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EFFECTS OF PRESCRIBED BURNING ON A SERAL BRUSH COMMUNITY IN NORTHERN IDAHO

by

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INTRODUCTION

The forests of northern Idaho have a long history of recurring wildfires. In 1883, over 1 million acres were destroyed by the most disastrous recorded fire. More recent fires in 1910, 1919, 1929 and 1934 consumed another 2,240,000 acres (Thompson 1964).

These fires which destroyed millions of acres of timber led to the development of vast brushfields that are now the main source of winter feed for big game herds in the area. In the natural process of plant succession after fire, however, tall shrubs such as bitter-cherry *(Prunus emarginata)*, willow *(Salix scouleriana)*, and Rocky Mountain maple *(Acer glabrum)* grow out of reach of browsing animals within several years after a burn. Shorter and less shade tolerant shrubs such as redstem ceanothus *(Ceanothus sanguineus)* are shaded out as the canopy of the taller shrubs grows denser. Eventually, conifers will dominate the burned areas again, resulting in a reduction of winter range capacity and big game numbers.

Fortunately, most of the shrubs preferred by elk and deer are species that are fire-tolerant. They form seral communities which may be called "fire types" since they maintain themselves either by stump or root-sprouting after fire, or by germination of hard coated seeds that break dormancy due to the heat of the fire.

The use of prescribed burning to rehabilitate big game winter range in northern Idaho was first investigated by the U.S. Forest Service in 1960 (Brown 1966). Five years later, staff members of the Clearwater National Forest and the Idaho Fish and Game Department began an annual program of prescribed burning on the Clearwater and Lochsa Rivers (Leege 1967). Although the response of important browse species has been studied (Leege 1968 and 1969; Hickey and Leege 1970), little information about the effects of prescribed burning on the herbaceous vegetation or the soils had been obtained prior to initation of the present project.

The objectives of this project were to determine the effects of spring burning on (1) the shrubs and herbaceous understory of seral brush communities in key wintering areas of the Lochsa River drainage, and (2) the physical and chemical properties of the soils of these sites.

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DESCRIPTION OF STUDY AREA

Two sites from among thirteen scheduled for burning in 1971 were selected to represent habitat types most commonly encountered in the burning program. These sites were located along the Lochsa River near the confluence of Holly Creek, approximately 33 miles northeast of Lowell, Idaho (Fig. 1). Within the areas of the proposed burns, six study plots were chosen on the basis of uniformity of vegetation, soil, available fuels, and aspect. Two control plots were established outside the burn areas since it was too early to sample the vegetation prior to the burning date of May 4, 1971.

The study area lies within the cedar/hemlock *(Thuja plicata/ Tsuga heterophylla)* zone *(Daubenmire and Daubenmire 1968)*. The present vegetation on relatively undisturbed sites in the Holly Creek area indicated a habitat type transitional between the *Thuja plicata/ Pachistima myrsinites* and the *Thuja plicata/Adiantum pedatum* described by Steele (1971).

No year-round weather stations are maintained that directly reflect conditions in the study area. Extrapolating from weather stations located in similar habitat types and elevations in northern Idaho, it is estimated that the mean annual precipitation lies between 37 and 42 inches with a mean annual temperature between 42° and 49° F.

Igneous intrusive rocks of the Idaho batholith make up the predominant parent material of the area. The soils developed from these materials belong in the Inceptisol order that characteristically indicates past colluvial and alluvial soil movement.

METHODS OF STUDY

A modification of the technique of Poulton and Tisdale (1961) was used with macroplots 25 x 25 m in size for vegetational measurements on all study plots. Three 1 x 25 m belt transects, each containing ten 20 x 50 cm microplots, were used to estimate frequency and cover of all species and the density of selected species. A list of all species found on each macroplot was also prepared.

Photopoints were established at each macroplot to provide a photographic record of the vegetation before and after the burning treatment.

A soil core sampler, 2.5 cm in length and 2.5 cm in diameter, was used to sample the surface 2.5 cm of mineral soil in each marcoplot. This was done just prior to burning, immediately after burning, and in the late summer after the burning treatment. Surface samples were analyzed for pH, electrical conductivity, nitrate and ammonium nitrogen, and percent organic matter.

