Effects of Pasture Size on the Efficacy of Off-stream Water or Restricted Stream Access to Alter the Spatial/Temporal Distribution of Grazing Cattle

A.S. Leaflet R2613

Justin Bisinger, graduate assistant;
Jim Russell, professor of animal science

Summary and Implications

Cattle congregating near pasture streams decrease forage sward height and root mass and increase fecal cover, increasing the risk of sediment, nutrient, and pathogen loading of the streams. Restricting stream access to stabilized crossings or offering off-stream water may decrease the amount of time cattle spend near or in the stream, in turn reducing the risks of water quality impairment. However, the effectiveness of these management practices may be affected by pasture size. Six 30-acre cool-season grass pastures on the Rhodes Research Farm bisected by a 46375-ft stream reach were used to analyze the effects of pasture size on the efficacy of restricted stream access or off-stream water to alter the spatial/temporal distribution of grazing cattle in and near the pasture stream. Three grazing management treatments: unrestricted stream access without off-stream water (CSU), unrestricted stream access with off-stream water (CSUW), and restricted stream access to 16-ft wide stabilized crossings (CSR) were compared in pastures with two sizes (10 and 30 acres) in an experiment with a 3 x 2 switchback design with 2 week periods over 5 monthly intervals. Five and fifteen fall-calving Angus cows (mean initial weight, 1305 lbs) were continuously stocked in each small and large pasture, respectively. At the beginning of each period, 2 or 3 cows per pasture were fitted with GPS collars that recorded cow position every 10 minutes for the two week period. Pasture size had little effect on the proportion of time that cows in pastures with restricted stream access were in the stream until the fourth (August 17 to September 14) and fifth (September 14 to October 12) interval. However, cows in pastures with unrestricted stream access with or without off-stream water spent more ($P<0.05$) time in Streamside Zones (between 15 and 110 feet of the stream) in small pastures than large pastures. Cows with restricted stream access spent less ($P<0.05$) time in the Stream (0 to 15 feet from the stream) and Streamside Zones than cows in pastures with unrestricted stream access regardless of pasture size. Off-stream water had little effect on the amount of time cattle spent in or near pasture streams regardless of pasture size.

Introduction

With poor grazing management, cattle grazing riparian pastures may spend more time in pasture streams to meet needs for thermoregulation and thirst. As a result, these cows may increase sedimentation and fecal contamination of pasture streams. However, the extent of this damage is related to the intensity, duration, frequency, and timing of grazing.

The proportion of time that cattle spend in or near pasture streams is reduced by restricting stream access to stabilized crossings. Access to off-stream water has also reduced the percentage of time that cattle spend in streams in some studies, but not in others. Pasture size and shape has been shown to supersede the effects of pasture shade distribution or botanical composition on the proportion of time cattle spend in or near streams. Therefore, pasture size may affect the efficacy of restricted stream access or off-stream water on cattle temporal/spatial distribution in or near pasture streams. The purpose of this study was to evaluate the efficacy of pasture size on restricting stream access to stabilized crossings and the availability of off-stream water to influence the amount of time cattle spend in and within 110 feet of pasture streams.

Materials and Methods

Six 10-acre cool-season grass pastures in central Iowa, each bisected by a 463-ft reach of Willow Creek, were used to determine the effects of grazing management and pasture size on cattle distribution. The experiment was arranged as a 3 x 2 switchback design with three grazing management treatments: unrestricted stream access without off-stream water (CSU), unrestricted stream access with off-stream water (CSUW), and restricted stream access to 16-ft wide stabilized crossings (CSR) and two pasture sizes (10 and 30 acres). The 10-acre pastures were constructed with temporary electric fence in the center of the 30-acre pastures. Off-stream water sites in pastures with the CSUW treatment were an average of 888 and 424 feet from the stream in the large and small pastures, respectively. A phosphorus-free mineral supplement was available ad libitum in feeders located near the off-stream water sites continually. Beginning on May 18, large and small pastures were continuously stocked with 15 and 5 fall-calving cows (mean body weight, 1305 lbs), respectively, in mid-gestation for a 2-week period.

During this time, two or three cows in each pasture were fitted with collars with GPS receivers which recorded cow position at 10 minute intervals. At the end of each period, collars were removed, the data downloaded, new batteries inserted, and the collars reattached to the cows. When the cows returned to the pastures for the second 2-week period of each interval, size treatments were rotated to pastures that had been the opposite size, but had the same grazing management treatments as the previous period. This procedure continued for a total of five 4-week intervals. Intervals were: Interval 1: May 18 to June15; Interval 2: June 15 to July 13; Interval 3: July 13 to August 10; Interval 4: August 17 to September 14; and Interval 5: September 14 to October 12.

Position of the cattle was determined on aerial maps using ArcGIS version 9.3 software. To evaluate cattle position data, two zones on either side of the stream were analyzed. The Stream Zone was 0 to15 feet from the stream. The Streamside Zone was 15 to 110 feet from the center of the stream.

