PRODUCTION AND REGROWTH OF RIPARIAN SEDGE/GRASS COMMUNITIES

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Summary

Stubble height regulations are frequently used to manage livestock grazing of herbaceous riparian vegetation. The objective of this study was to determine the impact of clipped stubble height and time of clipping on production and regrowth of herbaceous riparian vegetation. In June and July of 2000–2003, 2.2-ft^2 experimental plots were clipped to stubble heights of 2, 4, or 6 inches, and paired control plots were left unclipped. All plots were clipped to ground level in October and regrowth was calculated by comparing clipped and control plots. Results indicate that 1) height of regrowth was associated positively with stubble height and 2) regrowth was less with July compared to June clipping. Annual production was higher with July (3,430 lbs/acre) compared to June (3,169 lbs/acre) clipping but did not vary by clipping height. Production values for clipped plots were higher than for unclipped plots, indicating compensatory production in response to defoliation. Timing and intensity of defoliation were reliable predictors of regrowth and production performance. Most clipping height by time combinations produced end-of-season heights sufficient to meet current federal stubble height requirements (i.e., 4–6 inches). Our results provide insight on the timing and intensity of defoliation that will allow for adequate regrowth to meet different management objectives. However, other factors such as stream channel morphology, animal selectivity, and annual weather variation will need to be considered.

Introduction

End-of-growing-season herbaceous stubble height is an important consideration for managers of riparian areas grazed by livestock. Development of stubble height guidelines in systems grazed by livestock is a difficult task involving knowledge of 1) the relationship between stubble height and sediment deposition (Skinner 1998); 2) the regrowth dynamics of riparian vegetation following grazing (i.e., can the vegetation regrow by the end of the growing season to meet desired conditions) (Clary 1995); 3) the interaction of stubble height and streambank degradation (Clary and Leininger 2000); and 4) special habitat considerations such as optimizing stubble height for wildlife needs (e.g., Neel 1980). Previous research indicates that both timing and intensity of defoliation can impact production and regrowth of herbaceous riparian vegetation (Pond 1961, Clary 1995, Sheeter and Svejcar 1997). However, only a limited number of studies (e.g., Clary 1995) have addressed the simultaneous effects of timing and intensity of defoliation, or the influence of environmental factors on regrowth and production dynamics of riparian communities. Our objective was to determine the impact of timing and intensity of defoliation on regrowth and above ground production of herbaceous riparian species.

Methods

Experimental design

Our study incorporated a randomized block design with split plots within blocks. We utilized three small (<8 ft width) C-channel (Rosgen 1994) streams in Harney County, Oregon. On each creek we selected four 16- by 33-ft research sites (blocks, Fig. 1). Sites ranged in elevation from 3,900 to 4,600 ft. Electric fencing was established around each block in April of 2000 and data were collected during 2000–2003. Plant community types varied across and within streams and included sedge, rush, and grass-dominated stands. Predominant sedges included Nebraska sedge and wooly sedge, dominant grasses were Kentucky bluegrass and redtop, and baltic rush was the most common rush. Treatments were applied within macroplots (split plots) located within 3 ft ("CLOSE") and 13 ft ("FAR", Fig. 1) from the edge of the stream. In all cases, the FAR plots remained within the stream's zone of hydrophytic influence. We located 2.2-ft^2 paired treated (clipped) and control (unclipped) plots in each macroplot (Fig. 1). Each plot pair was randomly assigned to a clipping date and stubble height combination (Fig. 1).