Profile descriptions of soils from each macroplot were made in the field in accordance with the Soil Survey Manual (Soil Survey

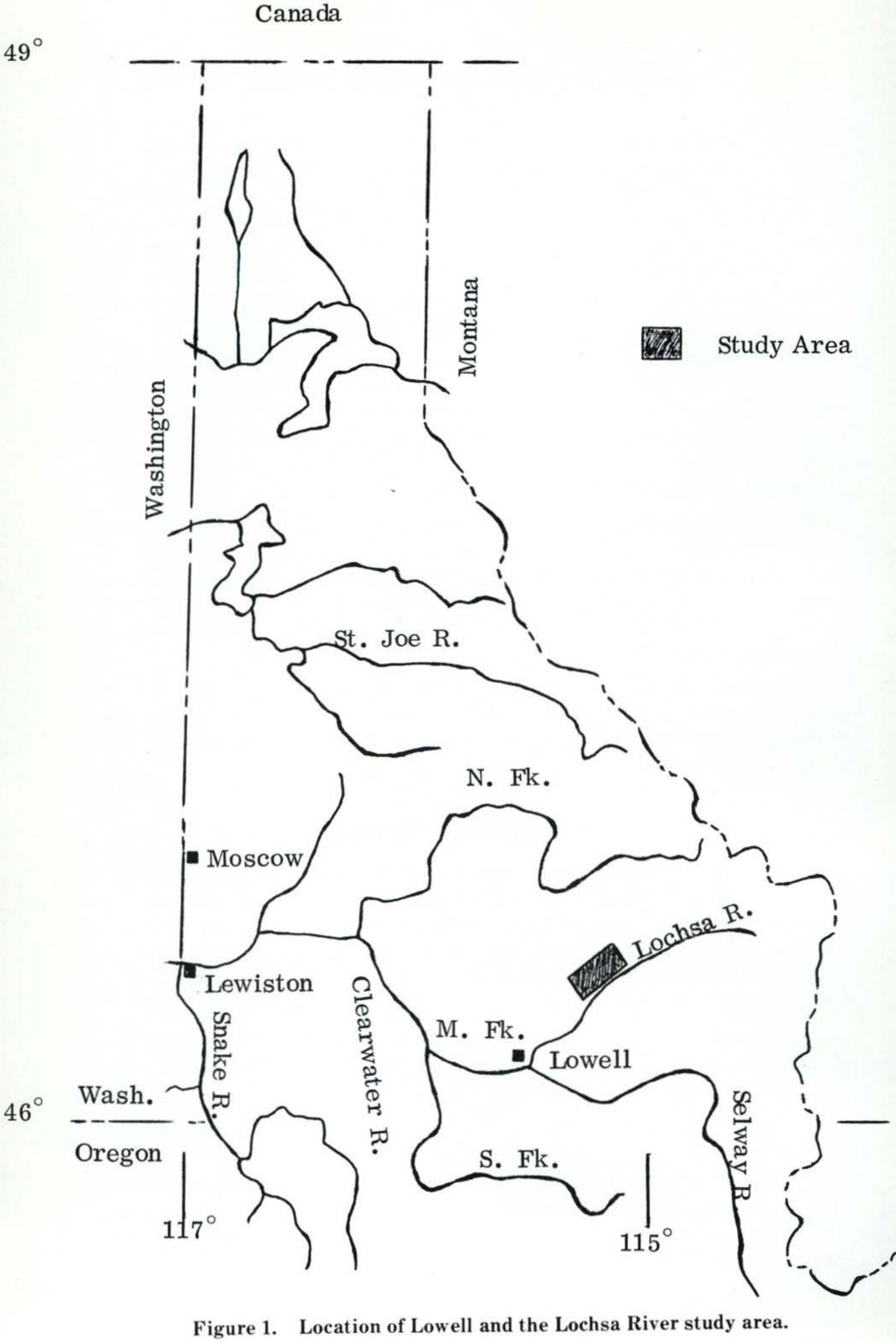


Figure 1. Location of Lowell and the Lochsa River study area.

Staff 1962). Samples were taken from each horizon for laboratory analysis and pedon classification.

