

# EFFECTS OF CATTLE GRAZING ON SHOOT POPULATION DYNAMICS OF BEAKED SEDGE

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## ABSTRACT

More information is needed on the grazing responses of wetland graminoids to improve management of riparian shrub community types. To study the effect of cattle grazing on the number of new shoots produced by beaked sedge (*Carex rostrata*) within the 1989 and 1990 growing seasons, 40 plots were protected and 40 plots were grazed by cattle in June and September each year. Although number of shoots produced on grazed and ungrazed plots were similar in 1989, grazed plots produced 27.4 percent more shoots per plot than ungrazed plots ( $P < 0.05$ ) in 1990. Preliminary analysis of monthly shoot production data indicates that the greatest difference between grazed and ungrazed plots was in July. Seasonal mortality on grazed and ungrazed plots was similar, although high rodent-caused mortality in the ungrazed plots may have masked the effects of cattle grazing.

## INTRODUCTION

Riparian plant communities comprise only 1 to 2 percent of the total land area of the Western United States, but provide a disproportionately greater amount of cover and forage for wildlife and livestock. Although most riparian forage is produced by rhizomatous grasses in moist or wet soils, most grazing strategies have been developed for upland ranges dominated by cespitose graminoids in water-limited soils. The extent to which grazing response models produced for upland sites can be applied successfully to riparian sites is limited.

Beaked sedge (*Carex rostrata*) is widely distributed in temperate climates and is a dominant herbaceous component of willow communities in the Northern Rocky Mountains (Hansen and others 1988; Kovalchik 1987). Although beaked sedge has been described as moderately palatable to cattle and moderately tolerant of grazing (Hermann 1970; Ratliff 1983) the species may be invaded or replaced by other riparian graminoids when subjected to prolonged heavy grazing. Information about how populations of beaked sedge respond to grazing by cattle would be useful in developing grazing strategies in riparian plant communities.

Beaked sedge shoots have a biennial growth cycle with low survivorship to maturity (Bernard and Gorham 1978). Although total shoot numbers may vary considerably within a growing season, population numbers tend to remain relatively stable from year to year (Bernard 1976; Gorham and Somers 1972). High mortality is compensated for by the initiation of new shoots, with peak emergence in late summer (Bernard 1976; Bernard and Hankinson 1979; Gorham and Somers 1972).

Beaked sedge is strongly rhizomatous (Bernard and Gorham 1978), which allows for translocation of nutrients and water between shoots. Defoliated shoots can be subsidized by other connected shoots, or dormant buds can be stimulated by defoliation to initiate new shoot growth (Jonsdottir and Callaghan 1989). Although the apical growing points of beaked sedge remain low during the vegetative stage, leaf meristems of the sedges are typically less developed than other rhizomatous graminoids (Cronquist 1981). Thus defoliated leaves regrow slowly and nutrients may be translocated to shoot buds rather than to leaf growing points.

The removal of tall dense standing material increases soil insolation and soil temperatures. These conditions contribute to the stimulation of leaf regrowth and the initiation of new shoots from buds on rhizomatous graminoids (Jewiss 1972; Parsons and others 1984).

Using information from these studies we hypothesized that cattle grazing will increase the number of new shoots produced by beaked sedge in a growing season. We also wanted to determine when, by month, differences in the number of new shoots produced would occur within a growing season.

## METHODS

The study area lies along an upper reach of Cottonwood Creek in the Montana Agricultural Experiment Station's Red Bluff Research Ranch in southwestern Montana. Elevation is about 1,700 m, and the site receives about 460 mm annual precipitation. We used a population dynamics approach rather than determining biomass production because population ecology is typically a better measure of ecological status. Biomass production is highly variable and subject to seasonal and annual fluctuations in water level (Hultgren 1989). Beaked sedge mortality and natality occurs throughout the year, thus clipping and weighing once or twice within a growing season excludes shoots that die between cuttings or seasons, resulting in an underestimation of total forage production (Bernard and Gorham 1978). In a grazing study, the weight of forage produced

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in grazed plots would have to be estimated; population dynamics can be directly and continuously monitored.

