Enhancing Botanical Composition and Wildlife Habitat of Pastures in South Central Iowa through Soil Disturbance by Mob-grazing of Beef Cattle

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Summary and Implications

South central Iowa grasslands are dominated by cool season grass species with low productivity and plant species diversity which limits the forage for grazing animals and habitat for native grassland wildlife. Strategic spring mob-grazing may reduce competition from cool-season grass species allowing legumes, early successional species, and native plants to establish while improving soil characteristics. Two blocks of three replicated pastures were divided into 5 equal-sized paddocks to determine the effects of early spring mob-grazing on pasture forage and soil characteristics. In each pasture, one paddock was not grazed (U) and 4 were strip- (S; moved once per day with a back fence) or mob- (M; moved 4 times per day with a back fence) grazed beginning in May of 2011 (BL1) and 2012 (BL2) by 10 cows at a live forage DM allowance of 2% BW/d. Subsequently, one mob (MR) and strip (SR) paddock in each pasture was rotationally stocked to remove 50% of the live forage with 35-d rest periods beginning 60 d after spring grazing in yr 1 of each block. Measurements included water infiltration determined with double ring infiltrometers, soil penetration resistance determined with a penetrometer, pasture botanical composition determined by the line transect method, and ground nesting bird habitat measured as visual obstruction to a 3.3x 3.3 ft board by image analysis of digital photos. In BL1, there were no significant differences in water infiltration or penetration resistance between treatments in 2011. The proportions of annual grasses and bare ground were greater ($P< 0.05$) in grazed than U paddocks in July 2011. In 2012, the proportions of legumes were greater ($P< 0.05$) in M and SR paddocks in May and in M, S, and SR paddocks in July than U paddocks. In BL2, proportions of annual grasses in M and S paddocks and bare ground in MR, S, and SR paddocks were greater ($P< 0.05$) than U paddocks in July 2012. In 2011, visual obstruction to 1 m was greater ($P< 0.05$) in U than grazed paddocks of BL1 in July. However, in October, visual obstruction did not differ between S and U paddocks to 19.7 in. and was greater ($P< 0.05$) in S and M than SR and MR paddocks to a height of 15.7 in.

Introduction

Overgrazing from continuous stocking of pastures in southern Iowa allows cool season grasses like tall fescue to dominate other forage species and decrease the persistence of legumes. Even with nitrogen inputs, the production and nutritional value of these pastures are limited due to overgrazing, resulting in reduced vegetative cover and increased soil erosion in precipitation runoff. Furthermore, the low productivity of overgrazed pastures provides little incentive to deter producers from converting pastureland into cropland or selling it for recreational uses like hunting, upon which cattle are viewed as a nuisance and removed. Without grazing in grasslands, tree cover increases and cool season grasses become dominant resulting in poor habitat for some wildlife species including Bob White Quail. However the productivity and nutritional value of forage in pasture systems, as well as the habitat and food supply for native wildlife in grassland ecosystems may be altered through improved grazing management and innovative partnerships between cattle producers and recreational land owners.

Increasing plant diversity in cool-season grass pastures and grassland ecosystems with legumes and other plant species can increase seasonal productivity, resilience to weather disruptions, and wildlife habitat. Increasing the percentage of legumes with nitrogen fixing bacteria and higher protein concentrations improves productivity and forage quality for grazing livestock. Increasing plant species diversity in grassland ecosystems increases feed for wildlife such as forbs for whitetail deer, insects associated with forbs for wild turkeys, and seeds of annual forbs and grasses for bobwhite quail. However, competition from cool season grasses limits the establishment and persistence of legume and other less competitive plant species essential for improving pasture production and quality as well as establishing improved wildlife feed and habitat. In previous studies, moderate stocking for a short time in late May was successfully used to assist in establishment of red clover through reduction in competition from cool-season grasses.

