Initial Response of Bitterbrush to Disturbance by Logging and Slash Disposal in a Lodgepole Pine Forest

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Highlight: *The impact of logging and slash disposal on the bitterbrush understory in a lodgepole pine forest on easily disturbed pumice soils in central Oregon was evaluated. Soils were moderately to heavily disturbed on 75% of the area, and bitterbrush crown cover was reduced by 71%. Most of the damage resulted from slash disposal. Despite extensive damage, shrubs quickly responded to more favorable growing conditions in the postlogging environment. Current twig growth doubled, and large numbers of seedlings were established on disturbed soils.*

The lodgepole pine (*Pinus contorta*)[1] /bitterbrush (*Purshia tridentata*) communities on the pumice plateau of south-central Oregon are important summer range for mule deer (*Odocoileus hemionus hemionus*) and livestock. Increased harvests of lodgepole pine are planned, and managers are concerned about maintaining a bitterbrush understory sufficient for forage needs. Soil, site, and vegetation relationships have been described (e.g., Dyrness and Youngberg, 1966; Youngberg and Dahms, 1970; Franklin and Dyrness, 1973) but there is little information on the impact of logging on understory vegetation.

We studied bitterbrush reduction due to logging disturbance and the initial response of surviving shrubs to the postlogging environment. The results contributed to development of guidelines for coordinated management of timber and wildlife habitat.

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[1] Sources for scientific nomenclature are Little (1953), Hitchcock et al. (1955), and Ingles (1965).

Study Area

The study area was located on the Pringle Falls Experimental Forest, 40 miles southwest of Bend, Ore. Elevation is 4,300 ft and annual precipitation averages 20 inches, mostly as winter snowfall. The growing season is short and frosts are common during the summer.

Soils and vegetation are characteristic of much of the level to gently rolling plateau. Soils are poorly developed and belong to the widely occurring Lapine series formed on pumice deposits. They are primarily composed of easily disturbed sand and pumice gravels, variable in depth and underlain by buried soil (Cochran et al., 1967). Lodgepole pine occurs in extensive, nearly pure stands on flats and in shallow depressions and is the climax species due to topographic conditions preventing establishment of ponderosa pine (*Pinus ponderosa*) (Berntsen, 1967). Several communities dominated by lodgepole pine have been identified (Youngberg and Dahms, 1970), with the lodgepole pine/bitterbrush the most widespread. Characteristic species in the sparse understory include western needlegrass (*Stipa occidentalis*), bottlebrush squirreltail (*Sitanion hystrix*), and Ross sedge (*Carex rossii*).

Table 1. Percent of line intercept by ground disturbance classes.

Ground disturbance class	Definition	Percent of area in this condition
None	No disturbance	8
Light	Litter displacement only	12
Moderate	Soil disturbed <3 inches	32
Heavy	Soil disturbed >3 inches	46
Slash	Debris >3 inches diameter	2
All classes		100

