Effects of Grazing Management on the Physical and Nutritional Characteristics of Pastures

A.S. Leaflet R2323

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Summary and Implications

Grazing management may alter the characteristics of a pasture sward that affect both the nutritional value of the forage and the environmental impacts of the grazing system. Six 30-acre cool-season grass pastures, containing predominantly smooth bromegrass and bisected by a 642-foot stream segment, were grouped into 2 blocks and assigned one of three treatments: continuous stocking - unrestricted stream access (CSU), continuous stocking - restricted stream access (CSR), and rotational stocking (RS). Forage sward height and mass and the proportions of bare or fecal-covered ground were determined monthly from open and congregation areas within 4 zones in the pasture. Zones were defined as on the stream bank (bank), from the stream bank to 110 feet from the stream bank (110), 110 feet to 220 feet from the stream bank (220), and greater than 220 feet from the stream bank (upland). Forage samples were analyzed for *in vitro* dry matter disappearance (IVDMD), crude protein (CP), and phosphorus (P). Bare ground and fecal cover were greater and forage mass was lower in congregation than in open areas of pastures. Proportion of bare ground along stream banks did not significantly differ ($P>.10$) 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. However, proportions of bare ground and forage mass did not differ between grazing management treatments throughout the portions of the pastures available for grazing. *In Vitro* dry matter disappearance and concentrations of CP and P in available forage did not differ between grazing treatments in any month.

Introduction

Poorly managed grazing of beef cattle may have negative impacts on the quality of surface waters in the Midwest. Without proper management, grazing animals may remove protective vegetation from the soil surface and concentrate nutrients on the soil surface in their feces, thereby increasing runoff of sediment and nutrients into pasture streams. Improved grazing management practices should reduce fecal deposition and bare ground near pasture streams, reducing negative impacts of grazing livestock.

Use of rotational grazing systems may increase the quantity and nutritional quality of pasture forage. Because distribution of cattle is controlled, properly managed rotational grazing may not only improve animal performance, but also reduce the potentially negative impacts of grazing on surface water quality.

The objectives of the current study were to determine the effects of grazing management on forage sward height, mass, and nutrient concentration and the proportion of bare ground and fecal cover in cool-season grass pastures.

Materials and Methods

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. Cattle in the upland paddocks of RS pastures were moved between paddocks after 50% of available forage was removed. Riparian buffers on either side of the crossing in the CSR treatment were not grazed. Each pasture was stocked with 15 fall-calving Angus cows from mid-May through mid-October in 2005, 2006, and 2007 (initial mean BW = 1428, 1271, and 1369 lbs., respectively).

Forage sward height, mass and composition and the proportion of bare and fecal-covered were determined monthly from open and congregation areas within 4 zones in the pasture. Zones were defined as on the stream bank (bank), from the stream bank to 110 feet from the stream bank (110), 110 feet to 220 feet from the stream bank (220), and greater than 220 feet from the stream bank (upland). Congregation areas were defined as areas providing cattle access to the stream, water tanks or mineral supplementation sites, and under the drip-line of trees. Open areas were any areas that were not classified as a congregation area. Area of congregation areas was determined with tape measures in August of each year.

The proportions for bare and manure-covered ground and sward heights were measured and forage samples were hand-clipped from a 0.25-m^2 square at 6 sites in open and congregation areas on the banks and in the 110 and 220 foot zones in each pasture unless limited by the number of congregation areas. In the upland zone, proportions of bare and fecal-covered ground and sward height were measured in 24 open and 12 congregation areas and forage samples were hand-clipped from 12 open and congregation areas. The proportions of bare or fecal-covered ground were determined by the line-transect method over 50 feet. Forage sward height was measured with a rising plate meter (8.8 lb/yd^2). Forage samples were analyzed for *in vitro* dry matter disappearance (IVDMD), crude protein (CP), and phosphorus (P). Nutrient composition data have been determined only for samples collected in 2005 and 2006. Mean proportions of bare and fecal-covered ground and the forage mass, sward height and nutrient concentrations within each zone of each pasture were calculated as weighted averages, based on the ratio of open and congregation area. In analysis of the data in the areas available for grazing, data from the stream banks and the 110 foot zone in the CSR pastures were excluded.

Data were analyzed using the MIXED procedure of SAS. Proportion of congregation area within pasture zones was analyzed by zone with a model which included treatment, year and treatment × year. The proportion of bare and fecal covered ground, and forage mass, sward height and nutrient composition were analyzed by year and month with a model which included treatment. Block was a random variable for all analysis. Values reported in text and figures are LSmeans, effects were considered to differ at P<.10 and tended to differ at P<.20.

Results and Discussion

Congregation Area

The percentage of congregation area along stream banks was greater (P<.10) in CSU (60.7%) pastures than in pastures managed by CSR (31.1%) or RS (30.8%). The percentage of congregation area within the 110 foot zone tended to be greater (P<.20) in pastures managed by CSR (16.8%) or CSU (13.1%) than in RS (5.0%) pastures. Congregation areas within the 220 foot zone (7.3, 4.0, and 6.5% for CSU, CSR, and RS pastures, respectively) and upland zone (4.7, 10.6, and 5.5% for CSU, CSR, and RS pastures, respectively) did not differ between grazing management treatments. There were no year or year × treatment interactions for the proportion of congregation area within any pasture zones.