We chose grazing over a clipping treatment because we wanted to study the response of beaked sedge in the field, and we felt that intrinsic differences between grazing and clipping might affect the applicability of our results to natural systems (Jameson 1963). Defoliation pattern, selectivity, trampling, and nutrient cycling may all be important factors that would be excluded in a clipping treatment.

We conducted the study in an eight-paddock grazing system established along Cottonwood Creek in 1986. We used a block design, selecting four beaked sedge-dominated stands located in four of the paddocks. Eighty 400-cm<sup>2</sup> round plots were systematically distributed among the blocks and were the experimental units. Forty plots were established in the grazed portion of the stands and 40 plots were protected by 1.0-m-diameter cages. Stands were grazed in late June and mid-September of 1989 and 1990 by 12 cow/calf pairs until utilization of the riparian vegetation reached 60 to 80 percent. All existing shoots were marked with red wires in June 1989, and all emerging shoots in subsequent months were marked with wires of different colors. Mortality was also measured monthly within each plot and wires of dead shoots were removed. Basal groundcover of competing vegetation, soil penetration resistance, initial shoot counts, and rodent-caused mortality were used as covariates in the statistical analysis.

We estimated sample adequacy from a preliminary sample of 10 randomly placed plots in spring of 1989. We determined that we should be able to detect a 10 percent difference between two treatment means of total shoots per plot at  $P < 0.10$  with 40 plots per treatment. We used the SAS General Linear Model procedure for Analysis of Variance (with covariates) for monthly and cumulative new shoots and mortality for 1989 and 1990. A square-root transformation was used for our data, which is typical for counting data with a Poisson distribution (Sokol and Rolf 1981). We used the Block\*Treatment Mean Square Error combined with Model Error for the error term in the tests of significance, and back-transformed the Least Square (LS) Means when presenting treatment means. Confidence intervals were determined by multiplying the LS Standard Error by the "t" value ( $P < 0.05$ , 3 df) and squaring the differences.

## RESULTS

In 1989 the grazed and ungrazed plots produced similar numbers of total new shoots (fig. 1). In 1990 the grazed plots produced 27 percent more total new shoots than the ungrazed plots ( $P < 0.05$ ). A preliminary summary of monthly new shoot data indicated that the greatest difference between grazed and ungrazed plots was in July following the June grazing period (fig. 2). Grazed plots produced 15 percent more new shoots than ungrazed plots in July 1989, and produced 10 percent more new shoots than ungrazed plots in July 1990. We expect to be able to detect about a 10 percent difference in new shoots produced per month.

Shoot mortality in 1989 was lower than in 1990 (fig. 3), mainly because we monitored shoots only from July through September in 1989, but we monitored shoots from April

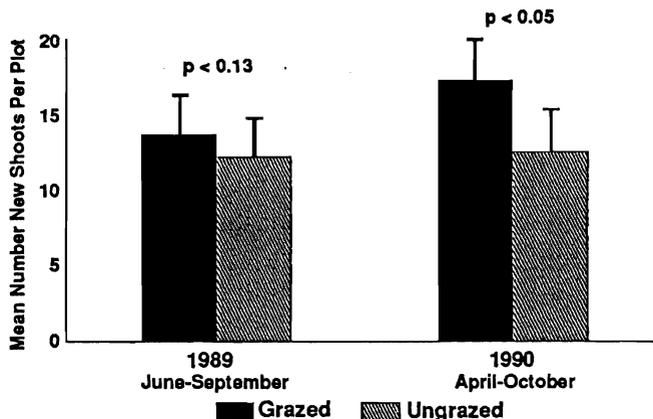


Figure 1—Mean number of new shoots produced per plot during 1989 and 1990.