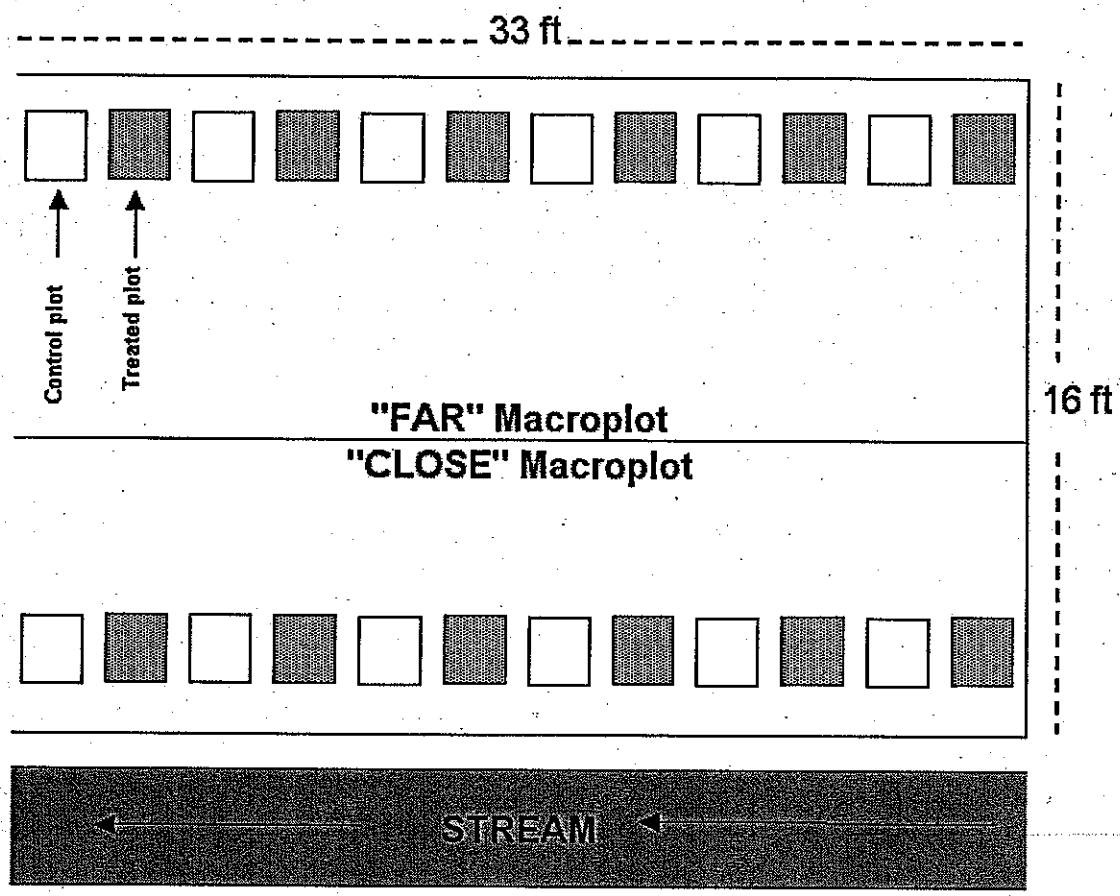


Figure 1. The basic block design used along streams in Harney County, Oregon. There were four such sites used along each of three, C-channel streams.

Clipping treatments

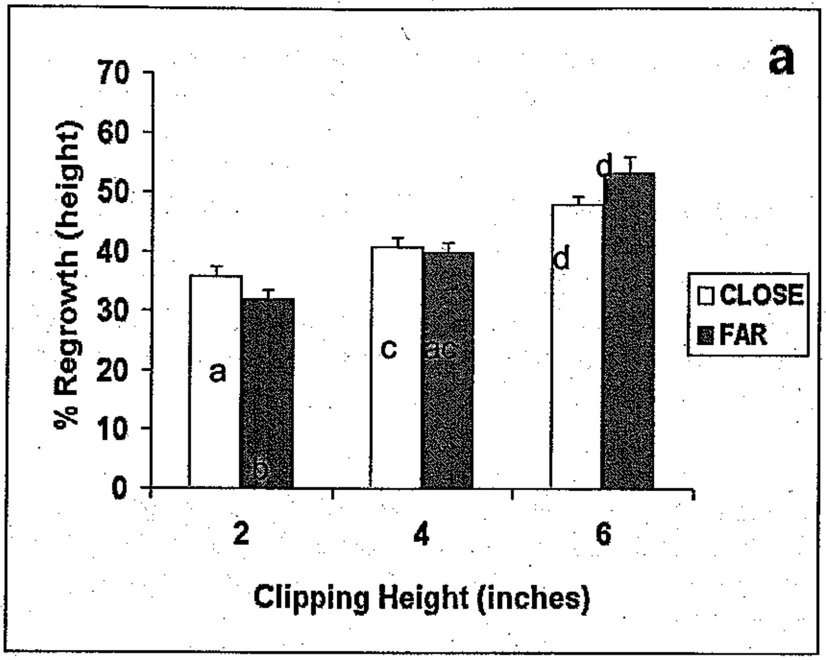
Plots were clipped to 2, 4, or 6 inches in either late June or late July. Most herbaceous species were in early flower at the time of the June clipping and seeds were nearing maturity by the July clipping. All plots, including the controls, were clipped to ground level at the end of each growing season (Oct), and regrowth and annual (season long) aboveground production were determined. Regrowth was calculated by dividing the end-of-growing-season (Oct) height of the treated plots by that of their paired control plot. We calculated annual production of treated plots by summing the weight of clipped vegetation across the growing season. Annual production in treated plots was also calculated as a percentage of paired control plots.