Bare and Fecal-covered Ground

The proportions of bare ground (Fig. 1) and fecal-covered ground (Fig. 2) in pastures managed by either continuous or rotational stocking were greater (P<.10) in congregation than in open areas of pastures in most months over three grazing seasons. There were no grazing management treatment by cattle distribution interactions for bare or fecal-covered ground in any month. These results imply that while grazing management might affect the proportion of area that the cattle congregate in, the effects of that congregation are similar across treatments and zones.

The proportion of bare ground on stream banks did not differ (P>.10) or tend to differ (P>.20) between grazing management treatments in any month except September and October 2007 when CSU pastures had a greater (P<0.10) proportion of bare ground than did CSR pastures (Fig. 3). The lack of significance between treatments resulted from a large degree in variability in bare ground on banks within pastures. The proportion of bare ground within 110 feet of the stream was greater (P<0.10) in the CSU pastures than in pastures managed by either CSR or rotational stocking (RS) during July and August of 2005, August, September, and October of 2006, and August of 2007 (Fig. 4). There was no difference in the proportion of bare ground on or within 110 feet of the stream banks in pastures managed by CSR and RS in any month.

Fecal cover was greater (P<.10) on stream banks in CSU pastures than in CSR or RS pastures in July, August, and October of 2005, July and August of 2006, and June and July of 2007 (Fig. 5). Only in October, 2005 was there greater fecal cover on stream banks of RS pastures than CSR pastures. Only in June, July, and September of 2005, July of 2006, and August of 2007 was there greater (P<.10) fecal cover within 110 feet of the stream in RS than in CSR pastures (Fig. 6).

The proportion of bare ground in pasture areas available for grazing did not differ between grazing management practices in any month (Fig. 7). Similarly, the proportions of fecal-covered ground in grazed pasture areas did not differ (P>.10) between grazing treatments in most months (Fig 8).

Forage Mass and Sward Height

Forage mass was greater (P<.10) in open than congregation areas of pastures in all months except May and July of 2005 and June of 2007 (Fig. 9). Similarly, forage sward height was less (P<0.10) in congregation areas than in open areas of pastures (Data not shown).

Forage mass on stream banks was greater (P<.10) in CSR pastures at the end of the 2005 grazing season, but did not differ between grazing management treatments during the 2006 grazing seasons. Forage mass was greater (P<.10) or tended to be greater (P<.20) in CSR pastures than in CSU pastures during 2007 (Fig. 10). However, forage mass on or within 110 feet of the stream banks in CSR and RS pastures did not differ in any month. However, in every month except May, June, and July of 2005 and May of 2006, CSU pastures had a lower (P<.10) forage mass within 110 feet of the stream banks than CSR or RS pastures (Fig. 11). Forage sward height was inversely related to forage mass (Data not shown).

Forage masses in pasture areas available for grazing did not differ between treatments during the 2005 or 2006 grazing seasons. However, the areas available for grazing in the RS pastures had greater forage mass than either the CSU or CSR pastures in June and October 2007 (Fig. 12).

Forage Nutrient Concentration (2005, 2006)

In Vitro dry matter disappearance (Fig. 13) and concentrations of CP and P in available forage did not differ between grazing treatments in any month. Crude protein concentrations of available forage were below requirements for a 1200 pound beef cow at peak lactation in June and July of both years, but were at or above required concentrations for the remainder of the grazing seasons (Fig. 14). Phosphorus concentrations of available forage were below requirements for a 1200 pound beef cow at peak lactation in July of 2006, but were at or above required concentrations for the remainder of the grazing seasons (Fig. 15). As cattle are able to select forage of better quality than the average of the forage that is hand-clipped, the quality of the forage in these pastures may not have a negative impact on animal performance. Nutrient concentrations were never below maintenance requirements for a non-lactating beef cow.