Strategic grazing at high stocking densities for short periods of time followed by long rest periods, known as mob-grazing, may assist in establishing more diverse plant communities while providing other environmental benefits. An increase in plant species diversity, specifically legumes may improve the quality of established pastureland. Furthermore the improvement of wildlife habitat associated with mob-grazing could increase potential grazing land for cow/calf producers through alliances between cow/calf producers and landowners wanting to improve or establish wildlife habitat. Increased plant diversity and trampled mature forage increases root mass and soil organic matter which may increase soil carbon sequestration, resilience to environmental stress, and water infiltration rates decreasing soil erosion in pastures. Because of the potential benefits of mob-grazing, it was introduced in the western U.S. However, its proponents utilize a large range of stocking densities and frequency of animal movement. Optimum mob-grazing stocking densities and frequency of animal movement will likely vary with site, time, and management objectives. The objective of this study is to evaluate the effectiveness of strategic spring mob-grazing to improve botanical composition of forage for grazing, wildlife habitat, and soil quality under the soil and climatic conditions prevalent in south central Iowa.

Materials and Methods

Two blocks of three replicated pastures predominated with cool season grasses (BL1), and warm season grasses (BL2) were divided into 5 equal-sized paddocks (BL1, 1 acre; BL2, 0.5 acre) to determine the effects of early spring mob-grazing on grassland plant species diversity and soil characteristics. In each pasture, one paddock was not grazed (U) and 4 were strip (S; moved once per day with a back fence) or mob (M; moved 4 times per day with a back fence) grazed beginning in May of 2011 (BL1) and 2012 (BL2) by 10 August-calving cows (mean body weight; BL1 and BL2, 1291 and 1416 lb) at a live forage allowance of 2% BW/d. Subsequently, one mob (MR) and strip (SR) paddock in each pasture was rotationally stocked with 35-d rest periods beginning 60 d after spring mob-grazing in the first year of each block and beginning in May of the subsequent year. When grazing by rotational stocking, cattle were stocked to remove 50% of the live forage measured with a falling plate meter (8.8 lb/yd^2).

The dominant plant species or vegetative cover including annual grasses, perennial cool and warm season grasses, legumes, broadleaf weeds, dead plant residue, and bare soil were identified at 100 equally spaced sites on a 50 ft string and counted to quantify plant diversity and vegetative cover at 10 sites per paddock in May, July, and October. The number of sites with annual grasses, perennial cool and warm season grasses, and broadleaf weeds were summed as the number of sites with live forage and each proportion of sites with each plant class was expressed as a percentage of sites with live forage. Water infiltration was determined at three randomly selected sites in each pasture in May and October by adding to double ring infiltrometers to maintain a ponding depth between 2 and 1 inches over 90 minutes. Water infiltration was calculated as the average of the amount and time of the last three additions of water to the infiltrometers. Compaction was determined to a depth of 6 inches with a field scout SC 900 penetrometer with a 0.5 inch diameter cone tip at 10 sites in each pasture in May and October. Ground nesting bird habitat was measured as visual obstruction in digital photos taken of a 3.3x3.3 ft board at a distance of 13.2 ft and height of 3.3 ft in July and October. Digital photos were cropped and visual obstruction determined at 10 cm intervals marked on the visual obstruction board with Sigma Scan Pro 5. Data were analyzed by month with the MIXED procedure of SAS within BL1 and BL2. Differences between means with significant treatment effects were determined by the PDIFF procedure of SAS.

Results and Discussion

Average year 1 stocking densities for mob- and strip-grazed paddocks were 530,000 and 147,000 lbs/acre in BL1 and 470,000 and 108,000 lbs/acre in BL2, respectively. In comparison to U paddocks, grazed paddocks in BL1 had greater ($P<0.05$) proportions of annual grasses in the live forage (fig. 1) in July and greater ($P<0.05$) proportion of dead plant residue and bare ground (fig. 2) in October. As a result of increased annual grasses, bare ground, and plant residue in grazed paddocks, proportions of cool-season grasses (fig. 3) were lower ($P < 0.05$) in grazed paddocks than U paddocks in July and M paddocks in October in 2011, and were still lower in grazed paddocks in May and M, S, and SR paddocks in July of 2012. The proportion of bare ground in MR and SR paddocks (fig. 2) remained greater ($P < 0.05$) than U paddocks in May 2012, and in MR than U paddocks in July 2012. Proportions of legumes (fig. 4) were greater ($P < 0.05$) in M and SR paddocks than U paddocks in May and in M, S, and SR paddocks than U paddocks in July likely as a result of increased bare ground from mob-grazing the previous spring.