One hundred pyrometers made of 5 x 23 cm pieces of asbestos 6.4 mm thick were used to record approximate soil surface temperatures reached during burning. Depressions in each pyrometer contained small pieces of "tempilstic," representing melting point ranges from 150° F. to 1,500° F.

Surface litter and other ground cover was sampled by the point method. Five-hundred point determinations at ground level were made for each macroplot.

Production of vegetation on burned and unburned sites was compared by clipping ten 1.0 x 0.5 m plots by species at each of three burned macroplots and the two control plots.

Rates of plant recovery on burned plots were studied by means of ten individually marked plants of each of several species. Periodic measurements of height and growth development were made on these plants throughout the season.

RESULTS

The wildfires that swept through the Holly Creek area in 1919 and 1929 (Norberg and Trout 1957) were highly destructive and few areas along the Lochsa River retain traces of the forests that existed before those fires. These and earlier wildfires also caused significant changes in the soils. The soil pedons described were coarse loamy and loamy skeletal, mixed, mesic, typic Haplumbrepts of the order Inceptisol. Such pedons indicate that a great amount of soil movement had occurred since the removal of forest vegetation, especially on the steeper slopes. Older horizons buried beneath colluvial deposits were found frequently in the study area. Soils of gently sloping areas were colluvial or alluvial in nature and relatively young. Although soil materials had been in place long enough for horizons to be differentiated by soil color, structure was not well developed in the profiles examined.

Other indicators of soil instability observed in the area were soil slips, colluvial or alluvial fans, and colluvial movement or dry surface creep. A small amount of surface creep was observed on steeper slopes even after prescribed burns.

Burning Intensity—Pyrometers placed in the field prior to ignition indicated the approximate surface soil temperatures reached and the great variation in temperatures from spot to spot. In an extreme case, surface soil temperatures varied from less than 150° F. to 1,050° F. within a distance of 2.5 m. The overall intensity of the burns conducted in the Holly Creek area was not high, since ground temperatures at 23% of the pyrometer positions were less than 150° F. and at 51% were less than 250° F. Only two percent of the positions indicated temperatures exceeding 1,000° F.

Of the six macroplots burned, sites 2 and 6 had the lowest burning temperatures. These sites had fuels comprised mainly of brush and forb leaf litter and little or no bracken fern. In contrast, sites 4 and 5, with dense stands of old brush and fern, had much hotter fires.

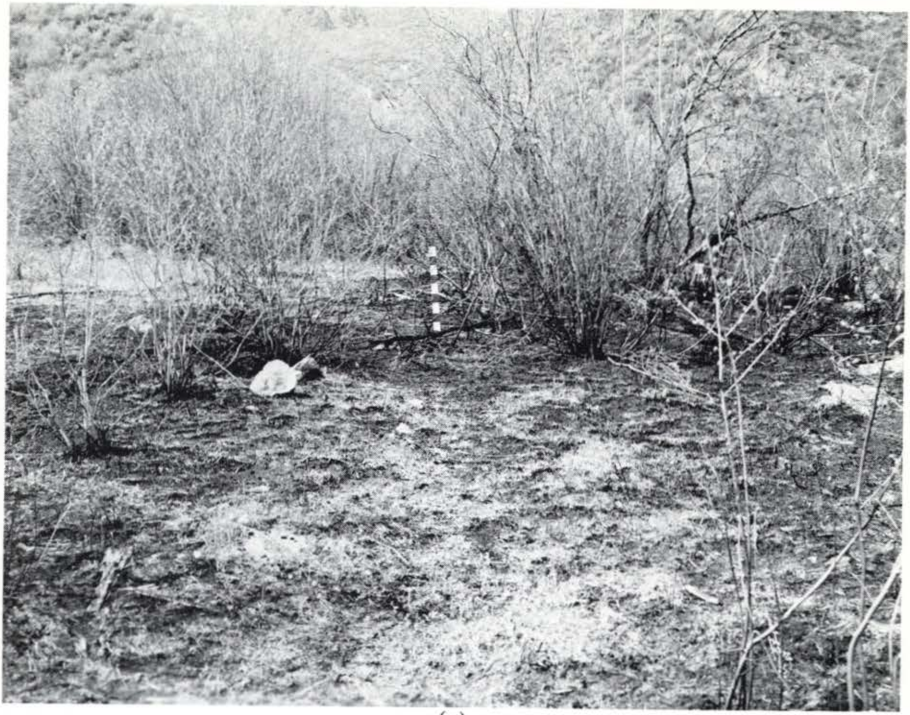
Effects of Burning on Vegetation—The rate of recovery of vegetation after burning was spectacular: Bracken fern was foremost in rate of recovery (Fig. 2). Immature fern stipes were observed on burned plots within ten days after the burning treatment. During their first three weeks of growth, tagged bracken fern plants averaged approximately 0.5 inches of growth per day. At the end of six weeks, the mean height of the ferns were 31.8 inches, or approximately 99% of their maximum growth. During the second three weeks, the ferns grew approximately one inch per day.