Acknowledgments

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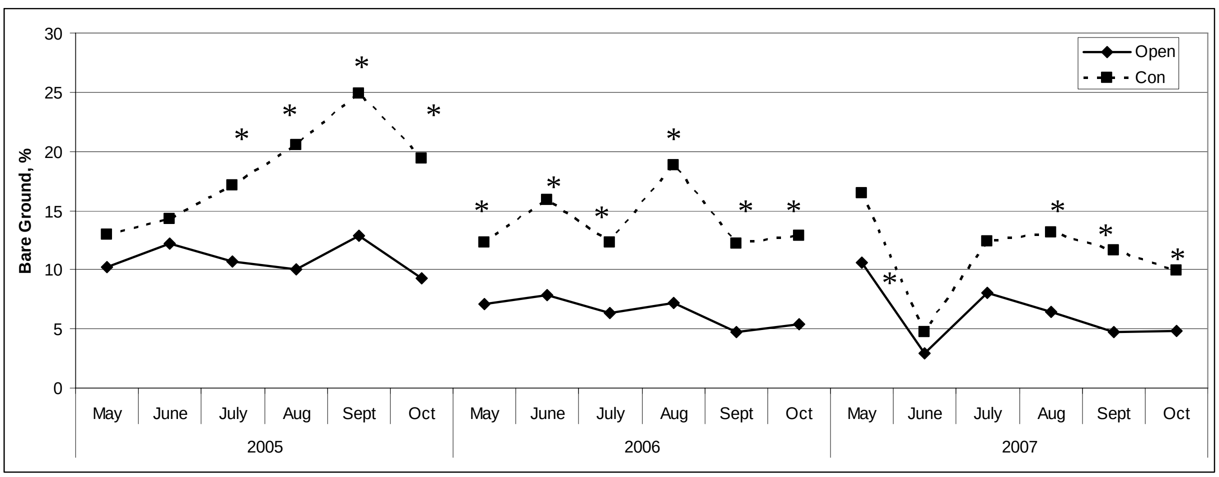

Figure 1. Proportion of bare ground in open and congregation areas of pastures managed by continuous or rotational stocking over three grazing seasons. * = values differ (P<.10).

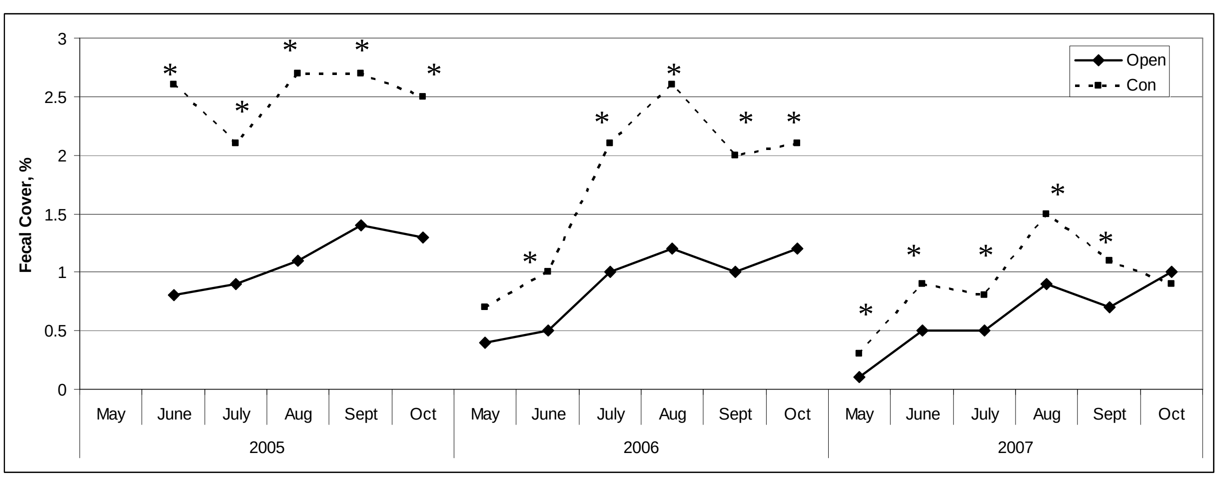

Figure 2. Proportion of fecal-covered ground in open and congregation areas of pastures managed by continuous or rotational stocking over three grazing seasons. * = values differ (P<.10).

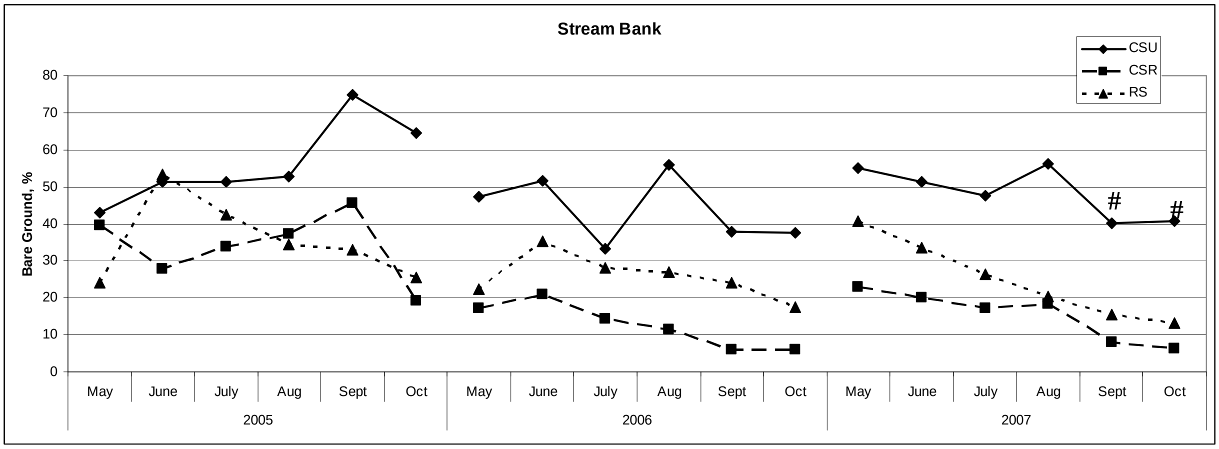

Figure 3. Proportion of bare ground on stream banks in pastures managed by continuous stocking with unrestricted stream access (CSU), continuous stocking with restricted stream access (CSR), and rotational stocking (RS). * = CSU differs from RS, # = CSU differs from CSR, @ = CSR differs from RS (P<.10).