Similar to BL1, proportions of annual grasses in BL2 (fig. 5) in M and S paddocks and bare ground (fig. 6) in MR, S, and SR paddocks were greater ($P < 0.05$) than U paddocks in July 2012. However unlike BL1, there was established population of annual grasses in BL 2 in May. While no difference in cool season grasses between grazed and U paddocks in BL2, the proportion of sedge (fig. 7) in grazed paddocks was lower ($P<0.05$) in U paddocks in July. This reduction possibly resulted from decreased rainfall which decreased the impact of hoof action on the soil surface and increased stress on sedge populations on top of grazing pressure. Average daily precipitation during mob and strip grazing in BL1 in 2011 and BL2 in 2012 were 0.55 and 0.05 in., respectively.

In July 2011, visual obstruction to 3.3ft (fig. 8) was greater ($P < 0.05$) in U than grazed paddocks of BL1. However, in October, visual obstruction did not differ between S and U paddocks to a height of 19.7 in. likely resulting from regrowth in the S paddocks with no subsequent grazing. As a result of rotational grazing, visual obstruction was greater ($P < 0.05$) in S than M, SR, and MR paddocks to a height of 15.7 in. In BL1, there were no significant differences in water infiltration or penetration resistance between treatments in 2011.

Conclusion

This study indicates mob-grazing can be used to increase pasture forage quality and wildlife habitat, specifically for bobwhite quail, without decreasing soil water infiltration or compaction. Spring mob-grazing decreased competition from cool season grasses and increased the proportion of legumes such as trefoil and red clover which increase pasture quality. Mob-grazing would be beneficial to Bob White Quail and other bird populations in Iowa because of the increase in annual grasses and bare ground which allows young birds to travel to feed sources such as annual grasses. Bare ground was most persistent in mob-grazed paddocks followed by rotational grazing; however, use of rotational grazing decreased cover for wildlife and ground nesting birds. Following mob-grazing with rotational grazing allows greater use of available forage nonetheless it may decrease wildlife habitat and without proper management increase the loss of nutrients through soil erosion. Further analysis on the impact of soil moisture on the change in plant species and pasture characteristics is needed to determine environmental conditions most likely to produce the desired change in plant species and pasture characteristics desired following spring mob-grazing.

Acknowlegements

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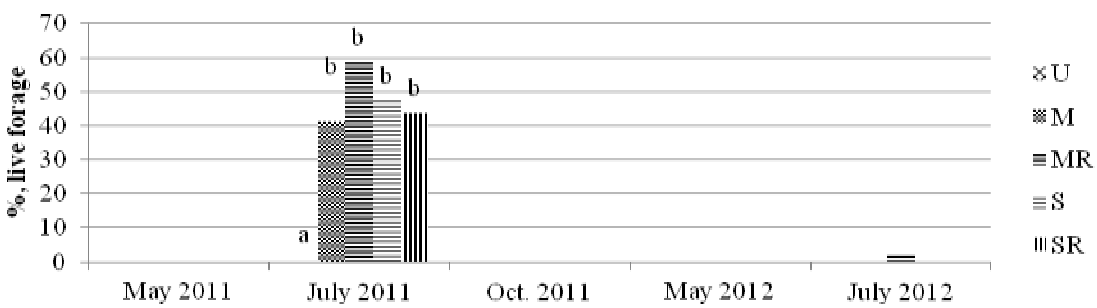
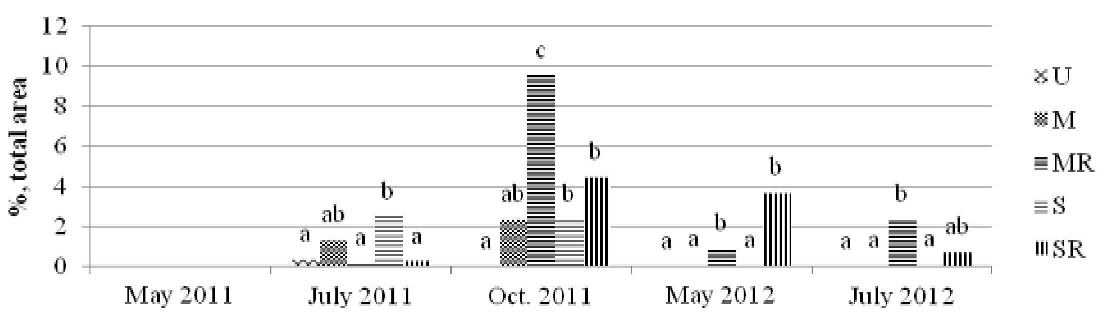
Figure 1. The Effects of Strip or Mob-grazing with or without Subsequent Rotational Grazing on the Proportion of Annual Grasses as a Percentage of Total Live Forage in BL1 paddocks not grazed (U), Mob-grazed (M), Mob-grazed with 60 Days Rest Followed by Rotational Grazing (MR), Strip-grazed (S), Strip-grazed with 60 Days Rest Followed by Rotational Grazing (SR).