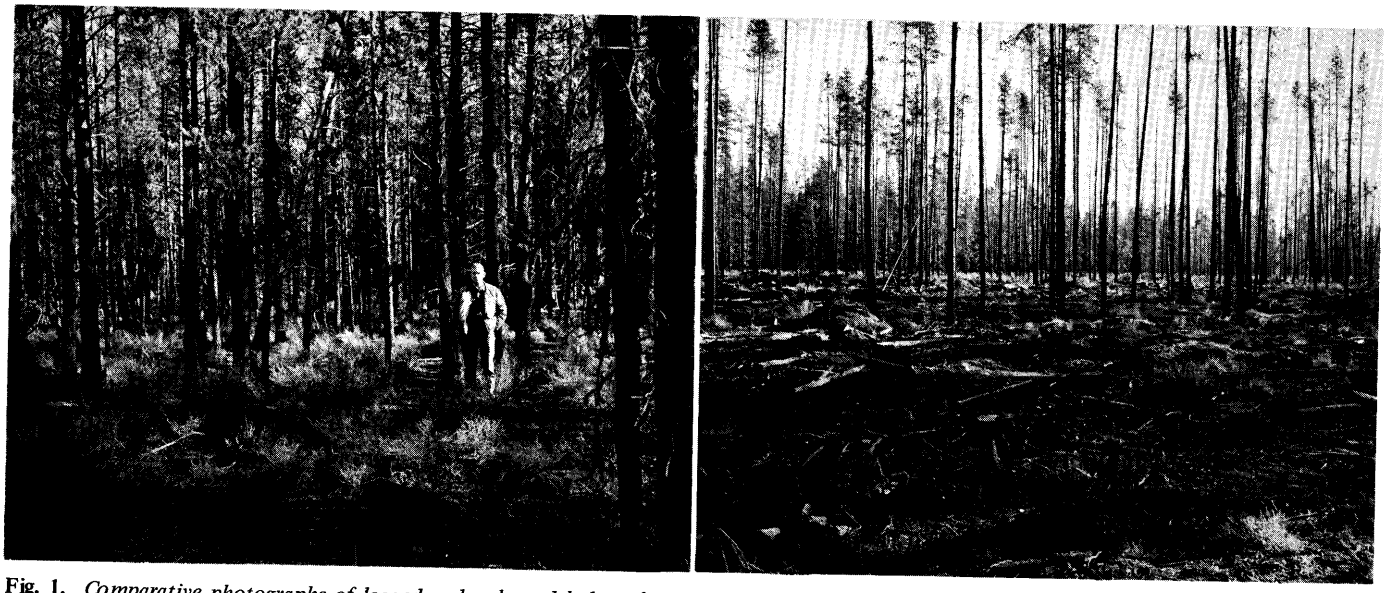

Fig. 1. *Comparative photographs of logged and unlogged lodgepole pine stands. (Left) Unlogged stands averaged 339 trees per acre with a basal area of 91.3 ft². (Right) Logged stands averaged 114 trees per acre with a basal area of 20.5 ft².*

Methods and Results

The study was conducted in three cutting units and three adjacent uncut strips 6 X 40 chains in size. Trees were cut on a 9-inch diameter-limit basis, i.e., only trees 9 inches dbh or larger were harvested. Logging and slash disposal occurred between 1969 and 1971.

Yarding of logs was mostly by a rubber-tired skidder, but a D-4 crawler tractor was also used. Slash was piled with TD-6 and D-8 tractors with brush blades and burned on two units in 1970 and on one in 1971. Data on ground disturbance and bitterbrush damage on all units were included in the analyses, but only the two units piled and burned in 1970 were used for comparing density and age classes of bitterbrush.

Logging dramatically altered the lodgepole pine/bitterbrush community and its environment (Fig. 1). A cruise of 1/20-acre circular plots in each logged (27 plots) and unlogged (15 plots) unit indicated the diameter-limit harvest removed 67% of the trees and 80% of stand basal area.

Prior to logging, nine randomly located 100-ft line transects were established in each unit and marked inconspicuously to minimize their influence on operation of logging equipment. In November, 1972, ground disturbance caused by logging and slash disposal was recorded as percent intercept.

As shown in Table 1, ground disturbance was extensive and severe. Some of the severely disturbed areas showed churning to depths of 9 to 12 inches. Deepest disturbance was noted in slash piles and on fire lanes circling them.

Bitterbrush crown area was measured as crown intercept in November, 1967, (prelogging) and November, 1972, (postlogging). Results (Table 2) for the logged units were surprisingly uniform. Disturbance by logging significantly ($P < .001$) reduced shrub crown area. Intercept/100 ft of transect averaged 15.0 and 4.3 ft before and after logging and slash disposal, a 71% reduction.

Slash piling caused much more damage to shrubs than log skidding, except on frequently used skid trails. Skidding pushed plants over, broke limbs, and uprooted some, but many survived. In contrast, slash piling deeply disturbed the soil, uprooting or burying most plants.

By 1972, damage to the understory was partially mitigated by increases in growth and reproduction of surviving shrubs due to better growing conditions. Measurement of current twigs on randomly selected secondary branches on 30 mature shrubs on each logged and unlogged stand gave a comparative index to the quantity of growth (Smith and Urness, 1962). Annual twig length was significantly greater ($P = .03$) in logged versus unlogged stands, averaging 73 mm and 35 mm, respectively, a 108% increase (Table 2). We felt there was also a related increase in number of twigs but have no supporting quantitative data.

Although logging destroyed 71.5% of the bitterbrush crown area, it created conditions favoring establishment of new plants. Potential recovery to initial levels was estimated from comparative densities of age classes on 27 100-ft² circular plots systematically located in each stand. Shrubs were classified as seedlings, 1 to 3 years old, and ⩾3 years. This separated plants present before logging from those established after logging and slash disposal. Dense clumps of seedlings from rodent caches were counted as one seedling, and care was taken to minimize errors due to layered and multiple stems commonly found in bitterbrush.