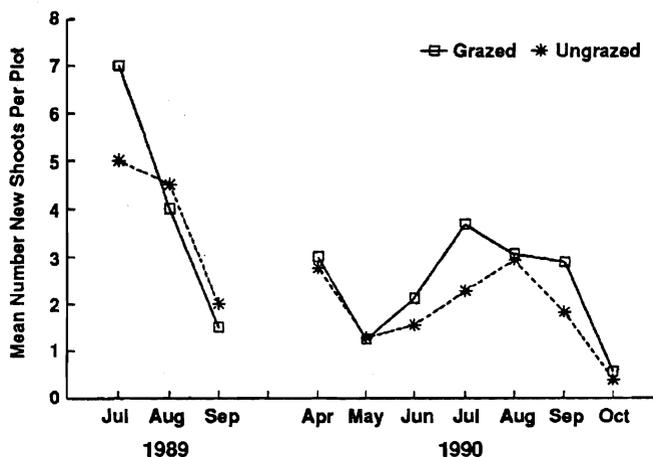


Figure 2—Mean number of new shoots produced monthly per plot in 1989 and 1990.

through October in 1990. In 1989 the first grazing treatment began in late June, which has historically been the turn-on date for the Cottonwood Creek pasture at Red Bluff. Consequently, monitoring plots prior to grazing in spring of 1989 would not have been useful in determining the effects of our treatment. Although 1989 mortality was different between grazed and ungrazed plots ( $P < 0.01$ ), this result is probably not biologically meaningful because of the low totals. Mortality was similar between grazed and ungrazed plots in 1990, although this result was strongly affected by rodent-caused mortality, which was significant as a covariate in 1990. Meadow voles (*Microtus pennsylvanicus*) and deer mice (*Peromyscus maniculatus*) were the most common rodent grazers in the beaked sedge stands. Rodents killed shoots mainly by removing stem bases, crowns, and roots. Rodent-caused mortality was highly variable, but was greater in the ungrazed plots in 1990. Accordingly, the effects of the cattle grazing treatment may have been masked in 1990.

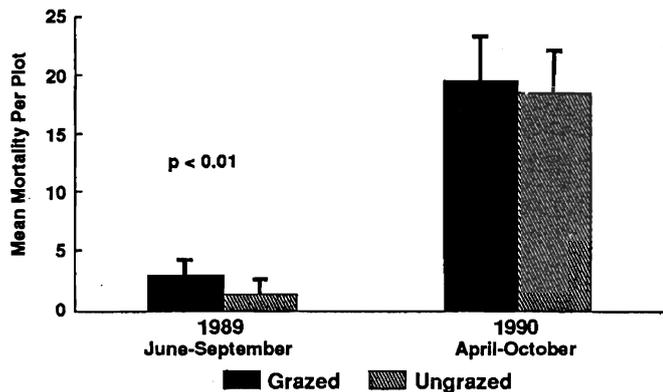


Figure 3—Mean mortality of shoots per plot during 1989 and 1990.

## DISCUSSION

In 1989 grazing did not affect new shoot production of beaked sedge shoots, although in 1990 grazing increased the number of new shoots produced in grazed plots compared with ungrazed plots. Most of this difference was accounted for during the rapid growth period (July) following the June grazing treatment. These results provide strong evidence to support our hypothesis that grazing by cattle affects shoot population dynamics of beaked sedge in our study area. Our results support findings in the literature that rhizomatous forages and forages with low growing points during the vegetative stage are grazing tolerant. For beaked sedge, however, grazing tolerance appears to be more a function of increased initiation of new shoots than one of regrowth of existing leaves. Our results also support findings that removing standing material, particularly on rhizomatous graminoids, stimulates the initiation of new shoots.

Trends in mortality, and consequently net population trends, are not yet apparent from our results, partly due to the confounding effect of rodent-caused mortality, primarily on ungrazed plots. Our data tend to support the findings of Gorham and Somers (1972) that overwinter and late summer are the periods of greatest shoot mortality.

Grazed beaked sedge stands in the Cottonwood Creek drainage seem to be able to maintain or increase population numbers by increasing the production of new shoots to replace mortality during a growing season. Given an adequate regrowth period, beaked sedge should be tolerant of moderate to heavy, controlled early summer and fall grazing in southwestern Montana willow/beaked sedge communities similar to our study area.

We plan to collect monthly data in April, May, and June of 1991. These additional data will give us two 12-month sampling periods, or 2 years of treatment effects, which roughly equals the life span of a beaked sedge shoot. These data will help us to further assess total mortality and net population changes.

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