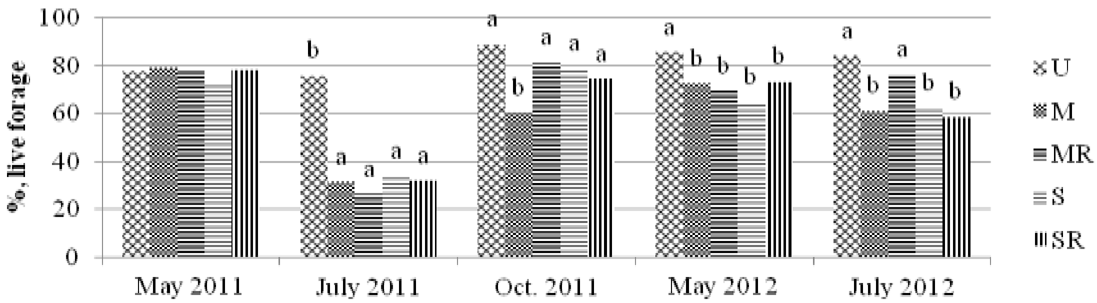
[a-b] Differences between treatment (U, M, MR, S, SR) means within month with different superscripts are significant (P<0.05)

Figure 2. The Effects of Strip or Mob-grazing with or without Subsequent Rotational Grazing on the Proportion of Bare Ground as a Percentage of Total Pasture Area in BL1 paddocks not grazed (U), Mob-grazed (M), Mob-grazed with 60 Days Rest Followed by Rotational Grazing (MR), Strip-grazed (S), Strip-grazed with 60 Days Rest Followed by Rotational Grazing (SR).



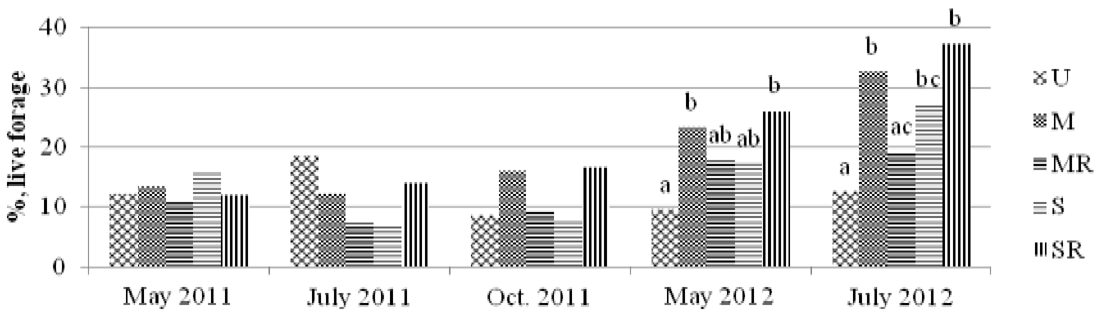
[a-c] Differences between treatment (U, M, MR, S, SR) means within month with different superscripts are significant (P<0.05)

Figure 3. The Effects of Strip or Mob-grazing with or without Subsequent Rotational Grazing on the Proportion of Cool Season Grasses as a Percentage of Total Live Forage in BL1 paddocks not grazed (U), Mob-grazed (M), Mob-grazed with 60 Days Rest Followed by Rotational Grazing (MR), Strip-grazed (S), Strip-grazed with 60 Days Rest Followed by Rotational Grazing (SR).