Statistical analysis

Data were statistically analyzed for clipping height, time, and distance from stream channel effects on annual production and percent regrowth by height using mixed model analysis of variance (PROC MIXED, SAS 1999). Clipping height, time, and distance from stream were designated as fixed effects. Main effects and interactions were considered significant at $\alpha = 0.10$. When significant main or interactive effects were found we assessed differences in treatment means using the LS MEANS (SAS 1999) procedure at $\alpha = 0.10$.

Results

Height regrowth was influenced by the interactive effects of clipping height by clipping time, and clipping height by distance from active stream channel. Values for height regrowth were generally less than 50 percent (of control plots) and increased with increasing clipping height (Fig. 2). Distance from stream had little impact on height regrowth with the exception of the 2-inch clipping height, where the CLOSE plots had 13 percent greater regrowth than FAR plots (Fig. 2a). Plots clipped in June had greater height regrowth at all clipping heights compared to those clipped in July, with an average increase (across clipped stubble heights) of 34 percent for June clipping (Fig. 2b). End-of-growing-season height (Fig. 3) ranged from a low of 3.5 inches for the 2-inch, FAR, July clipping treatment to 7.5 inches for the 6-inch, FAR, June clipping treatment (Fig. 3). End-of-season height for unclipped plots averaged about 15 inches. Annual production varied by time of clipping and increased from 3,169 lbs/acre for June clipping to 3,430 lbs/acre for July clipping (Fig. 4a). Weight of vegetation harvested at the time of clipping made up a greater proportion of annual production for plots clipped in July than in June (Fig. 4a). Production as a percent of control plots was influenced by year of clipping and ranged from 123 percent in 2000 to 108 percent in 2001 (Fig. 4b). Values for 2000 were 14 and 10 percent higher than 2001 and 2002, respectively (Fig. 4b).



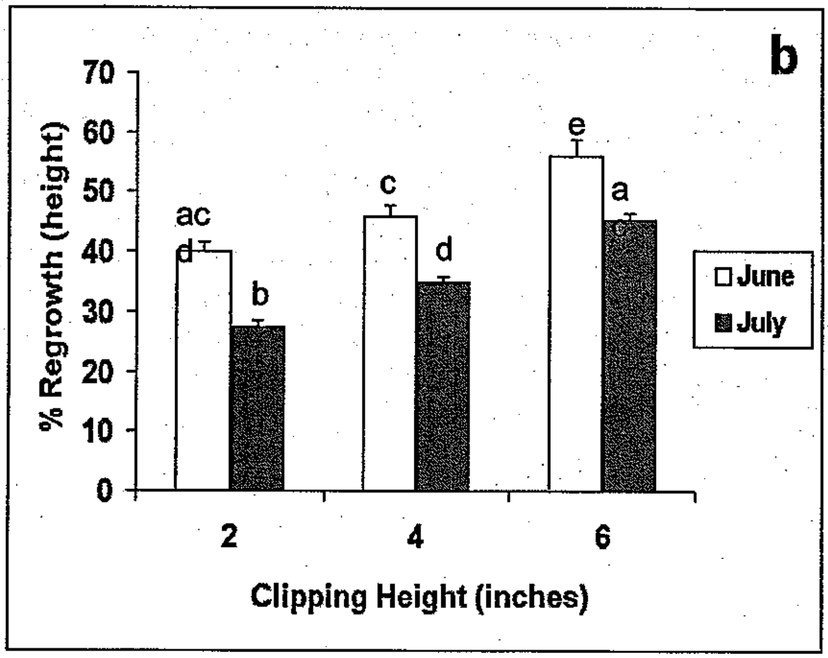


Figure 2. The influence of clipping height and a) distance from active stream channel and b) clipping time, on percent height regrowth for herbaceous riparian plants in plots located along streams in Harney County, Oregon. Regrowth was calculated by dividing end-of-growing-season (Oct) height of experimental plots by that of paired control plots. Bars without a common letter are different at $\alpha = 0.10$

