THE EFFECTS OF STREAM FENCING AND WATER TROUGHS ON CATTLE MOVEMENT PATTERNS AND STREAM WATER QUALITY

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Abstract. Information about cattle impact on streams is limited in the southeastern United States. This study is being conducted to determine the effects of stream fencing and use of water troughs on stream water quality in the Georgia Piedmont. Base flow and storm flow samples are taken and analyzed for N, P, *E. coli*, total sediments, turbidity, dissolved oxygen, and temperature. Global Positioning System collars are used to track cattle and determine the amount of time spent within the stream riparian area. Results from the first year of the study showed that the amount of time cattle spent in riparian areas (over 10%) was positively correlated with daily maximum air temperature (r^2 = 0.92). Additional results reveal that the concentration of *E. coli* in base flow samples was higher in unfenced than in fenced streams, and also showed a positive relationship with the time cattle spent in riparian areas. Maximum dissolved reactive P concentrations in storm flow were higher in unfenced than in fenced streams. Removing water troughs from the pasture resulted in an immediate increase in the amount of time cattle spent near the streams.

INTRODUCTION

Research results from other geographic areas have shown that cattle can impair the general health of streams (e.g. Sheffield et al., 1997). One solution to this problem has been the use of fences to exclude cattle from the streams. However, the high cost of fencing an entire stream has led to other management strategies. Alternative drinking water sources for the cattle have been proposed as a Best Management Practice (BMP) to improve stream health (Smith et al., 1992; Godwin and Miner, 1996; Sheffield et al., 1997). These previous studies were not conducted in the southeastern United States. The objectives of this ongoing, 2-year study (conducted in the Piedmont area of central Georgia) are to 1) evaluate stream water quality in fenced and unfenced streams; 2) determine the amount of time cattle spend within the riparian area of unfenced streams; 3) evaluate the effect of off-stream water troughs on water quality in unfenced streams.

METHODS

Two 20-ha. pastures (each bisected by the same stream) were selected as the study site. In the upstream pasture the riparian area is fenced to prevent cattle access, whereas in the downstream pasture the riparian area is unfenced and accessible by cattle. Stocking rates remained the same in each pasture at two cow/calf pairs per ha. Water troughs are present in both pastures, but were closed in the unfenced stream in spring 2002 (from March 14 till June 3, 2002) to evaluate the effect of a lack of alternative water supply on cattle movement and stream water quality.

Eleven Global Positioning System (GPS) collars (manufactured by Lotek, Inc.) are used to track randomly selected cattle 24 hours per day for 2-week periods. These GPS collars take a position fix every 5 minutes, which can then be differentially corrected to within approximately 3 m of the true position. A Leika GPS system with submeter accuracy was used to delineate stream riparian areas (6-m buffers in both directions from the center of the stream). ArcView Spatial Analyst software is then used to determine the number of cattle position fixes within the stream riparian area.

Storm flow samples are taken based on changes in stream height during a storm event. The stream height is monitored constantly by DRUCK Pressure Transducers

connected to Campbell Scientific Dataloggers (CR510). At predetermined stream heights, the dataloggers send a signal to automatic samplers (ISCO 6700) to take a stream water sample. Water samples are collected in three areas (where water entered the project area, at the end of the fenced area, and at the end of the unfenced area). Storm flow samples are analyzed for total N, total P, dissolved reactive P (DRP), ammoniacal N, nitrate, total suspended solids, and turbidity. Base flow samples are taken biweekly (first year) or weekly (second year), and evaluated for the same parameters as storm samples with the addition of *E. coli*, dissolved oxygen, and temperature.

PRELIMINARY RESULTS

During the spring and summer of 2001, cattle spent 10 to 11% of their time within the riparian area of the unfenced stream (Fig. 1). Time spent in the riparian area decreased during fall and winter and increased again during the spring of 2002. An operating water trough (approximately 30 m away from the stream) was available for the cattle until March 14, 2002 (indicated by arrows Fig. 1, 3 and 4). Closing the water trough revealed an immediate increase in the amount of time spent near the stream.

The mean daily average of time cattle spent in the riparian areas was positively correlated ($r^2 = 0.92$) with daily maximum air temperature (Fig. 2). The increase in *E. coli* concentration in base flow between upstream and downstream stations was typically higher in the unfenced stream segment than in fenced segment. The increase in the unfenced stream segment was positively related to the amount of time cattle spent within the riparian area of the unfenced stream (Fig. 3). At the present time, a fair determination cannot be made of the effect of closing the water trough on bacterial contamination in the stream (due in part to the ongoing drought).

Dissolved reactive phosphorus (DRP) concentrations in storm flow were higher in unfenced streams than in fenced streams (Fig. 4). As with E. coli, the drought hindered determination of the effect of closing the water trough on DRP concentration.

Analysis of the remaining water quality variables are currently being completed. The study will continue through 2004.