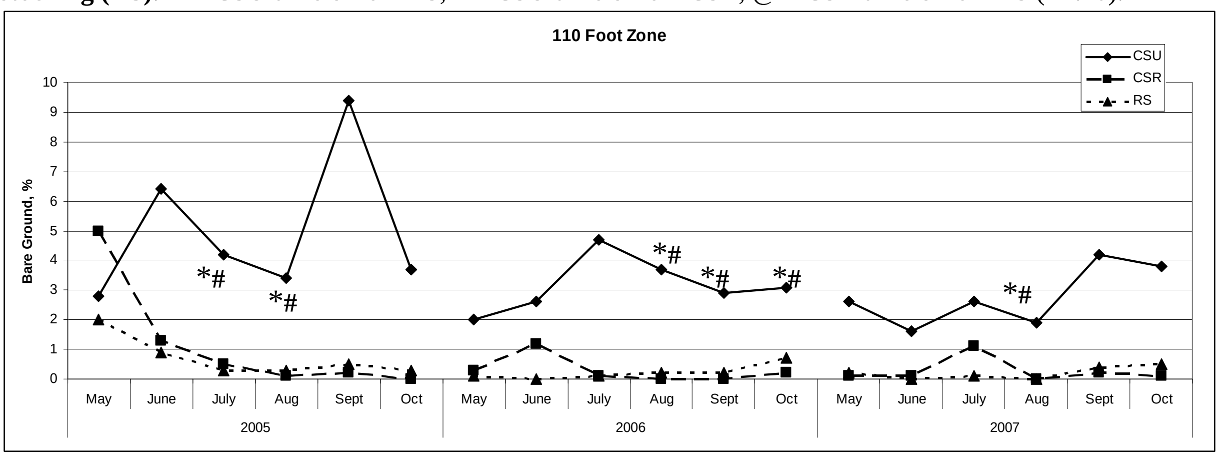

Figure 4. Proportion of bare ground within 110 feet of streams in pasture managed by continuous stocking with unrestricted stream access (CSU), continuous stocking with restricted stream access (CSR), and rotational stocking (RS). * = CSU differs from RS, # = CSU differs from CSR, @ = CSR differs from RS (P<.10).

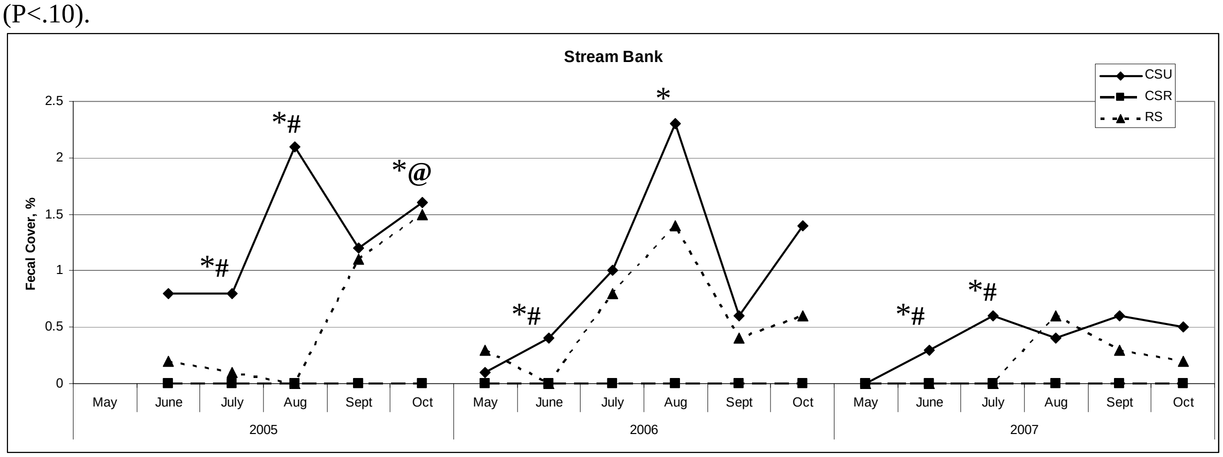

Figure 5. Proportion of fecal-covered ground on stream banks in pastures managed by continuous stocking with unrestricted stream access (CSU), continuous stocking with restricted stream access (CSR), and

rotational stocking (RS). * = CSU differs from RS, # = CSU differs from CSR, @ = CSR differs from RS (P<.10).

