddocks in each pasture:

1. Grazing exclusion (NG),
2. Mob grazing once at a high stocking density for short durations (10 cattle moved four times daily; 440,000 lbs/acre)
    - o without subsequent rotational grazing (HD), or
    - o with subsequent rotational (HDR), or
3. Mob grazing once at a moderate stocking density for moderate durations (10 cattle moved once daily; 110,000 lbs/acre)
    - o without subsequent rotational stocking (MD), or
    - o with subsequent rotational stocking (MDR).

The initial mob grazing event, at high and moderate stocking density, began in May 2011 at S1. Grazing start didn't start at S2 until May 2012 due to delays in processing a request to graze grasslands enrolled in the Conservation Reserve Program (CRP).

Rainfall during the initial grazing events at S1 averaged 0.26 in. per day (relatively high) while rainfall during initial grazing events at S2 was only 0.06 in. per day (relatively low). Subsequent rotational stocking in HDR and MDR treatments occurred at 35-day intervals beginning 60 days following initial mob grazing in the first year at each site. It continued May through October at S1 (two years) and S2 (one year).

Yearly measurements included: plant community composition and forage; *in vitro* dry matter disappearance; crude protein concentration; soil penetration resistance, bulk density, organic carbon, and water infiltration rates. Vegetation structure for wildlife habitat was determined annually as the average height with 50 percent visual obstruction in the NG, HD and MD treatments.

To simulate grasslands maintained in a deferred grazing system for wildlife habitat, one HD and one MD paddock in each pasture were not grazed (in year 3 at S1 and year 2 at S2). Additionally, a 10-acre demonstration site focused on use of mob grazing to develop a home range for bobwhite quail was established on an adjacent farm of a cooperating cow-calf producer. Three 3.3 acre paddocks were used with a three-year deferred stocking rotation (in each of the three years, stocking in only one of the three paddocks). Stocking density was 24,000 lbs#/acre to achieve estimated dry matter intake of 2 percent of body weight. Botanical composition, bare ground and vertical forage (visual obstruction) were measured.

Results and discussion

Following initial mob grazing at either stocking density in May 2011 at S1, there was a reduction in the proportion of cool-season grass species through July 2012 compared to NG paddocks. Successively, in paddocks grazed at either density, there were increases in the proportions of annual grass species in July 2011, dead forage in

Strips in a paddock two years after mob-stocking under high precipitation. (Photo by Justin Bisinger.)

October 2011, and legume species in May and July 2012 compared to the NG paddocks. However, apparently as a result of drought, there were no differences in the proportions of cool-season grass species, annual grass species or legumes after July 2012.

For both sites (S1 and S2) over the three years, forage crude protein and *in vitro* digestible dry matter concentrations were greater in the HDR and MDR paddocks in comparison to NG, HD and MD paddocks in all years and months with the greatest differences occurring after July 2012. While a single mob grazing event at a high or moderate stocking density increased the percentage of bare ground, the proportions of bare ground did not approach the levels hazardous to water quality, but also did not achieve the 25 to 50 percent desired for nesting areas for bobwhite quail. Following grazing at the high or moderate stocking densities, the average vegetation height with 50 percent visual obstruction over all months and years was greater in the NG treatment than the HD and MD treatments. However, following July 2011, the average height with 50 percent visual obstruction in the NG treatment was similar or less than the HD and MD treatments and above the minimum levels recommended for bobwhite quail habitat.

At site S1 over all years and months, there were no differences in soil penetration resistance to a depth of 6 in. or soil bulk density to a depth of 3 in. between the NG and HD treatments. But at a depth of 3.9 in., penetration resistance was greater in the HDR, MD and MDR treatments compared to the NG treatment. Similarly, bulk density was greater in the HDR, MD, and MDR treatments than the NG treatment. Water infiltration rates were greater in the NG, HD, and MD treatments than the HDR and MDR treatments. Yearly and monthly variation may have led to the lack of differences in the concentration or content of soil organic carbon.

In contrast to S1, a single S2 mob grazing event at either a high or moderate stocking density did not affect botanical composition, bare ground, or visual obstruction of the plant community or penetration resistance, bulk density, soil organic carbon or water infiltration rate of the soil. The lack of differences between treatments at S2 is likely the result of dry soil conditions when the treatments were begun. In S2 paddocks, subsequent rotational stocking decreased the proportion of warm-season grass species and increased soil penetration resistance at a depth of 3 in. in comparison to paddocks with or without an initial grazing event without subsequent rotational stocking.

Conclusions

While the central hypothesis of this project was that strategic utilization of ‘targeted’ mob-grazing would be practical for attaining specific production or ecological objectives, the results are mixed. If soil moisture is adequate, a single mob grazing event in an established cool-season pasture at either a high stocking density with movement four times per day or a moderate stocking density with movement once daily will initiate succession of species in the plant community, which are desirable for both grazing livestock and wildlife species. However, only the high stocking density with frequent movement generated changes in the plant community with minimal effects on soil physical properties. At low soil moistures, a single mob grazing event (even at a high stocking density) had minimal effects on the plant community composition or soil physical properties in established grasslands.