Weather data was measured with two HOBO weather stations. Weather stations were placed near the center, and on the north end of the study pastures. Weather stations recorded ambient and black globe temperatures, wind speed and direction, relative humidity, dew point, and precipitation. Precipitation was also measured using two rain gauges located on opposite ends of the pastures. The amount of rain was measured the day after any rainfall.

To monitor the effects that forage height, mass, and quality may have on cattle distribution, forage sward heights were measured with a falling plate meter (8.8 lb/yd^2) at 16 sites within 10 acres of the stream, 16 sites in the 20 acres beyond this area in each pasture, and 6 sites within the riparian buffer areas in CSR pastures biweekly. Forage was hand-clipped from a .25-m^2 square at 16 sites within 10 acres of the stream and in the 20 acres beyond this area in each pasture monthly. In addition, forage was hand-clipped from 6 sites within the riparian buffer areas of each CSR pasture monthly.

Cattle distribution was calculated as the proportion of total observations that cows were in the Stream or Streamside Zones. The MIXED procedure of SAS was used with a model that included grazing management treatment, pasture size, and the grazing management by size interaction by interval with pasture as the experimental unit. Differences between means with significant treatment effects were determined by the PDIFF procedure of SAS.

Results and Discussion

In pastures grazed by the CSU treatment, pasture size affected the proportion of time that cattle were in the Stream Zone only during interval 4, and 5, when cows in the large pastures spent less ($P<0.05$) time in the Stream Zone than cows in small pastures (Figure 1). In contrast, in pastures grazed by the CSUW treatment, cows in large pastures spent less ($P< 0.05$) time in the Stream Zone than small pastures during intervals 2, 3, 4, and 5. The presence of off-stream water had no advantageous effects on the proportion of time that cows were present in the Stream Zone regardless of pasture size in any interval. Likely due to the 16-foot stabilized crossings with 110-ft riparian buffers on either side of the stream, cows in the CSR pastures spent less ($P<0.05$) time in the Stream Zone than cows in the CSU or CSUW pastures of either size in every interval. Thus, there were no differences in the proportion of time that cows in the CSR pastures spent in the stream zone of pastures at either size.

Throughout the grazing season, cows in the CSU and CSUW treatments spent less ($P<0.05$) time in the Streamside Zone of large than small pastures in every interval. While cows in large CSU and CSUW pastures spent 3.6 and 9.7% of their time in the Streamside Zone, cows in small CSU and CSUW pastures spent 17.2 to 32.0% of their time in the Streamside Zone. Similar to the Stream Zone, off-stream water did not affect the proportion of time that cattle were present in the Streamside Zone of the pastures in any interval. Restricting stream access to stabilized crossings reduced ($P<0.05$) the proportion of time that cattle were in the Streamside Zone of small pastures in every interval. In large pastures, cows in CSR pastures spent less ($P<0.05$) time in the Streamside Zone than cows in CSU or CSUW pastures only in intervals 1 and 4, but tended to reduce the proportion of time in the Streamside Zone in the other months as well.