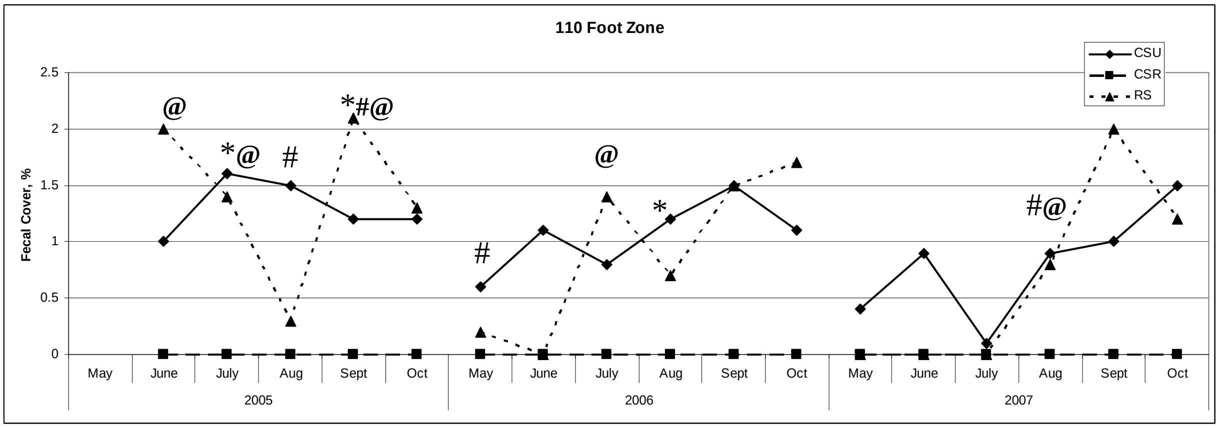

Figure 6. Proportion of fecal-covered ground within 110 feet of streams in pasture managed by continuous stocking with unrestricted stream access (CSU), continuous stocking with restricted stream access (CSR), and rotational stocking (RS). * = CSU differs from RS, # = CSU differs from CSR, @ = CSR differs from RS (P<.10).

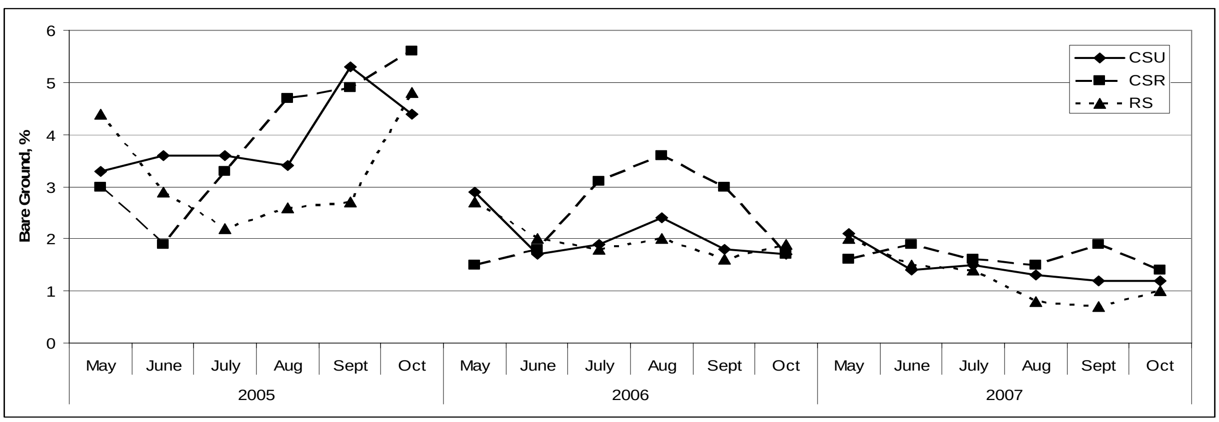

Figure 7. Proportion of bare ground, in areas available for grazing, in pasture managed by continuous stocking with unrestricted stream access (CSU), continuous stocking with restricted stream access (CSR), and rotational stocking (RS). * = CSU differs from RS, # = CSU differs from CSR, @ = CSR differs from RS (P<.10).