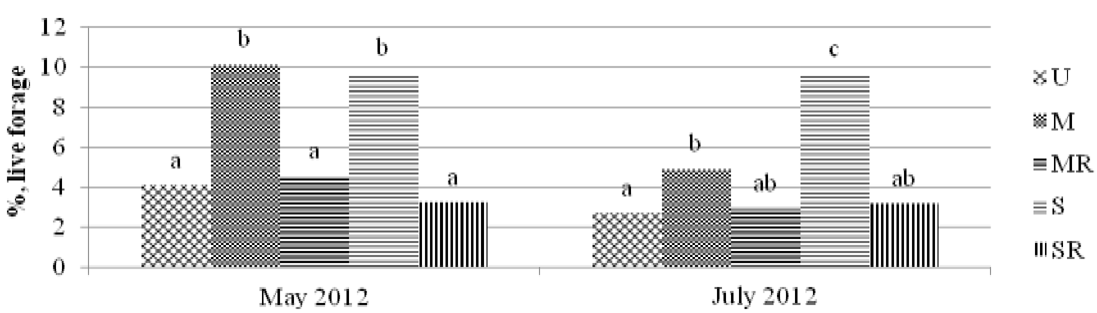
[a-b] Differences between treatment (U, M, MR, S, SR) means within month with different superscripts are significant (P<0.05)

Figure 4. The Effects of Strip or Mob-grazing with or without Subsequent Rotational Grazing on the Proportion of Legumes as a Percentage of Total Live Forage in BL1 paddocks not grazed (U), Mob-grazed (M), Mob-grazed with 60 Days Rest Followed by Rotational Grazing (MR), Strip-grazed (S), Strip-grazed with 60 Days Rest Followed by Rotational Grazing (SR).



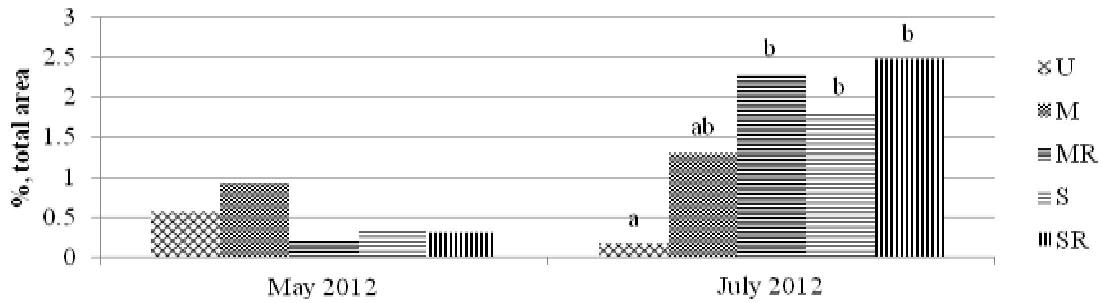
[a-c] Differences between treatment (U, M, MR, S, SR) means within month with different superscripts are significant (P<0.05)

Figure 5. The Effects of Strip or Mob-grazing with or without Subsequent Rotational Grazing on the Proportion of Annual Grasses as a Percentage of Total Live Forage in BL2 paddocks not grazed (U), Mob-grazed (M), Mob-grazed with 60 Days Rest Followed by Rotational Grazing (MR), Strip-grazed (S), Strip-grazed with 60 Days Rest Followed by Rotational Grazing (SR).



