LIVESTOCK GRAZING IN CUT JUNIPER WOODLANDS

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INTRODUCTION

Cutting to remove tree competition is commonly used in areas invaded by western juniper and has resulted in increased understory biomass, forage quality, ground cover, and diversity. These results are based on resting sites two or more years after cutting. Reintroduction of livestock after treating juniper has not received adequate study. Juniper treatments occupy relatively small areas (a few acres to several hundred acres) in large pastures (thousands of acres) used by livestock. Resting entire pastures until these areas recover may be warranted biologically, but may not be practical from a management perspective. At the same time, introducing livestock too soon after juniper treatments may inhibit understory recovery, particularly on sites with a diminished perennial bunchgrasses component, and/or permit dominance by weedy annuals. Understory dynamics in western juniper woodlands were assessed under grazed and ungrazed conditions in years immediately following tree cutting. The grazing prescription was intensive and of short duration (5 days or less). Cover, density, and seed production of understory species were monitored over a 3-year period after cutting in 1991.

MATERIALS AND METHODS

Study Site

The study site was located on Steens Mountain, southeast Oregon. Elevation at the site is 1550 m (5000 ft) and aspect is west facing with a 22% slope. The pasture used is 300 acres in size. Livestock since 1999 have access to about 160 acres of the pasture. Juniper has fully occupied about 40% of the site. The other 60% of the pasture is open woodland with a sagebrush/bunchgrass understory. Juniper dominated areas are where the experimental treatments were applied. On the juniper-dominated sites, big sagebrush has been largely eliminated with only a scattering of old, decadent shrubs remaining. On ungrazed plots, juniper canopy cover averaged 27% and tree density averaged 112 trees/ac. On grazed plots, juniper cover averaged 25% and tree density was 97 trees/ac. Bare ground was 95% in intercanopy zones and rill erosion was evident throughout the site. Sandberg's bluegrass is the dominant understory species comprising about 75% of total understory perennial plant cover. Other species found on site are bottlebrush squirreltail, bluebunch wheatgrass, Thurber's needlegrass, basalt milkvetch, and pale alyssum. Water year (Oct. 1 - Sept. 30) precipitation at Malheur National Wildlife Refuge weather stations located 16 miles southwest (elev. 4265 ft) and 18 miles northwest (4100 ft) have averaged 11.2" and 9.7" over the past 34 years. Soils on the site are 16 to 20 inches deep, rocky, and are clay loam in texture. Soils are underlain by a welded ash tuff of rhyolite/ rhyodacite composition which blocks root penetration.

Experimental Design

The experimental design includes for 2-acre sized blocks. Vegetation was characterized prior to tree cutting. Trees in half of each block were cut with chainsaws in Sept.-Oct. 1998. All cut juniper trees were left in place. A 4-strand barbed wire fence was built through the center of each plot in August 1999. Half of each woodland and cut treatment replicate was grazed in 1999 and 2000 with the other half protected from domestic livestock. Post-treatment measurements of understory characteristics were made in June 1999, 2000, and 2001. Plots were short duration grazed in early May 1999 and 2000. Livestock were in this pasture 4-5 days. Plots were not grazed in 2001.

Understory Sampling

Understory measurements were canopy cover, density, and seed production. Understory plants were measured by species, but for this article are condensed into five functional groups. Functional groups are Sandberg's bluegrass, perennial bunchgrasses (e.g. Thurber's needlegrass, bluebunch wheatgrass, squirreltail), perennial forbs, annual grasses, and annual forbs. Understory plant density and canopy/ground cover was measured using 0.2-m^2 (2-ft^2) frames along three 45-m (150-ft) transects in both grazed and ungrazed portions of the cut and uncut woodlands. Seed was collected in five 100 ft^2 plots for each treatment replicate. Seed was collected by hand for all perennial grass species by hand twice per week from late June into early August in 2000 and 2001. Seed was not collected in 1999 the first year after cutting as there was little reproductive development.

RESULTS

Understory Response

Pre-cutting

Measurements in 1998 did not show any major differences in plant cover (Tables 1 and 2) or density (Table 2) among plots that were left as woodlands and plots that were selected to be cut. Densities of perennial grass were greater in plots selected to be cut than those left as woodland.

