TWO FOREST FIRES: AND SOME SPECIFIC IMPLICATIONS IN BIG-GAME HABITAT MANAGEMENT

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Introduction

Most of the big-game ranges of western Montana and northern Idaho were created by uncontrolled forest fires. Between 1910 and 1934, wildfires devastated more than 4.5 million acres of timber land in the northern Rockies (Barrows 1951). And, while the initial destruction of trees and damage to watersheds was disastrous, some of the shrub vegetation which developed after these fires proved to be tremendously productive big-game range. Elk populations in Montana and Idaho swelled, during the late 1940's and early 1950's to a peak probably never equalled on forest lands in North America.

During the past 15 years this trend has been reversed. Forest vegetation is continuously changing, and the inevitable consequence of plant growth has been a decline in both shrub ranges and associated big-game herds. Some shrubs have disappeared under a canopy of timber while others have simply grown out of reach of animals. Use of remaining ranges has intensified and significant damage to soils and winter-range vegetation is all too common. In the face of increasing demands for wildlife-oriented recreation, animal numbers are actually decreasing. Unless this trend is reversed, the full potential of an important big-game resource will be shamefully wasted--to the ultimate detriment of a region in which outdoor recreation has a greater potential for expansion than any other resource use!

Available evidence establishes a strong historical precedent for the belief that fire could be an important tool in rebuilding declining big-game ranges. History also shows, however, that uncontrolled fire in the forest can cause destructive loss of timber and intolerable soil erosion. Thus, while it seems axiomatic that repetition of the damaging wildfires that created current game ranges cannot be allowed, the use of planned or prescribed fires on a smaller scale is at least possible. And, since fire already has a demonstrated utility in slash disposal and site preparation for silvicultural purposes, some very fortunate possibilities for coordination of timber and wildlife management can be postulated. Pengelly (1963) has pointed out that logging "...is the most effective and least expensive habitat management tool at the disposition of the game manager."

The basic problem is that wildland managers lack definitive information on the effects of burning. Before fire can be used in wildlife habitat management we must understand what it can do, what it cannot do, and, most important, we must be able to predict results of proposed treatments. Despite a long history of fires in the northern Rockies, our specific knowledge of vegetal reaction to fire is contained in only a few papers. Larsen (1923, 1929, 1930 and 1940) described some species associations and fire influences for northern Idaho; Mueggler (1965) reported a comprehensive study of seral cedar-hemlock forest communities as influenced by several kinds of disturbance, including fire; and Pengelly (1961 and 1963) examined the effects of logging and slash burning on white-tailed deer range in northern Idaho.

The Douglas-fir zone, which includes vast areas of important big-game winter range, has been studied much less intensively; and apparently there are no reports in which vegetation has been examined before burning and in the years immediately following a fire. This period, however, is probably the most important in the history of a burned-over forest stand because prefire vegetation, and the plants which survive or invade on the bare mineral seedbed, may govern the plant community for a hundred years. Until this brief postfire period has been adequately described, any habitat management technique involving the use of fire must also include a large element of luck.

Currently, scientists of the Forestry Sciences Laboratory of the Intermountain Forest and Range Experiment Station in Missoula, are studying a number of burned sites in the Douglas-fir zone with wildlife habitat evaluation as a specific research objective. While the studies are far from complete, two of these burned areas already provide an excellent background for discussion of problems and potential results when fire is used as a habitat management tool in the northern Rockies.

Methods

Comprehensive and specific descriptions of the two studies are planned for separate publication. For the purposes of this paper, our study methods can be summarized as including annual counts of plant numbers measurement of sizes for trees and shrubs over 18 inches high, and recording of species frequencies and canopy coverage for low woody and herbaceous plants. Shrub sizes are expressed as the volume of a cylindroid required to enclose the shrub crown.

The Sleeping Child Fire

The Sleeping Child Fire of 1961 is a too familiar memory for many residents of western Montana. It was started by lightning on the evening of August 4 and went out of control the next day. When finally contained, the fire had burned over 28,000 acres of second-growth timber, including both summer and winter range areas for deer and elk of the Bitterroot Valley.

Our examination of vegetal recovery actually started in 1962 with the establishment of 11 permanently marked transects on representative sites within the burned area. Descriptions of prefire vegetation were obtained from representative study plots outside the fire line.