Regrowth rates for 60 days, based on mean heights of randomly selected plants, were also calculated for thimbleberry *(Rubus parviflorus)*, spiraea *(Spiraea betulifolia)*, and rose *(Rosa gymnocarpa)* occurring on two burned sites. On the more severely burned site, mean growth rates were 0.25, 0.11, and 0.21 inches per day respectively for these species. Growth rates on the less severely burned sites were lower except for *Apocynum androsaemifolium* which increased its average daily growth rate. Studies by Leege (1967, 1968, 1969) indicate that other important browse species such as willow, bittercherry, Rocky Mountain maple, and redstem ceanothus also have rapid regrowth rates.

Vegetational production was compared for the three sites that received the most severe burning treatments and the control plots. Results indicate that burning was not harmful to subsequent shrub or forb production on the sites sampled. Burned sites had a mean forb production of 1,237.6 lbs. per acre compared to a mean of 1,170.6 lbs. on the controls. Shrub production on the burned plots averaged 940.5 lbs. per acre while controls had a mean of 766.5 pounds. Total shrub production on the control plots was underestimated, however, since only those portions of shrubs considered available to browsing animals were harvested.

Graminoid production was detrimentally affected by the higher burning temperatures, but Canada bluegrass *(Poa compressa)* recovered well on lightly burned sites. Graminoid regrowth averaged only 0.7 pounds/acre on two of the burned plots compared to an average of 10.2 pounds/acre on the control plots. On the third burned plot, where the fire was less severe, vigorous regeneration of Canada bluegrass resulted in a graminoid yield of 135 pounds/acre.

A combination of frequency, cover, and density data was used to determine the response of a particular plant species to fire. The approximate intensity of the burning treatment on each site and the amount of vegetation production was also considered. Since the response to burning of the taller browse species of the Lochsa River



(a)

(b)

Figure 2. Transect sequence showing mosaic pattern of burning (a) and amount of regrowth on the same site after sixty days (b).

area had been studied previously, emphasis was placed upon the reaction of lower growing shrubs and herbaceous plants.

Thimbleberry, spiraea, and snowberry *(Symphoricarpos albus)* were observed for response to various intensities of burning. Of these low shrubs, only thimbleberry seemed to be benefited by the higher intensity burning treatments. Fire of light intensity seemed to benefit snowberry on gently sloping alluvial fans. The response of spiraea to fire was difficult to determine since its highest combinations of cover, frequency, and density occurred on sites with widely different intensities of burning. The frequency and cover of spiraea was highest on control sites, but density on burned plots appeared to be twice that of control plots. This increase in numbers of shoots may be misleading, since what appeared to be two or three plants in the early stages of sprouting were often found to be connected below the soil surface.

Intensity of burning apparently did not affect bracken fern on the Holly Creek sites. The rhizomes of this species are located too deep in the soil to be affected by the burning temperatures generated.

Both strawberry *(Fragaria vesca)* and goatweed *(Hypericum perforatum)* were important forbs on the burned areas. Both species increased following low intensity burning but neither benefited when the treatment was more intense. Strawberry appeared to have an important stabilizing influence on the surface soils of the steeper slopes, since it was abundant after burning and sent out numerous stolons.