Grazing

The grazing application was intensive and of short duration (5 days or less), and occurred in early May 1999 and 2000. In 1999, plots were grazed by 140 cow/calf pairs for 5 days and by 50-75 cow/calf pairs for 4 days in 2000. Utilization in cut-grazed plots averaged 75% in 1999 and 2000. Utilization in grazed/woodland plots averaged 67% in 1999 and 15% in 2000. Regrowth (data not compiled) occurred in cut-grazed plots but not in the woodland. Most regrowth in the cut-grazed treatment was vegetative.

Post-Cutting

Sandberg's bluegrass - There were no differences in cover, density, and seed production between cut and woodland plots - grazed and ungrazed treatments (Table 2 and 3).

Table 1: Ground covers, bare ground, rock, and juniper cover for grazed and ungrazed cut and woodland treatments.

Year	Treatment	Herbaceous Cover	Litter	Moss/crust	Bare ground	Rock	Juniper Cover
1998	Grazed - Cut	5.3	3.9	0.9	54.6	10.3	25.5
	Ungrazed - Cut	4.5	2.8	0.9	55.4	12.1	25.1
	Grazed-Woodland	4.6	2.1	0.8	60.2	8.2	29.0
	Ungrazed-Wood.	4.6	2.5	0.7	60.4	10.2	27.4
2000	Grazed-Cut	7.3	41.2	0.1	47.9	7.9	---
	Ungrazed-Cut	8.6	33.0	0.1	47.8	7.8	---
	Grazed-Woodland	4.2	1.8	0.6	63.8	8.1	28.7
	Ungrazed-Wood	4.0	2.1	0.5	62.5	9.2	27.4
2001	Grazed - Cut	16.4	32.5	0.1	47.9	4.0	---
	Ungrazed - Cut	15.7	31.2	0.1	47.3	6.4	---
	Grazed-Woodland	3.7	1.0	0.4	59.7	7.4	28.4
	Ungrazed-Wood	3.6	2.4	0.5	61.2	10.0	26.5

Table 2: Functional group covers and densities for grazed and ungrazed cut and woodland treatments.

Year	Treatment	Sandberg Bluegrass		Perennial Grass		Annual Grass		Perennial Forb		Annual Forb	
		Cover	Density	Cover	Density	Cover	Density	Cover	Density	Cover	Density
1998	Grazed	2.3	8.6	1.0	2.2	0.2	22	0.6	2.1	1.2	409
	Ungrazed	1.9	7.1	0.7	2.8	0.4	28	0.3	1.2	1.2	444
	Graze-Wood	1.4	5.9	0.7	1.8	0.2	21	0.2	1.0	0.8	387
	Ungraze-Wood	1.5	5.5	0.6	1.7	0.4	19	0.1	1.4	0.8	389
2000	Grazed	1.1	3.1	1.3	2.0	1.5	24	0.4	3.0	3.0	33
	Ungrazed	1.7	3.7	1.6	2.4	0.7	13	1.7	4.4	2.9	33
	Graze-Wood	1.5	5.6	0.7	1.8	0.5	20	0.3	0.8	0.8	45
	Ungraze-Wood	1.5	5.7	0.6	1.6	0.4	12	0.3	1.1	0.6	47
2001	Grazed	2.1	6.2	2.2	3.3	9.4	282	0.5	1.5	2.1	346
	Ungrazed	1.6	4.8	2.9	2.6	7.1	233	1.3	2.4	2.3	429
	Graze-Wood	1.4	6.1	0.5	2.1	0.8	11	0.2	0.5	0.9	344
	Ungraze-Wood	1.6	5.9	0.6	1.7	0.3	11	0.4	1.5	0.7	254

Table 3: Seed Production (lb/ac) for grazed and ungrazed cut and woodland treatments.

