Riparian-Fisheries Habitat Responses to Late Spring Cattle Grazing

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Abstract.—A grazing study was conducted on a cold, mountain meadow riparian system in central Idaho in response to cattle grazing-salmonid fisheries conflicts. Six pastures were established along a 3rd order, 2 to 3 m wide stream to study the effects on fisheries habitat of no grazing, light grazing (20 to 25% use), and medium grazing (35 to 50%) during late June. Most measurements of streamside variables moved closer to those beneficial for salmonid fisheries when pastures were grazed to a 10 cm stubble height; virtually all measurements improved when pastures were grazed to 14 cm stubble height, or when pastures were ungrazed. Many improvements were similar under all 3 treatments indicating that these riparian habitats are compatible with light to medium spring use by cattle (Clary 1999).

Introduction

Riparian areas, among the most important features of natural landscapes, have a unique biotic productivity and diversity compared with the surrounding mosaic of terrestrial habitats (Kondolf et al. 1996). These areas typically function to moderate hydrologic conditions (Hawkins 1994), and they are highly valued for their multiple-use values, including grazing. Concerns about the impacts of grazing on riparian areas have been raised in the last several decades (US GAO 1988). Therefore, there is a critical need for grazing practices that permit livestock production while preserving the riparian characteristics needed for wildlife habitat, native fisheries, and water quality.

The present study was initiated in response to grazing-fisheries conflicts in the Sawtooth National Recreation Area. This study spanned a 10-year period and examined the response of a cold, mountain meadow riparian system to three intensities of late June cattle grazing.

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Study Area

The grazing study was initiated in 1987 on Stanley Creek, Sawtooth National Recreation Area, Sawtooth National Forest, central Idaho. The study area is at latitude 44° 15' 46" N; longitude 114° 59' 02" W, where Stanley Creek flows through a broad, flat valley with a westerly aspect at an elevation of 1,950 m. The creek averages 2 to 3 m in width. Annual precipitation during the treatment years (1987 through 1995) was approximately 20% to 25% below the 389 mm average. Precipitation was 46% higher than average during the post-grazing year (1996) when final measurements were taken. Long-term average temperature during the June grazing period is 11 °C; average annual temperature is 2 °C.

The area is representative of a mountain meadows ecosystem in a forest zone of the Western United States containing wet to intermittently wet sites. Typical plant species included: Kentucky bluegrass *(Poa pratensis)*, tufted hairgrass *(Deschampsia cespitosa)*, water sedge *(Carex aquatilis)*, beaked sedge *(C. rostrata)*, Baltic rush (*Juncus balticus)*, foxtail *(Alopecurus* spp.*)*, timber danthonia *(Danthonia intermedia)*, thick-stemmed aster *(Aster integrifolius)*, cinquefoil *(Potentilla* spp.*)*, gentian *(Gentiana* spp.*)*, Lemmon's willow *(Salix lemmonii)*, and Drummond willow *(S. drummondiana)*.

Stanley Creek and the surrounding meadows have had a long history of use and disturbance by European settlers. Mining, water diversion, travel routes, and heavy grazing by sheep and cattle all occurred within the last 140 years. Few records of grazing history are available before the 1970s. In the decade immediately preceding this study the dry meadow areas were experiencing use rates of 60 to 65%. No records of use along the stream edge were available.

Materials and Methods

Six experimental pastures, 3.7 to 9.0 ha, were established along Stanley Creek in fall 1986. Grazing was conducted annually with cow-calf pairs in the last half of June from 1987 through 1995, except for 1993 when concerns about federal listing of chinook salmon *(Oncorhynchus tshawytscha)* as a threatened species precluded grazing. Two pastures were assigned to each of the three treatments: medium grazing (average of 2.20 animal units months [AUM] ha^{-1}), light grazing (average of 1.27 AUM ha^{-1}), and no grazing. Target use rates on the dry meadow portions of the pastures were 50% for the medium, 25% for the light, and 0% for the no grazing treatments. Stocking was adjusted so that all pastures were grazed for a similar period (usually 14 days).

Stream channel characteristics were determined on 31 cross-stream transects per pasture during mid summer in 1986, 1990, 1994, and 1996. Variables measured included wetted width, average wetted depth, bank stability, bank alteration, channel bottom embeddedness, and channel bottom textural composition. Streamside plant attributes were determined on 45 to 59 0.25-m^2 plots per pasture. Sampling was conducted in 1987, 1990, 1994, and 1996. Willow heights were measured at the beginning and the end of the study (1987 and 1996).