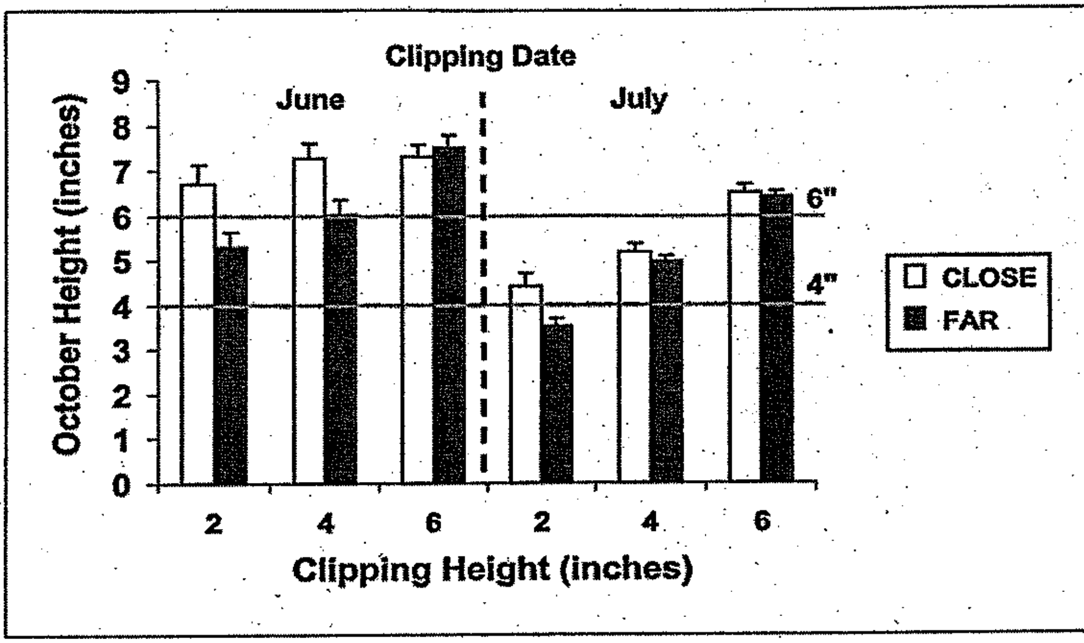
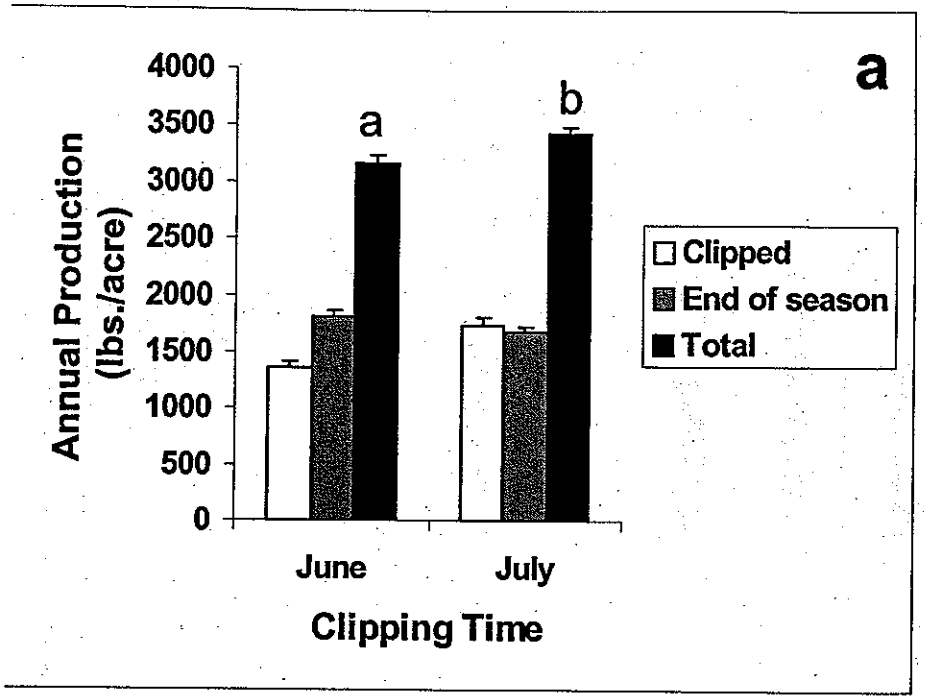


Figure 3. The influence of clipping height, clipping time, and distance from active stream channel on end of growing season (Oct) height for herbaceous riparian plants in plots located along streams in Harney County, Oregon. Lines have been superimposed to indicate 4- and 6-inch stubble height requirements.