Year	Treatment	Native Bluegrass	Bluebunch Wheatgrass	Basin Wildrye	Junegrass	Indian Ricegrass	Squirrel-tail	Thurber's Needlegrass	Total
2000	Grazed/Cut	0.1	0.04	0.03	0.0	1.6	0.4	0.5	2.7
	Ungrazed/Cut	0.6	1.8	0.3	0.5	3.8	2.1	5.3	14.4
	Grazed/Wood	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	Ungrazed/Wood	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2
2001	Grazed/Cut	4.8	6.3	0.3	0.3	11.2[1]	6.1	4.7	32.4
	Ungrazed/Cut	5.0	8.3	0.9	2.0	10.8[1]	5.2	11.4	42.2
	Grazed/Wood	4.5	0.0	0.0	0.0	0.1	0.0	0.1	4.7
	Ungrazed/Wood	4.1	0.0	0.0	0.0	0.0	0.0	0.2	4.4

[1] Ricegrass seed heads were clipped so weight includes all material in the upper seed stock. Thus the values shown here overestimate actual seed production of ricegrass.*Perennial Bunchgrasses* - Cover in cut plots increased between 1998 and 2001 and was greater than in the woodlands by 2001 (Table 2). Densities of perennial grass remained greater in cut plots versus the woodlands. No differences were found between grazed and ungrazed portions of the cut/woodland treatments in cover or density (Table 2). Seed production differed significantly among the treatments (Table 3). Seed production was greatest in the ungrazed-cut treatment. Woodland grazed and ungrazed treatments had little seed production in both collection years (and was primarily composed of Sandberg's bluegrass). Cut plots had greater seed production in 2001 versus 2000. Thurber's needlegrass seed production was sensitive to the grazing treatment. Thurber's needlegrass seed production was significantly less in the grazed compared to the ungrazed treatment in both years.

Annual Grasses - Annual grass response trend has been similar in ungrazed and grazed-cut plots (Table 2). Cover and densities of annual grasses did not differ between the two treatments in all years. Annual grass density and cover were greater in the cut versus woodland treatments. The increase in annual grass density and cover has largely been under cut trees and around old litter zones. Annual grass presence is limited in intercanopy zones.

Perennial Forbs - Perennial forb cover and density has tended to be greatest in the cut-ungrazed versus the other treatments (Table 2)

Annual Forbs - Annual forb density did not differ among treatments (Table 2). Annual forb cover was greater in cut treatments (grazed and ungrazed) in all years after cutting compared to the woodlands.

Total ground cover - Ground cover (herbaceous, litter, moss, and juniper cover) was nearly 50% greater in the cut treatment (grazed and ungrazed) than in the woodland treatments by 2001 (Table 1). Intercanopy herbaceous cover was 2 times greater in cut versus woodland plots in 2001.

DISCUSSION AND IMPLICATIONS

Grazing following the cutting of juniper had no impact on site recovery in terms of plant cover and density. Increases in herbaceous cover and density were similar in cut-grazed and ungrazed treatments. However, it is difficult to draw any firm conclusions from these results. These trials were conducted across three relatively dry years with little precipitation falling in the spring at this site. Soils on this site are shallow and dry relatively quickly. Regrowth on the cut grazed plots was adequate following May grazing in 1999 and 2000 but this growth was primarily vegetative with little seed produced. The dry conditions were probably a major factor for the lack of perennial grass recruitment in the grazed and ungrazed-cut treatments. Average or higher precipitation years would likely produce differing responses. The relatively short grazing prescriptions imposed were detrimental to seed production on the cut-grazed versus the ungrazed cut treatment. Thurber's needlegrass seed production was negatively impacted by the grazing prescription. Other perennial grass species seed crops were less affected by grazing. How this may affect further site recovery will be determined by continued monitoring of these treatments.

Grazing management, particularly on drier type-sites such as the one described here, will require thorough consideration. The site used in this study probably requires rest or deferment during the first few growing seasons to provide plants the opportunity to produce maximum seed crops and permit seedling establishment. Juniper cutting on these type of areas should attempt to coincide with regular pasture rotations so cut areas are rested or deferred in years immediately following juniper treatment. Grazing in late summer and fall may be permissible as plants are largely dormant during this time. Unplanned grazing on parts of 4 cut plots (cut in 1991) from an earlier study done on the same locale during late summer and early fall in 1992 and 1993 did not retard understory recovery on these plots (Bates et al. 1998 and 1999). However, these results should be considered anecdotal and require further investigation for research verification.