Densities and age structures are summarized in Table 3. The comparative photographs in Figure 1 show the appearance of the understory immediately before and after logging. Despite the obvious contrast, 2 years after final disturbance, differences in total shrub densities were not significant ($P = .56$), but there were significant differences ($P < .001$) in age structure. A loss of 76% of the original stand was offset by a 575% increase in shrubs 1 to 3 years old, and a 25% increase in seedlings. Most young plants and seedlings were found on moderately and heavily disturbed ground. The difference between numbers of current seedlings and shrubs 1 to 3 years

Table 2. Effect of logging on bitterbrush: percentage reduction in crown area due to disturbance and increase in twig length in response to better growing conditions.

Logging unit number	Reduction in crown area	Increase in twig length
1	75.2	109.0
2	74.3	94.4
3	65.0	122.1
Average	71.5	108.5

Table 3. Bitterbrush shrubs per acre by age classes in logged and unlogged lodgepole pine stands.

Age classes	Logged	Unlogged
Seedlings	645	516
1 to 3 years old	5,598	829
3 years and older	2,284	8,268
All shrubs	8,527	9,613

old may have been due to either seedling mortality or a lack of seed production.

Bitterbrush densities in both logged and unlogged areas exceeded 8,500 plants per acre (Table 3). In similar communities near La Pine, Ore., Stanton (1959) reported densities of bitterbrush older than 2 years ranging from 8,450 to 19,210 plants/acre. On most deer winter ranges, 500 to 2,000 plants/acre are considered adequate stocking (Hubbard, 1962). But shrubs in these lodgepole communities are small in stature, and many appear suppressed and low in vigor.

Better growing conditions in the logged stands were also reflected in noticeable increases in grasses and forbs which occurred infrequently in unlogged stands. We considered their addition to the forage base beneficial, because there is a need for greater forage diversity on these ranges.

Deer tracks and fecal pellets were found throughout all areas during the study. Evidence of occasional elk (*Cervus canadensis roosevelti*[2]) use was also noted. To determine the influence of logging on patterns of deer and elk use, fecal groups were counted on 27 100-ft^2 circular plots systematically located in each area. Logging did not significantly influence use (occupancy) by deer alone ($P = .21$) or deer and elk combined ($P = .18$). Fecal groups accumulated in logged and unlogged areas averaged 242 and 328 for deer, and 11 and 10/acre for elk, respectively.

Reforestation should also be considered in evaluation of logging impacts on these communities. Foresters want to establish a new lodgepole stand as quickly as possible. Wildlife biologists are also concerned with reforestation because lack of resting or escape cover in logged stands may limit their value as deer habitat. So we surveyed lodgepole pine regeneration on 27 1/100-acre circular plots systematically located in the logged areas. Although seedling density varied between plots, it averaged 526 trees/acre, indicating reforestation was well underway. Seedlings established since logging were nearly twice as numerous as mature trees in unlogged stands (Fig. 1). However, their survival is not assured, as populations of northern pocket gophers (*Thomomys talpoides*) often increase rapidly in such areas, causing reforestation problems. Other factors that may hinder the successful regeneration of lodgepole pine following logging include inadequate dispersal of seed and seedling mortality due to heat injury, drought, frost heaving, and especially low temperature injury (Cochran, 1969).

[2]Personal communication with Milton Griffith, Deschutes National Forest, 1973.

Conclusions

Despite extensive soil disturbance and damage to bitterbrush, the long-term effects of logging and slash disposal are probably not as drastic as they seem. With management to control excessive stocking of lodgepole pine, forage production should show substantial recovery in 5 years and an increase in 12 to 15 years. The latter will occur through (1) increased growth rate of surviving plants and (2) increased establishment and growth of new plants. Both may be influenced by increased deer and elk use. Bitterbrush should be more attractive and nutritious on logged areas, and there should also be a needed increase in the variety of forage species.

Recently a new method of handling logging slash has been developed and recommended for optional use on western National Forests (Tornbom, 1973). It uses a rubber-tired, front-end loader with a hydraulic grapple. This equipment is more efficient, causes less disturbance to soil and understory vegetation, but is not yet widely used. Our results on bitterbrush response to more extensive disturbance will serve as a base line for evaluating this and other methods that may be developed.

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