Effects of Burning on Soils—Prescribed burning had its most noticeable effect on the surface characteristics of the soils of the study area. Surface litter was reduced, but even the most intense burning treatment did not consume all of it (Fig. 3). The six burned sites had a mean of 70% litter remaining after treatment compared to a mean of 92% on the two control plots (Table 1). The macroplot that received the most severe burning treatment still retained 55.8% litter and 3.6% live vegetation for a total of 59.4% cover at ground level.

Data obtained by Packer (1951) and Meeuwig (1969) indicate that a combined cover of 70 to 90% of live plants, rock, and litter appears necessary to protect the surface of highly erosive soils. In the Holly Creek area, regrowth of vegetation on the six burned sites brought total cover, including rock, to an average of 79% within 3 months after burning. This level approximates those set by Packer and Meeuwig and indicates that the burned plots were reasonably well protected during fall and winter when the bulk of the annual precipitation occurs. A check of the study area approximately one year after burning showed no evident soil erosion.

Burning produced less obvious effects in the chemical characteristics of the soils. Significant changes in nitrate nitrogen, pH, and

Table 1. Comparison of surface conditions on six burned macroplots to conditions on two control plots based on 500 point determinations per macroplot and expressed in percent.

	Burns		Controls	
	Percent		Percent	
Litter	69.6		92.0	
Vegetation	4.7		3.5	
Total		74.3		95.5
Bare Soil	18.1		1.7	
Gravel	2.9		0.0	
Rock	4.7		2.8	
Total		25.7		4.5

electrical conductivity occurred due to burning, but no differences in ammonium nitrogen or percent organic matter were detected.

Prior to burning, the control macroplots tended to be higher in nitrate nitrogen than the proposed burn sites. The latter had a mean of 160 ppm nitrate nitrogen compared to 267 ppm on the controls. The trend throughout the sampling period was towards lower nitrogen levels on all sites. By late September the burned plots had a mean of 31.4 ppm nitrate nitrogen while the control plots had dropped to a mean level of 2.9 ppm. This difference is highly signi-

Figure 3. Abundant litter remaining on plot burned in the spring. Surface temperature reached at this part of the plot ranged from 200 to 250° F.

ficant statistically. It appears that the burned sites will have higher levels of nitrate nitrogen available for plant growth the following spring than do comparable unburned areas.

Changes in electrical conductivity indicated that prescribed burning affected amounts of ash and soluble cations in the surface mineral soils. Electrical conductivity responded to burning in a manner similar to nitrate nitrogen and was found to be significantly lower on all plots at the end of the sampling period. Proposed burn plots and control plots had mean conductivities of 1.53 and 1.83 respectively prior to spring burning. By late September, the burned plots had a mean conductivity of 0.50 while the controls mean level had dropped to 0.24. Evidently, the burned areas had a higher nutrient level at the end of the growing season, presumably due to ash from the burn.

PH of surface soil on the burned sites averaged 5.85 compared to 5.65 for the controls when all were sampled shortly sfter the fire. Increases in pH during the summer occurred on all plots, however, and by September the average was 6.56 for the burned plots and 6.67 for the controls: These pH values, even in the spring, did not indicate a degree of acidity likely to inhibit most plant species.

CONCLUSIONS

The results of this study, within the limits of time and replication inherent in a one-year, one-man project, support the current practice of prescribed burning for improvement of big game range in the Lochsa-Selway area. The vegetation responded well to the fire treatment, with removal of much of the older shrub growth, and a high percentage of recovery for most of the plant species involved. All of the major shrub species and most of the forbs survived well. Only the graminoids, with the exception of *Poa compressa,* showed a general decrease due to burning.

The other major concern in a program of prescribed burning is that of detrimental effects on soil. Considerable evidence was obtained of soil erosion due to past wildfires in the general study area. This is to be expected in a region of steep slopes and erosive soils. On the other hand, no such effect was observed on the prescribed burns included in the present study. The major reason appeared to be the relatively low intensity of burn which results from burning in the spring of a site with relatively limited fuel supply. The combination of high soil moisture with relatively low air temperatures existing at the time of these burns resulted in a large residue of unburned litter, and a high rate of survival for the live vegetation. The rapid rate of regrowth for most plant species was another factor favoring soil stability. The above factors seemed to be of prime importance in preventing soil erosion, and need to be carefully considered in any future prescribed burning in the area.

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