Older cut treatments (1991) that were rested 2 years following cutting have seen significant increases in perennial grass density and cover with or without grazing (Bates et al. 1998 and 1999). In cut-grazed plots (spring grazed 1994-1997), perennial grass density increased by 333% and cover by 300% between 1991 and 1998. In ungrazed-cut plots, perennial grass density increased by 575% between 1991and 1997 with similar increases in cover.

Finally, increases in annual grass density and cover occurred under both grazed and ungrazed conditions. Removal of grazing did not prevent annual grass from increasing in the cut treatment.

LITERATURE

Bates, J., R.F. Miller, and T.J. Svejcar. 1998. Understory patterns in cut western juniper (*Juniperus occidentalis* spp. *occidentalis* Hook.) Woodlands. Great Basin Nat. 58(4):363-375.

Bates J., R.F. Miller, and T.S. Svejcar. 1998. Understory dynamics in a cut juniper woodlands (1991-1997). Eastern Oregon Agricultural Research Center Annual Report. Special Report 991, June 1998. Agri. Exp. Sta. Oregon State Univ. & USDA-Agric. Res. Ser. p. 24-33.

Bates J., R.F. Miller, and T.S. Svejcar. 1999. Plant succession in cut juniper woodlands: 1991-1998. Eastern Oregon Agricultural Research Center Annual Report. Special Report 991, June 1998. Agri. Exp. Sta. Oregon State Univ. & USDA-Agric. Res. Ser. p. 24-33.

Bates, J.D., R.F. Miller, and T.J. Svejcar. 2000. Understory vegetation response following cutting of western juniper. J. Range Manage. 53(1): 119-126.

Burkhardt, J.W. and E.W. Tisdale. 1969. Nature and successional status of western juniper vegetation in Idaho. J. Range Manage. 22:264-270.

Burkhardt, J.W. and E.W. Tisdale. 1976. Causes of juniper invasion in Southwestern Idaho. Ecology 57:472-484.

Driscoll, R.S. 1964. Vegetation-soil units in the central Oregon juniper zone. Res. Pap. PNW-19. USDA - Forest Service, Pacific Northwest Forest and Range Experiment Station. Portland, Ore.

Eddleman L.E. 1987. Establishment and stand development of western juniper in central Oregon. pp. 255-259. In: R.L. Everett, ed., Proceedings, Pinyon-Juniper Conference. Inter. For. Range Res. Sta., USDA-For. Ser., Gen Tech. Rep. INT-215. Ogden, Utah.

Everett, R.L. 1987. Plant response to fire in the pinyon-juniper zone. p. 152-157. In: Proc. Pinyon-Juniper Conference, R.L. Everett (ed), Inter. For. Range Res. Sta., USDA-For. Ser. Gen. Tech. Rep. INT-215. Ogden, Utah.

Everett, R.L. and K.O. Ward. 1984. Early plant succession in pinyon-juniper controlled burns. Northwest Science 58:57-68.

Miller, R.F. and J. D. Bates. 2001. History, Ecology, and Management of Western Juniper Woodlands and Associated Shrublands: 2000 Annual Report. Eastern Oregon Agric. Research Center, Burns Oregon. 80 pp.

Miller, R.F. and J.R. Rose. 1995. Historic expansion of *Juniperus occidentalis* southeastern Oregon. Great Basin Nat. 55:37-45.

Miller, R.F. and P.E Wigand. 1994. Holocene changes in semiarid pinyon-juniper woodlands; responses to climate, fire, and human activities in the U.S. Great Basin. BioSci. 44:465-474.

Rose, J.R. and L.E. Eddleman. 1994. Ponderosa pine and understory growth following western juniper removal. Northwest Sci. 68:79-85.

Vaitkus, M.R., and L.E. Eddleman. 1987. Composition and productivity of a western juniper understory and its response to canopy removal. pp. 456-460. In: Proceedings-Pinyon-juniper Conference, R.L. Everett, ed. Inter. For. Range Res. Sta., USDA-For. Ser. Gen Tech. Rep. INT-215. Ogden, Utah.