Additionally, rotational stocking after initial mob grazing did not maintain improvements in botanical composition. However, it did increase bare ground and compaction and reduced water infiltration. These results indicate that 50 percent forage removal does not eliminate the risk for negative impacts on soil physical properties from grazing. Furthermore, weather conditions and grazing management in ensuing years will influence the repetition of treatments to maintain desirable characteristics.

Results on the cooperator's demonstration farm site followed those observed at the research site. While all of the forage was removed by short-term mob stocking of the paddocks under conditions of relatively low precipitation in years 1 and 3, there was little soil disturbance or change in the botanical composition in these paddocks. However, as a result of mob stocking under conditions of high precipitation in year 2, there was greater proportions of legume forage species and more bare ground which is desirable in bobwhite quail habitat.

Impact of results

As dominance of cool-season grass species continues in Iowa pastures, strategic integration of a single mob-grazing event into pasture management provides a tool to increase both the productivity (forage quality) of pastures and the suitability of pastures for wildlife habitat (specifically bobwhite quail) through increased biodiversity and without decreasing soil water infiltration or compaction. Strategic use of a single mob-grazing event on grasslands in governmental contracts and/or used for recreational activities provides the opportunity to improve the wildlife habitat of grassland landscapes while also providing grazing lands.

While a single mob-grazing event can increase the biodiversity of grassland plant communities, it is important to note that the value of this management tool is dependent on climatic, soil and landscape conditions. To optimize the use of mob-grazing on ecological services, flexibility in the use and integration of this management practice with other practices is desirable. If soil conditions are dry either during or after the grazing treatment, mob-grazing may need to be repeated more frequently than if implemented at high soil moisture levels. Also, to maximize the effects of mob-grazing on the plant community, appropriate soil pH control and fertilization is necessary. In order to graze grasslands in government contracts or used for recreational activities, issues regarding the rules for grazing land in government contracts, rental payments, the length of agreements, and responsibilities for fencing and water sources need to be considered and included in grazing contracts.

Education and outreach

Refereed Journal Manuscripts:

Russell, J.R. and J.J. Bisinger. 2015. *Forages and Pastures Symposium*: Improving soil health and productivity on marginal lands using managed grazing of livestock

Abstracts:

Russell, J.R. and J.J. Bisinger. 2014. Improving soil health and productivity on marginal lands using managed grazing of livestock. *J. Anim. Sci.* 92 (E-Supplement 2):155.

Bisinger, J.J. and J.R. Russell. 2014. Stocking density effects in short duration grazing systems on botanical composition and soil characteristics of grasslands. *J. Anim. Sci.* 92 (E-Supplement 2):158.
Bisinger, J.J. and J.R. Russell. 2013. Enhancing botanical composition, wildlife habitat, and carbon sequestration of pastures in Southcentral Iowa through soil disturbance by mob-grazing of beef cattle. *Proceedings and Abstracts: 2013 Annual Conference of the American Forage and Grassland Council.* Covington, KY, CD-ROM
Bisinger, J.J. and J.R. Russell. 2013. Enhancing habitat for ground nesting birds in Midwest grasslands through soil disturbance and initiation of plant community succession by high density grazing of beef cattle. America's Grassland Conference, August. Manhattan, KS

Extension publications:

2013, 2014 and 2015 Animal Industry Reports, Iowa State University

Workshop and Field Day Presentations:

Russell, J.R. 2014. Mob-grazing as a tool for grassland management. University of Missouri Extension In-service Training. University of Missouri, Columbia (~60 attendance; state and area Extension specialists)
Russell, J.R. 2013. Mob-grazing as a tool for grassland management. Missouri Forage and Grasslands Council/Grazing Lands Conservation Initiative. Lake of the Ozarks, MO (~80 attendance; NRCS personnel and farmers)
Russell, J.R. and J.J. Bisinger. 2013. Iowa State University Beef Nutrition Showcase. Iowa State University, Ames (~80 attendance; Extension specialists and farmers)
Russell, J.R. and J.J. Bisinger. 2013. Use of mob-grazing for wildlife habitat. CRP Grazing Pasture Walk. McNay Research Farm, Chariton, IA (~15 attendance; governmental and nongovernmental organization personnel)
Bisinger, J.J. 2013. Enhancing botanical composition, wildlife habitat, and carbon sequestration of ecosystems through soil disturbance by spring mob-grazing of beef cattle. Iowa Grazing Conference, Creston, IA (~60 attendance; Extension specialists and farmers)
Russell, J.R. and J.J. Bisinger. 2012. Potential of mob grazing for pasture management. Southern SARE Forage Webinar. Lexington, KY (~50 attendance; research and Extension faculty)
Russell, J.R. 2012. Strategic use of mob-grazing to improve botanical composition and wildlife habitat in pastures in south central Iowa. McNay Research Farm Field Day. Chariton, IA (~60 attendance; Extension specialists and farmers)

For more information, contact :
James Russell, 313 Kildee Hall, Iowa State University, Ames, Iowa 50011; (515) 294-4631, e-mail jrussell@iastate.edu

Leveraged funds

No additional funds have been leveraged from this project.