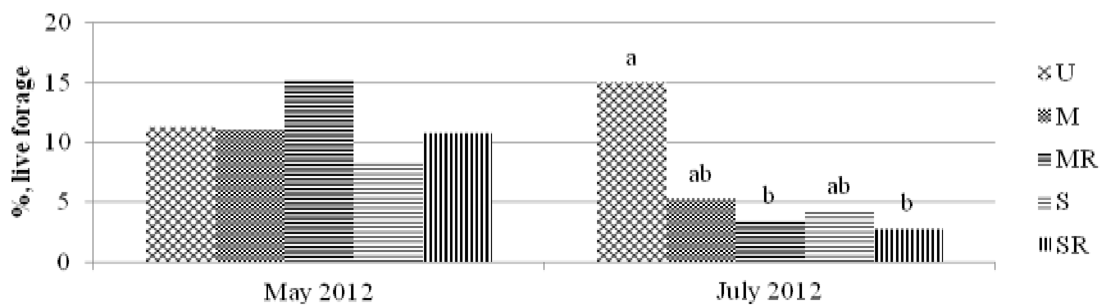
[a-b] Differences between treatment (U, M, MR, S, SR) means within month with different superscripts are significant (P<0.05)

Figure 6. The Effects of Strip or Mob-grazing with or without Subsequent Rotational Grazing on the Proportion of Bare Ground as a Percentage of Total Pasture Area in BL2 paddocks not grazed (U), Mob-grazed (M), Mob-grazed with 60 Days Rest Followed by Rotational Grazing (MR), Strip-grazed (S), Strip-grazed with 60 Days Rest Followed by Rotational Grazing (SR).



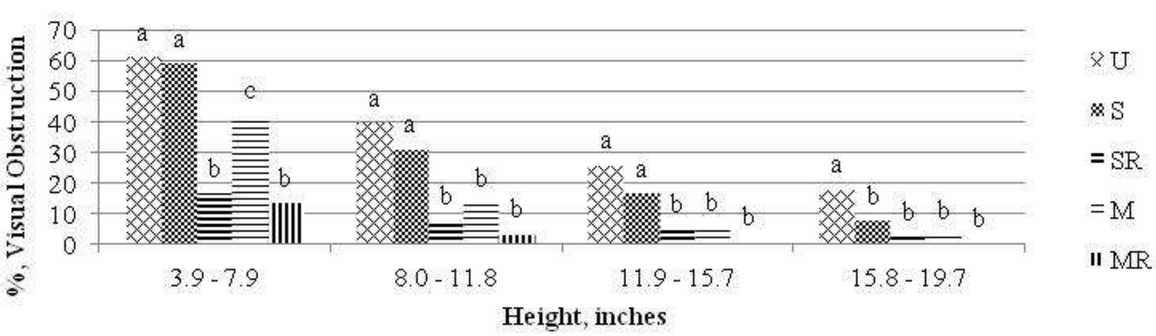
[a-b] Differences between treatment (U, M, MR, S, SR) means within month with different superscripts are significant (P<0.05)

Figure 7. The Effects of Strip or Mob-grazing with or without Subsequent Rotational Grazing on the Proportion of Sedge as a Percentage of Live Forage in BL2 paddocks not grazed (U), Mob-grazed (M), Mob-grazed with 60 Days Rest Followed by Rotational Grazing (MR), Strip-grazed (S), Strip-grazed with 60 Days Rest Followed by Rotational Grazing (SR).



[a-b] Differences between treatment (U, M, MR, S, SR) means within month with different superscripts are significant (P<0.05)

Figure 8. The Effects of Strip or Mob-grazing with or without Subsequent Rotational Grazing on the Visual Obstruction at Height Increments of 3.9-7.9, 8.0-11.8, 11.9-15.7, and 15.8-19.7 inches at a Distance of 13.2 feet in BL1 paddocks not grazed (U), Mob-grazed (M), Mob-grazed with 60 Days Rest Followed by Rotational Grazing (MR), Strip-grazed (S), Strip-grazed with 60 Days Rest Followed by Rotational Grazing (SR) in October 2011.



[a-b] Differences between treatment (U, M, MR, S, SR) means within month with different superscripts are significant (P<0.05)