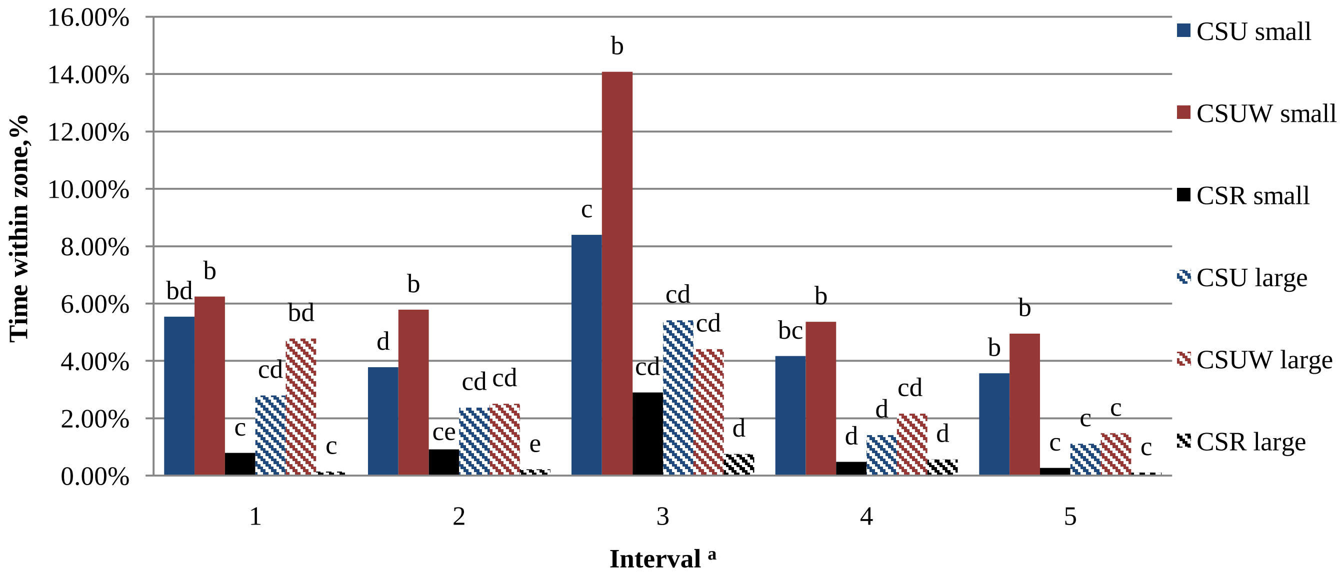
Conclusion

This study indicates pasture size is a major contributing factor in the amount of time cattle spend near or in pasture streams. Cows in small pastures spend more time in and near pasture streams, thereby, increasing the risk of non-point source pollution of pasture streams in comparison with large pastures. Off-stream water has little effect on cattle distribution in and near streams in pastures with plentiful sources of natural off-stream water. However, restricting stream access to stabilized crossings is effective in reducing the time that cattle spend in and near pasture streams regardless of pasture size.

Acknowledgements

The authors would like to thank the undergraduate and graduate students that have helped with the data collection and analysis. This material is based upon work supported by the Leopold Center. 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.

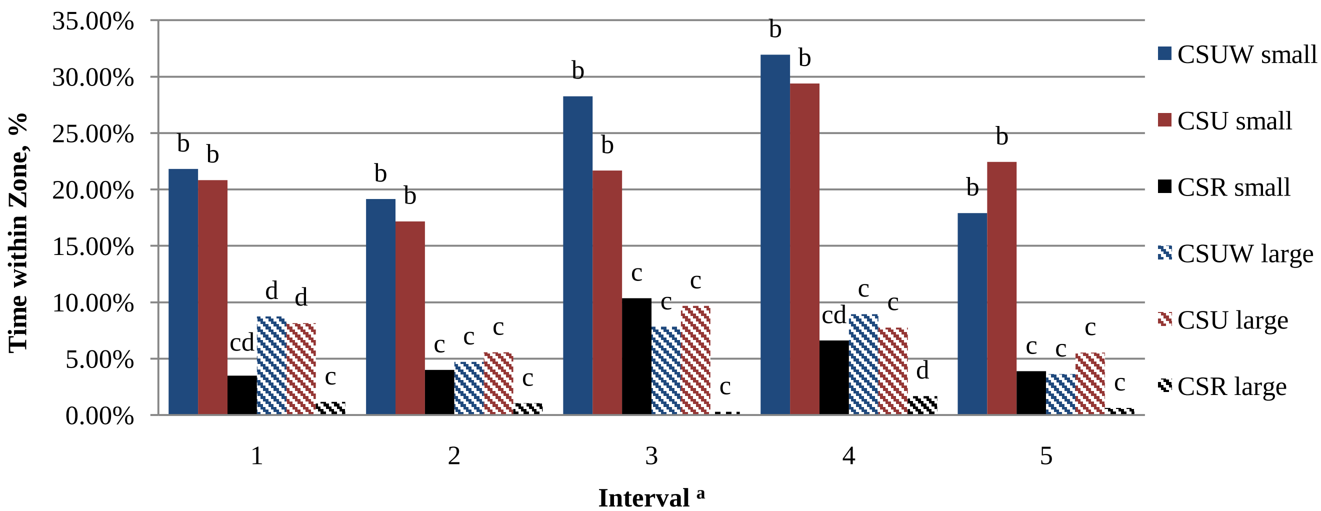
Figure 1. Mean proportions of time cattle spent in the Stream Zone of large (30 acres) and small (10 acres) pastures with continuous stocking with unrestricted stream access with access to off-stream water (CSUW), continuous stocking with unrestricted stream access (CSU), or continuous stocking with restricted stream access (CSR) during the 2010 grazing season.



[a] Intervals include: 1=May 18-June, 2=June 15-July 13, 3=July 13-August 10, 4=August 17-September 14, 5=September 14: October 12

[b-e] Differences between pasture size and treatment (CSUW, CSU, CSR) means with different superscripts are significant ($P<0.05$)

Figure 2. Mean proportions of time cattle spent in the Streamside Zone of large (30 acres) or small (10 acres) pastures with continuous stocking with unrestricted stream access (CSU), continuous stocking with unrestricted stream access with access to off-stream water (CSUW), or continuous stocking with restricted stream access (CSR) during the 2010 grazing season.



[a] Intervals include: 1=May 18-June, 2=June 15-July 13, 3=July 13-August 10, 4=August 17-September 14, 5=September 14: October 12

[b-d] Differences between pasture size and treatment (CSUW, CSU, CSR) means with different superscripts are significant ($P<0.0$)