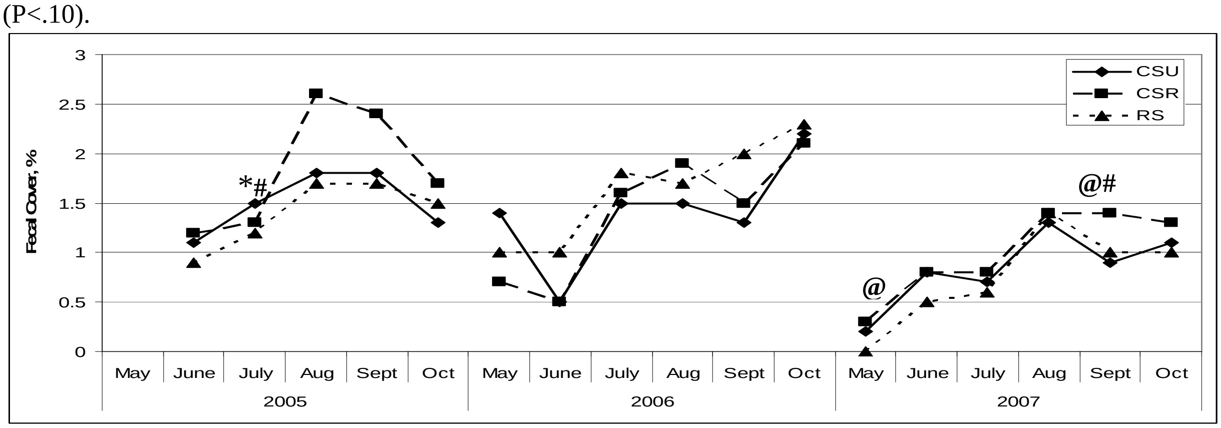

Figure 8. Proportion of fecal-covered ground, in areas available for grazing, in pasture managed by continuous stocking with unrestricted stream access (CSU), continuous stocking with restricted stream

access (CSR), and rotational stocking (RS). * = CSU differs from RS, # = CSU differs from CSR, @ = CSR differs from RS (P<.10).

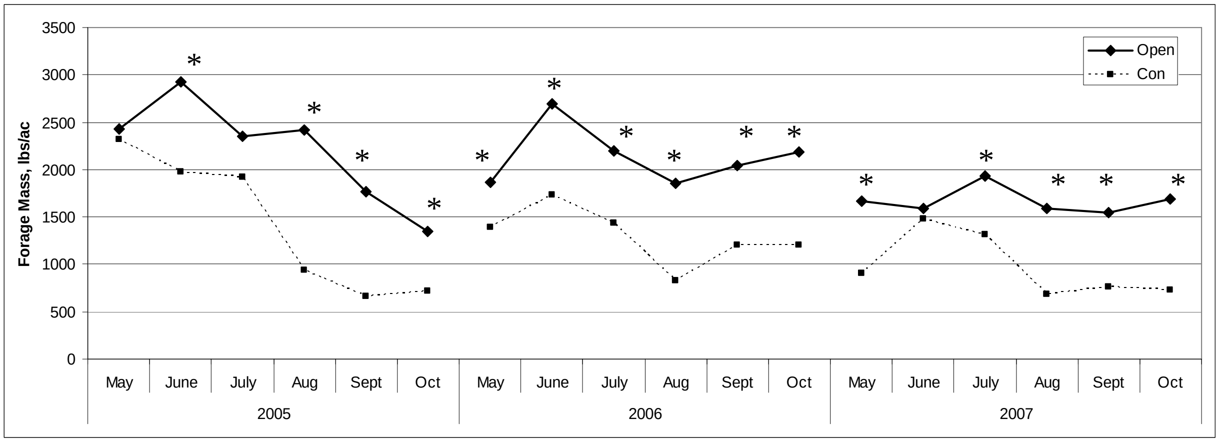

Figure 9. Forage mass (lbs/ac) in open and congregation areas of pastures managed by continuous or rotational stocking over three grazing seasons. * = values differ (P<.10).

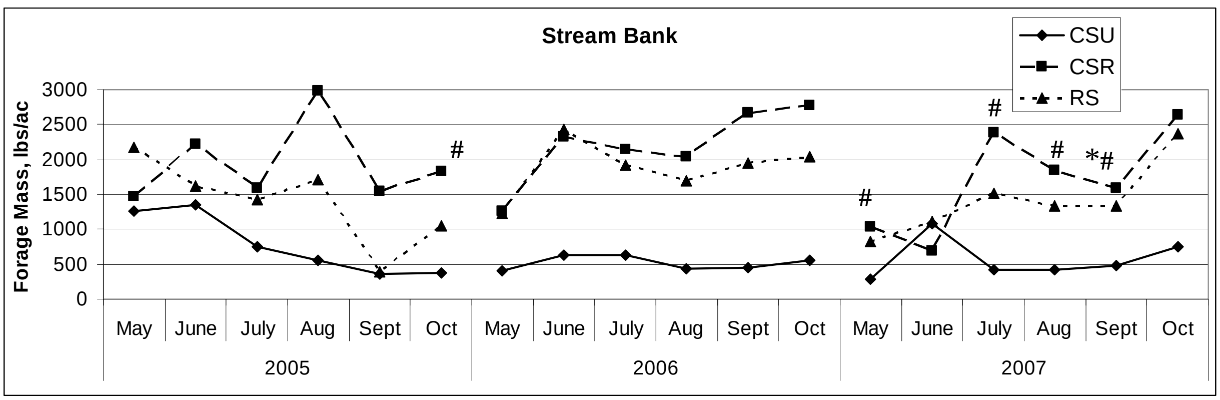

Figure 10. Forage mass (lbs/ac) on stream banks in pasture managed by continuous stocking with unrestricted stream access (CSU), continuous stocking with restricted stream access (CSR), and rotational stocking (RS). * = CSU differs from RS, # = CSU differs from CSR, @ = CSR differs from RS (P<.10).