ACKNOWLEDGMENTS

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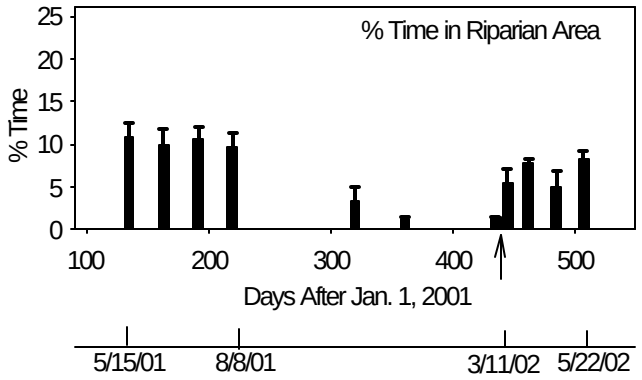

Figure 1. Percent time cattle spend in the riparian area during 2001, 2002 at the Central Research and Education Center (arrow indicates date when the water trough was closed).

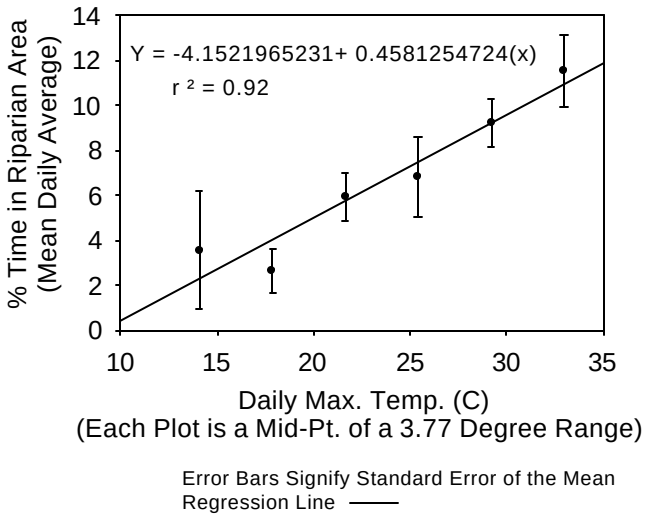

Figure 2. Mean daily average of time cattle spent in the riparian area vs. daily max. temp. ranges during 2001, 2002 at the Central Research and Education Center.

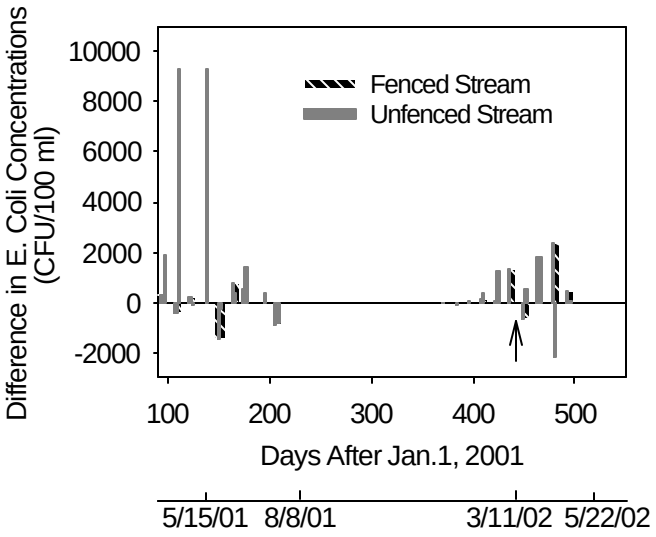

Figure 3. Difference in *E. coli* concentrations between water sampling stations during 2001, 2002 at the Central Research and Education Center (arrow indicates date when the water trough was closed).

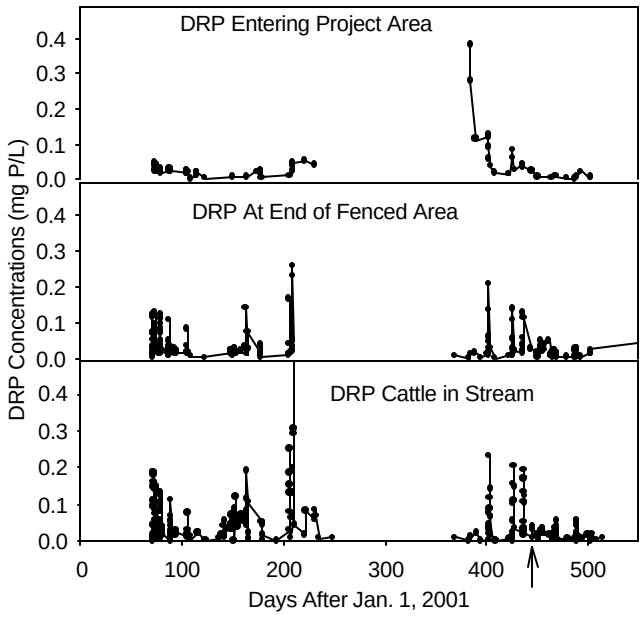

Figure 4. DRP concentrations in stream water during 2001, 2002 at the Central Georgia Research and Education Center (arrow indicates date when the water trough was closed).