Analyses were based on comparisons between the initial reading for a variable and later readings. Stream profile variables were analyzed as proportional changes because stream channel width and width / depth ratio were physically limited in their potential response. Other variables were analyzed based on numeric differences between initial and later readings. Variables were transformed as necessary to normalize data distributions. Analyses of treatment effects were conducted by Analysis of Variance (ANOVA) using a General Linear Model. Repeated measures analysis was used when data included more than one response year. Plant community-type frequency of occurrence was examined by Chi-square analysis. Significant differences among means in ANOVA tests were identified using a protected Fisher's Least Significant Difference. Additional T-tests were conducted to determine if responses within individual treatments differed from the initial readings. Probabilities of 0.05 or less were considered significant in all analyses.

Results

Streamside graminoid use averaged 35.2% for the medium grazing treatment and 21.6% for the light grazing treatment (equivalent rates for the dry meadow were 51.8% and 25.0%). The residual streamside stubble heights for graminoids immediately following grazing were 10.5 cm for medium grazing and 14.1 cm for light grazing. Season-end stubble heights were 12.9 cm for medium grazing, 16.4 cm for light grazing, and 26.2 cm for no grazing. These use levels were apparently less severe, and the season of grazing more restricted, than had been the situation on the study site for most of this century.

Stream Channel

A decrease in stream width occurred under all treatment regimes from 1986 to 1996 (Clary 1999). The average amount of narrowing was inversely associated with grazing intensity. The ungrazed pastures, which displayed the greatest stream narrowing, showed the greatest increase in stream depth compared to 1986. The width / depth ratio decreased under all treatments at study end as compared to pre-study conditions; the ungrazed treatment produced greater decreases than either grazed treatment. Ratings of streambank stability improved at a similar rate for the three grazing treatments. Ratings of physical streambank alteration decreased under all treatments by the end of the study; the ungrazed treatment showed the most change. Large particle embeddedness in the stream channel bottom had decreased in all treatments at study end; the least change occurred under medium grazing. By the end of the study, fine sediments had decreased under light grazing, but they had remained the same under heavy grazing and no grazing.

Riparian Vegetation

Willow height and cover increased under all treatments during the study period (Clary 1999). The changes in height did not differ among treatments; whereas, the greatest increase in willow cover occurred in the absence

of grazing. Graminoid heights and cover did not differ among treatments, nor did differences occur in frequencies of individual plant community-types in the streamside locations. An increase occurred, however, in frequency of a combined group of strongly-rooted, late seral species (water sedge, beaked sedge, baltic rush, and bluejoint reedgrass [*Calamagrostis canadensis*]) in the ungrazed and lightly grazed pastures. This increase was nearly matched by a nonsignificant downward trend in the Kentucky bluegrass community-type. The grazed treatments experienced a greater increase in total plant species during grazing than the ungrazed treatment.

Discussion

Grazing along streambanks does as much or more damage to stream-riparian habitats through bank alteration as through changes in vegetation biomass. Overuse by cattle can easily destabilize and break down streambanks as vegetation is weakened and hoofs shear bank segments. As grazing and trampling damage decrease, residual vegetation helps to trap sediments that serve as base material to rebuild streambanks (Clary et al. 1996). When streambanks rebuild and channels narrow, the decreased width / depth ratio improves the stream's hydraulic and sediment transport efficiency, and provides potential increases in fish hiding cover (Bjornn and Reiser 1991, Kozel et al. 1989, Morisawa 1968).

All treatments decreased in substrate embeddedness by the end of the study, but the decrease in proportion of the surface composed of fine sediments was variable. This response may have been affected by downstream movement of old dredge mining sediments. Channel bottom conditions are greatly affected by sediments from upstream sources and may not respond rapidly to on-site management (Rinne 1988).

Streamside vegetation canopies, particularly of various species of willow, provide fish with cover, modulate stream temperatures, and contribute leaf detritus and terrestrial insects that expand food sources for fish (Murphy and Meehan 1991). Willow characteristics of height and cover increased under all treatments of this study. Maintenance of an adequate herbaceous forage supply (Winward 1994, Pelster 1998) and control of grazing season (Kovalchik and Elmore 1992, Winward 1994) reduced impacts on the willow community compared to historic grazing procedures . Some impact on willows is typical even under managed grazing (Myers and Swanson 1995), thus, the positive growth response of willows in this study exceeded expectations.

The extent and strength of late seral, graminoid community-type roots and rhizomes provide essential stability to streambanks in meadow sites (Kleinfelder et al. 1992, Dunaway et al. 1994) allowing undercuts to form as habitat segments for salmonids (Platts 1991). The increase in frequency of these plants in moist streamside locations under light or no grazing was expected (Green and Kauffman 1995).

Although changes were slow in this cold mountain valley, these early season grazing regimes allowed improvements in stream channel conditions and streamside characteristics. Most measurements improved to some degree under all 3 treatments. This suggests that practices that leave 10 to 14 cm of residual forage stubble height provide an avenue for riparian habitat improvement while maintaining substantial livestock use of cold mountain meadow areas.

Acknowledgments

The authors wish to thank Alma Winward, USDA Forest Service, and Clayton Marlow, Montana State University, for their helpful reviews of this paper.

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