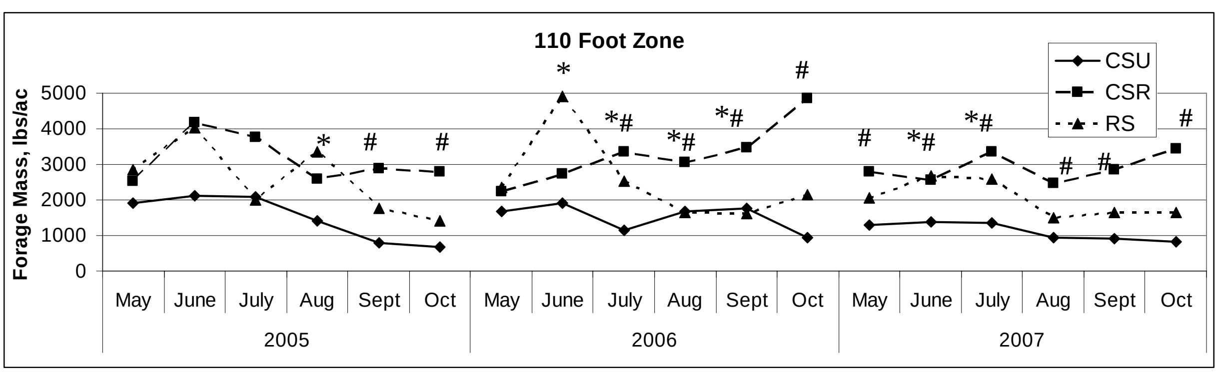

Figure 11. Forage mass (lbs/ac) within 110 feet of streams in pasture managed by continuous stocking with unrestricted stream access (CSU), continuous stocking with restricted stream access (CSR), and rotational stocking (RS). * = CSU differs from RS, # = CSU differs from CSR, @ = CSR differs from RS (P<.10).

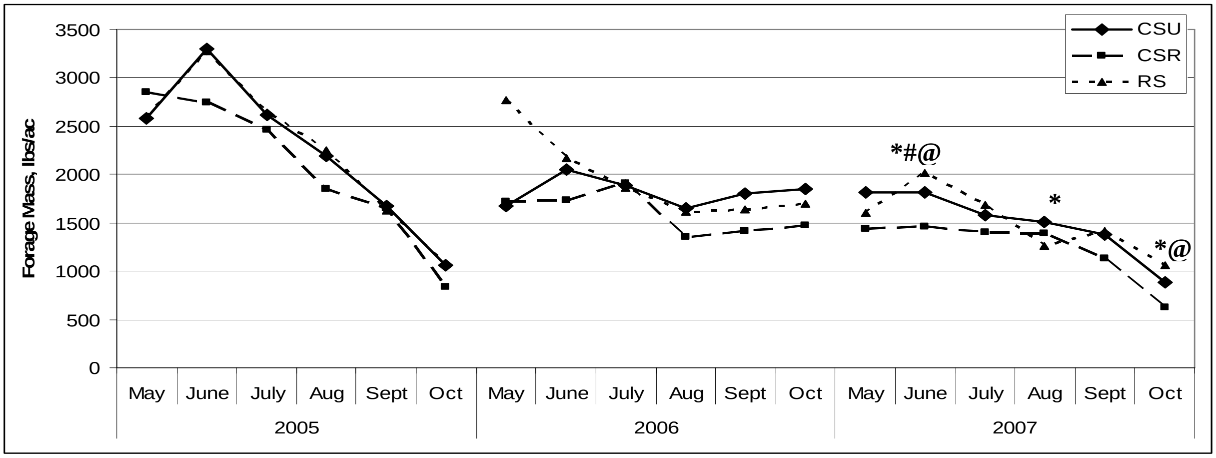

Figure 12. Forage mass, in areas available for grazing, in pasture managed by continuous stocking with unrestricted stream access (CSU), continuous stocking with restricted stream access (CSR), and rotational stocking (RS). * = CSU differs from RS, # = CSU differs from CSR, @ = CSR differs from RS (P<.10).

