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VEGETAL RESPONSES AND BIG GAME VALUES AFTER THINNING REGENERATING LODGEPOLE PINE[1]

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Abstract.— Understory vegetal response was found to significantly increase with the degree of thinning in an early regenerating, dense stand of lodgepole pine (*Pinus contorta*). The value of the increased vegetation for deer and elk was determined to be important through comparisons with known dietary and habitat preferences.

Following removal of mature lodgepole pine stands, regeneration is frequently dense and results in early stagnation (Forest Service 1962). Although thinning of young stands often increases the rate of growth (Trappe 1959) and harvested yields (Wikstrom and Wellner 1961), other values should be considered, especially when cost/benefit ratios for timber are marginal. Increases in forage production are a potential additional value; however, the relationship between forest thinning and big game habitat values remains ambiguous (Wallmo and Schoen 1981:445). This paper reports the response of understory vegetation four years following thinning treatments in a dense, 16-year-old lodgepole pine stand and, using previously determined diets and habitat preferences, assesses the potential value for deer and elk.

Area and Methods

The study was on the Ashley National Forest in northeastern Utah near East Park Reservoir at 2700 m elevation. Lodgepole pine covers 92 percent of the area, which is an undulating upland draining to the south.

Natural regeneration of forest stands following harvest or fire in the area has resulted in dense stands of trees, usually requiring thinning to prevent stand stagnation. This study was conducted on one such stand bulldozed and broadcast burned for wildlife and timber values in 1960 and 1961. The regenerated stand in 1976 had a density of 6200 stems per ha and mean height of 2 m compared to the adjacent untreated stand with about 8500 stems per ha and 10 m height.

Three replicates of four macroplots, each 20 × 20 m with 4 m buffer strips, were arranged in a randomized block design. Clearcut, heavy thinning, moderate thinning, and control treatments were established during August 1976 (Fig. 1); trees were handcut and removed. The heavy and moderate thinning treatments left about 1100 and 2200 stems per ha, respectively, which compare with about 1300 stems per ha in nearby stands scheduled for logging and 2000 stems per ha for estimated maximum yield in the Rocky Mountains (Forest Service 1962). Vegetal production and ground cover were determined during August 1976 and 1980 using the microplot-macroplot approach (Poulton and Tisdale 1960) with the modifications of Deschamp et al. (1979). Estimates were recorded on each of 40 microplots (20 × 50 cm) within each macroplot, with every tenth plot subsequently clipped and weighed for double sampling regression analysis. The 1980 data were subjected to a covariance analysis using 1976 as the covariant.

Vegetal Change

The response of understory vegetation to tree removal was determined using four indices (Table 1). The first two indices, production and ground cover, indicate the amount of vegetal change, and the latter two, density

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Fig. 1. Stand reduction treatments on lodgepole pine regenerating forests: clearcut (upper left), heavy thinning (upper right), moderate thinning (lower left), and control (lower right).

and number of species, reflect community complexity. With the four indices the mean response between 1976 and 1980 was generally greatest in the clearcut, followed by the heavy thinning, moderate thinning, and control.

Mean understory production increased 82 percent on the clearcut, 8 percent on the heavy thinning, 2 percent on the moderate thinning, and the control decreased 18 percent. Ground cover increased a mean 102 percent on the clearcut, 47 percent on the heavy thinning, 17 percent on the moderate thinning, and 14 percent on the control. The differences in production and cover due to treatment effects were significant ($p<.05$).

Species density, the mean number of species encountered on the 0.1 m^2 plots, and the number of species present per macroplot showed similar trends. Density increased 59, 43, 26, and 16 percent on the clearcut, heavy thinning, moderate thinning, and control, respectively, and the mean number of species increased 5.4 on the clearcut and heavy thinning, 4.0 on the moderate thinning, and 1.6 on the control. However, responses due to treatment effects were not significant, although species density approached significance ($P<.06$).

Means adjusted for pretreatment condition showed significant differences between treatments (Table 1). The adjusted means represent the expected values in the fourth year following treatments that would have resulted had initial data on all macroplots within replications been equal. The clearcut treatment showed significant increases ($P<.05$) in indices' values over those of the control in production, cover, and density, with number of species approaching significance ($P<.08$). Similarly, the heavy treatment was significant in cover, density, and number of species, and production approached significance ($P<.07$). None of the values in the moderate thinning were significant ($P<.05$); production became significant at $P<.10$ and number of species at $P<.09$, however.

These results show a substantial increase in the amount of understory forage and plant community complexity following clearcut and heavy thinning treatments. Furthermore, although the control showed a decrease in production and only a slight increase in cover, density, and number of species, the clearcut and heavy thinning treatments, in contrast, showed a positive change in production and much larger increases in the other indices. The moderate treatment had lesser increases. Although each of the four indices evaluated in this study is useful in describing community composition, it is apparent that production and cover are more sensitive in detecting changes. Similar results have been reported by Basile and Jensen (1971) and Regelin et al. (1974) in clearcut areas of lodgepole pine forests elsewhere.

Value to Big Game

Although a treatment may result in significant increases in plant production, unless the increase is within preferred grazing areas and composed of species palatable to potential grazers, changes in forage production are inconsequential. Of the five major vegetal segments within the study area—wet and dry meadow and mature, stagnated, and regen-

Table 1. Mean indices of understory vegetal changes: production (kg/ha), ground cover (%), species density (species/0.1 m^2), and number of species (species/macroplot).