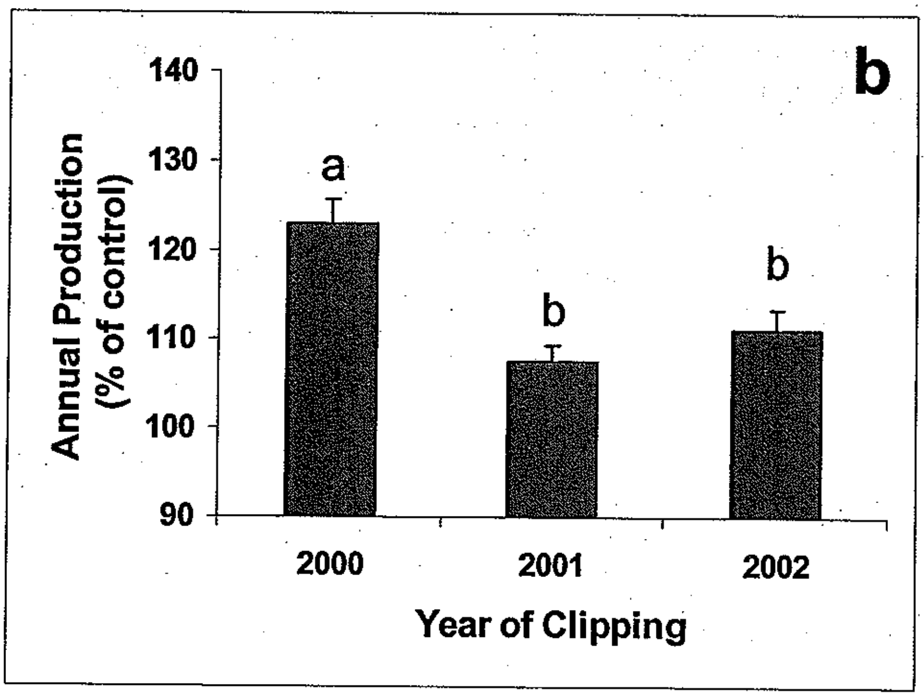


Figure 4. The influence of a) clipping time on annual above ground production, and b) year of clipping, averaged over clipping height and location, on annual above ground production (expressed as a percentage of control plots) for herbaceous riparian plants in plots located along streams in Harney County, Oregon. Bars without a common letter are different at $\alpha = 0.10$. In figure 4a only "total" production was tested in the statistical model; "clipped" bars represent the weight of vegetation harvested at the time of clipping and "end-of-season" bars represent standing crop after clipping plus regrowth.

Discussion

Clipped stubble height and time of clipping were strongly related to end-of-season height regrowth performance. The regrowth response of plants to timing of clipping supported the hypothesis that later clipping (July) produces less regrowth than early clipping (June). This trend would have probably been accentuated with clipping even later in the growing season. In Oregon, Sheeter and Svejcar (1997) reported minimal weight regrowth for herbaceous riparian species clipped to ground level in August, while Gillen et al. (1985) found no regrowth for riparian meadow species grazed after July.

Above ground annual production was relatively insensitive to clipping height, but our data suggest that early summer is a critical time for biomass accumulation, since clipping later in the growing season (July) resulted in greater season-long production (Fig. 4a). Absence of a year effect on annual production suggests that our clipping treatments would be sustainable over time. Production responses to defoliation reported in the literature are not definitive (Pond 1961, Clary 1995, Skinner 1998). Differences in production responses between studies may be associated with species-specific responses with grass-dominated communities responding more positively to defoliation than sedge communities (Pond 1961, Clary 1995). In our study, we observed a compensatory effect of clipping on annual above ground production (i.e., annual production was higher in clipped compared to control plots; Fig. 4b) and the degree of compensatory production was similar across clipping treatments.

From a management perspective, height regrowth response at the clipping heights and times used in this study generally provided sufficient regrowth to meet end-of-growing-season stubble height requirements on federal lands (approximately 4 to 6 inches; Clary 1995). A 4-inch stubble height requirement was met by all but the 2-inch, FAR, July clipping. Conversely, only about 50 percent of the clipping treatments (mainly those clipped in June) met a 6-inch requirement. While end-of-season height was sensitive to clipped stubble height, annual production was not; our data suggest that timing of grazing is more important to maximizing annual production, with late defoliation (July) producing more season-long forage than early (June).

Managers should consider that stubble height is only one of many tools available to gauge management impacts on resource integrity, and that our study of uniform clipping would be difficult to replicate with any type of grazing except very high stocking densities. During dry years and on sites with reduced water availability (e.g., down-cut stream channels), regrowth and production values may respond less positively to defoliation at a given stubble height. Grazed stubble height may interact with season of use, with early-season grazing producing less use of riparian areas at a given stocking rate because of improved palatability of upland forages at this time (Gillen et al. 1985, Clary and Booth 1993). In a larger context, the results of the current study may apply to grazing management of meadow systems that contain riparian-associated plant species but are not directly influenced by stream hydrology. In such cases, our data indicate that grazing during July can maximize herbaceous production compared to grazing earlier in the season. Where feasible, rotational grazing among pastures may be used to provide a balance between residual stubble height and forage production.

Acknowledgements

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