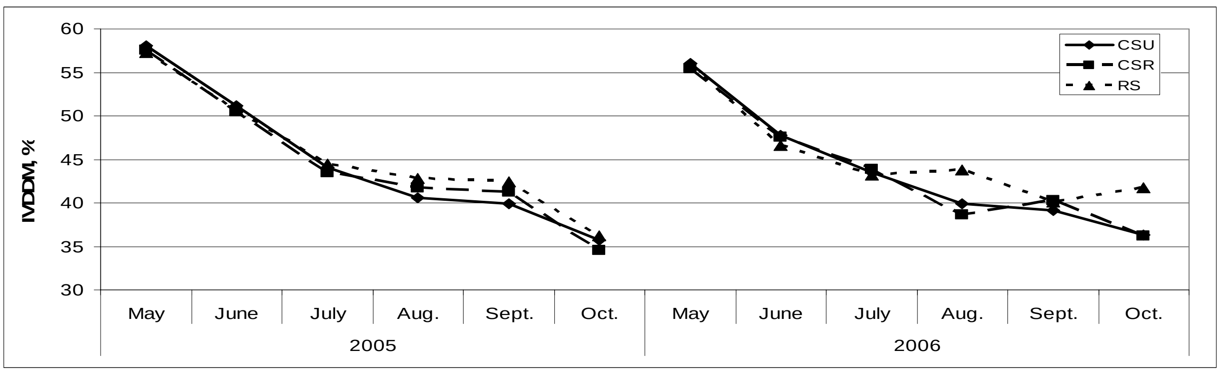

Figure 13. *In Vitro* dry matter digestibility of forage, in areas available for grazing, in pasture managed by continuous stocking with unrestricted stream access (CSU), continuous stocking with restricted stream access (CSR), and rotational stocking (RS). * = CSU differs from RS, # = CSU differs from CSR, @ = CSR differs from RS (P<.10).

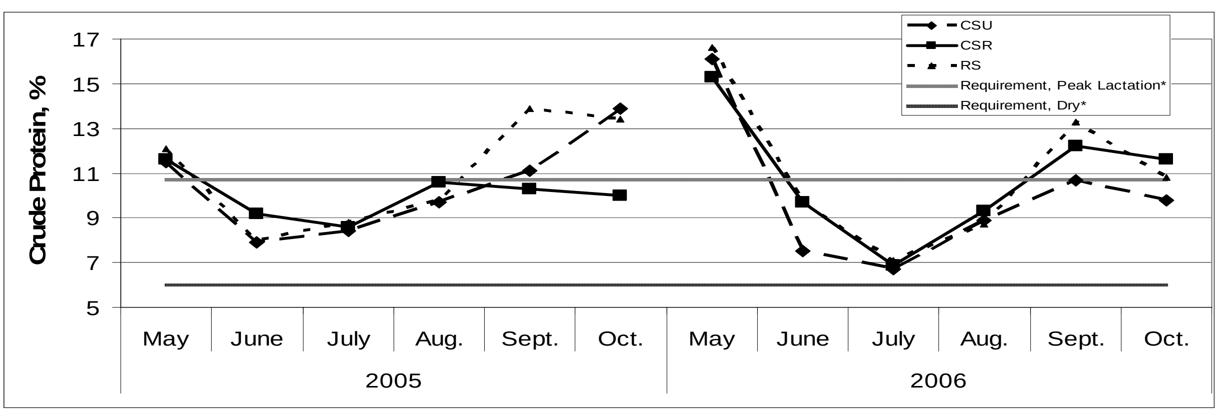

Figure 14. Crude protein concentration of forage, in areas available for grazing, in pasture managed by continuous stocking with unrestricted stream access (CSU), continuous stocking with restricted stream access (CSR), and rotational stocking (RS). * = CSU differs from RS, # = CSU differs from CSR, @ = CSR differs from RS (P<.10). Required dietary crude protein concentration for a 1200 lb beef cow producing 20 lbs. milk per day at peak lactation and when dry (NRC 1996).

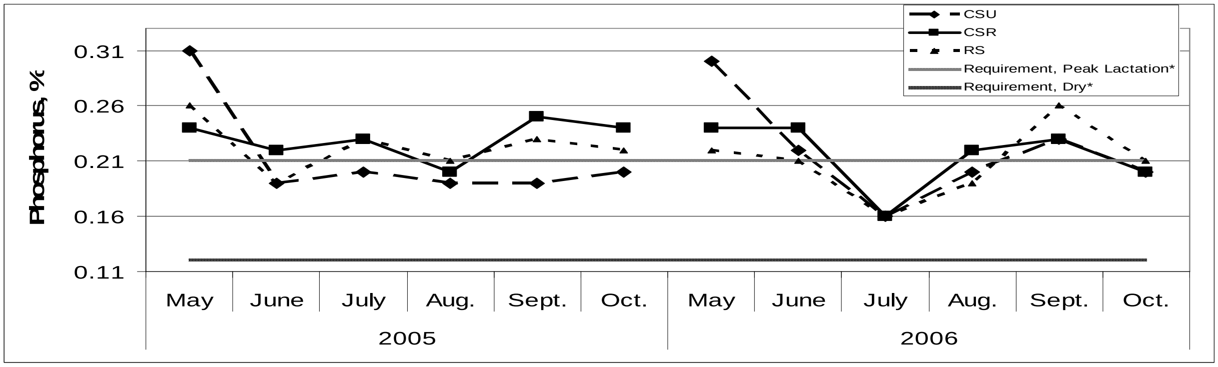

Figure 15. Phosphorus concentration of forage, in areas available for grazing, in pasture managed by continuous stocking with unrestricted stream access (CSU), continuous stocking with restricted stream access (CSR), and rotational stocking (RS). * = CSU differs from RS, # = CSU differs from CSR, @ = CSR differs from RS (P<.10). Required phosphorus concentration for a 1200 lb beef cow producing 20 lbs. milk per day at peak lactation and when dry (NRC 1996).