	Production	Cover	Density	Number
Treatment	1976–1980	1976–1980	1976–1980	1976–1980
Clearcut	181–329	21–43	2.8–4.4	13–19
Heavy thinning	195–210	20–30	2.5–3.6	11–17
Moderate thinning	172–176	20–24	2.7–3.3	9–13
Control	180–147	19–21	2.3–2.7	10–11
Clearcut	330^{a}	41^{a}	4.2^{a}	16^{ac}
Heavy thinning	196^{b}	30^{b}	3.7^{ab}	16^{ab}
Moderate thinning	187^{b}	23^{bc}	3.3^{bc}	15^{ac}
Control	149^{b}	23^{c}	2.9^{c}	13^{c}

[a,b,c]Different letters are Adjusted Means and indicate significance at $p<.05$ within columns.

erating lodgepole pine forest—regenerating lodgepole pine was the most preferred habitat for deer (Deschamp et al. 1979), and it was second only to the wet meadow for elk (Collins et al. 1978). Thus, increases in production due to thinning would occur in habitats favored by big game.

Potential forage benefits were assessed by comparing the 1976 and 1980 production data of major species (Table 2) with the corresponding dietary preferences for deer (Deschamp 1977) and elk (Collins 1977). Forage preferences were obtained from the ratio of percent diet composition to percent available production (Neff 1974); and preference categories (Table 2), although arbitrarily determined, corresponded to animal selection of forage species under free-ranging field conditions. In response to thinning, most forb species increased in production or remained about the same. Production of grass and sedge species also increased in production except short-stemmed sedge (*Carex brevipes*), which decreased. Conversely, production of browse species tended to show little response to treatment.

Generally deer and elk showed a preference for most browse and forb species, and grasses and sedges were rejected (Table 2). Consequently, the increased production of grasses and sedges would have little benefit to big game. Production increases in forbs could be highly beneficial, particularly since forbs comprised the large majority of the diets; deer 94 percent (Deschamp et al. 1979) and elk 86 percent (Collins et al. 1978). The small response of browse species would not likely affect the diet.

In densely forested areas where natural openings are few, created openings become important as foraging sites (Wallmo et al. 1972, Regelin et al. 1974, Hershey and Leege 1976). However, as regeneration begins to dominate site productivity, understory vegetation declines (Basile 1975). Maximum understory production in lodgepole pine forests occurred only 10–11 years following either timber harvest (Basile and Jensen 1971) or fire (Lyon 1976) disturbance. Consequently, thinning treatments would lengthen the effective forage-producing interval in forest succession.

Table 2. Major plant species within treatment areas, initial production (kg/ha), production after four grazing seasons, and deer and elk diet preferences.

	Control		Moderate		Heavy		Clearcut		Preference[1]	
Species	1976	1980	1976	1980	1976	1980	1976	1980	Deer	Elk
Forbs										
Antennaria spp.	8.1	6.1	4.1	7.0	7.0	3.7	7.2	18.5	+	--
Arnica cordifolia	0.1	5.2	0.3	2.8	1.1	15.2	0.6	5.9	+ +	–
Aster chilensis	0.7	1.5	2.7	4.2	4.8	3.6	8.4	16.3	+	+ +
Astragalus decumbens	38.4	39.7	19.9	33.5	20.1	28.2	26.5	37.9	0	--
Stellaria jamesiana	6.3	9.1	7.9	12.4	6.7	9.9	6.5	8.8	+	+
Taraxacum officinale	18.1	6.5	18.1	14.9	34.6	25.2	15.8	38.1	+	+
12 others	17.7	29.1	13.9	27.0	6.1	17.0	8.9	18.1	+	+
Total	89.4	97.2	66.9	101.8	80.4	102.8	73.9	143.6		
Grasses and Sedges										
Carex brevipes	47.4	23.2	60.5	19.2	62.6	41.8	56.8	42.0	--	--
Carex geyeri	1.1	2.8	11.7	21.3	3.7	7.7	2.1	4.4	--	+
Poa spp.	23.8	12.2	7.6	17.0	14.6	24.9	10.2	40.7	--	--
Sitanion hystrix	0.0	0.0	1.9	0.0	0.0	0.2	3.3	47.7	--	--
5 others	0.0	0.9	0.0	1.1	0.0	5.8	0.0	13.9	--	--
Total	72.3	39.1	81.7	58.6	80.9	80.4	72.4	148.7		
Browse										
Populus tremuloides	14.4	6.0	18.4	6.4	6.9	11.9	0.0	0.9	+	+ +
Rosa nutkana	3.8	4.9	4.7	8.4	25.5	14.2	21.9	23.9	+	+
Salix spp.	0.0	0.0	0.0	0.0	1.1	0.3	2.9	1.6	+	+
4 others	0.0	0.0	0.0	0.6	0.3	0.2	10.2	10.5	+	+
Total	18.2	10.9	23.1	15.4	33.8	26.6	35.0	36.9		
Total	179.9	147.2	171.7	175.8	195.1	209.8	181.3	329.2		

[1]Ratio of % Diet–% production: 0 = no preference (.75–1.50), + = preferred (1.51–4.00), + + = highly preferred (>4.00), – = rejected (.50–.74), -- = highly rejected (<.50).

Our findings indicated an inverse relationship between stand density following thinning and understory vegetal production. Although complete tree removal is untenable on tracts of high site quality, in areas of low timber potential, particularly in stagnated stands, permanent, small openings, consistent with scenic, wildlife, and watershed values (Wyoming Forest Study Team 1971), may be justifiably incorporated into the management plan. Furthermore, both heavy and moderate thinning of regenerating lodgepole pine stands must be considered practical treatments for maintaining or slightly increasing the amount as well as the longevity of the forage resource, particularly when contrasted to the control, which showed a decline in forage production.

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