The Neal Canyon Fire

Our second study is a prescribed burn in which diseased and worthless standing timber was destroyed to make room for a new timber crop. Only 120 acres were involved, but the fire was considered equivalent to wildfire in a Douglas-fir forest because it was burned under conditions ideal for crown-to-crown transmission of flames and complete reduction of surface vegetation. The Neal Canyon prescribed fire was conducted by the Ketchum District of the Sawtooth National Forest on August 1, 1963, in an area bordering on the winter range of the Big Wood River elk herd (Tanner 1965).

For this study, we were able to establish plots before the fire and return to the same plots each year to observe and measure vegetal growth. A comprehensive description of this study has been published (Lyon 1966).

Vegetal Responses

In describing the reaction of forest vegetation to fire, we are using a model with vegetation divided into three general classes: trees, shrubs, and low vegetation. Development rates vary widely from site to site.

The Sleeping Child Fire

Before August 1961, the upper reaches of Sleeping Child Creek and Rye Creek were representative of extensive forest tracts on the east side of the Bitterroot Valley. Beneath the lodgepole pine or Douglas-fir overstory, a tangled mass of beetle-killed and windthrown lodgepole was half hidden in an understory dominated by Douglas-fir reproduction and thin-leaved huckleberry (Vaccinium membranaceum) and containing Utah honeysuckle (Lonicera utahensis), white spiraea (Spiraea betulifolia) and scattered Scouler willow (Salix scouleriana), mountain alder (Alnus sinuata) and serviceberry (Amelanchier alnifolia)[1]. Data showing tree and shrub densities, shrub crown volumes and canopy cover for low vegetation are presented in Tables I, II, and III.

It is to be expected that a fire as large as the Sleeping Child would produce a wide variation among burned sites. Some small islands of timber, for example, were not burned while adjacent areas were charred to mineral soil. Our study plots

[1] Technical nomenclature follows Hitchcock, et al. (1955 et seq.) and common names are taken from Morris, Schmautz and Stickney (1962).

TABLE I

Number of Plants per 1,000 Square Feet, Before and After Burning

Sleeping Child Area

Species	Before Burning	Years After Burning 1	2	3	4
Trees (over 18 inches)	12.1	11.5[1/]	--	--	--
Subalpine fir	0.7	--	--	--	--
Lodgepole pine	0.8	--	--	--	--
Douglas-fir	10.6	--	--	--	--
Shrubs[2/]	117.4	--[2/]	11.6	44.8	52.6
Scouler willow	--	--	0.2	0.2	0.2
Utah honeysuckle	2.9	--	--	--	--
White spiraea	1.5	--	8.2	23.5	21.7
Thin-leaved huckleberry	113.0	--	2.2	18.4	28.3
Other	--	--	1.0	2.7	2.4

1/ Dead snags counted first year.

2/ Shrubs over 18 inches counted before the fire. After burning it was necessary to count plants over six inches to obtain any information.

Table I (continued)

Neal Canyon Area

Species	Before Burning	Years After Burning 1	2	3	4
Trees (over 18 inches)	31.2	--	--	--	--
Douglas-fir	31.2	--	--	--	--
Shrubs (over 18 inches)	8.3	0.9	15.3	--	
Mountain maple	4.3	0.6	5.7	--	
Serviceberry	0.2	0.1	1.1	--	
Snowbrush ceanothus	0.1	--	0.2	--	
Prickly currant	0.9	--	0.6	--	
Sticky currant	0.3	--	1.5	--	
Scouler willow	0.3	0.2	2.8	--	
Mountain ash	0.1	--	--	--	
Whortleleaf snowberry	2.1	--	2.6	--	
Black elderberry	--	--	0.7	--	

TABLE II

Crown Volume of Shrubs, Cubic Feet per 1,000 Square Feet,
Before and After Burning

Sleeping Child Area

Species	Before Burning	Years After Burning 1	2	3	4
Shrubs[1]	102.1	--[1]	3.7	19.0	27.3
Scouler willow	--	--	1.6	4.3	6.0
Utah honeysuckle	4.8	--	--	--	--
White spiraea	0.4	--	0.7	8.1	9.8
Thin-leaved huckleberry	96.9	--	1.2	2.5	5.4
Other	--	--	1.2	4.1	6.1

1/ Only shrubs over 18 inches counted before the fire.
After burning, it was necessary to count plants over six inches to obtain any information.

Table II (continued)

Neal Canyon Area

Species	Before Burning	Years After Burning 1	2	3	4
Shrubs (over 18 inches)	1,728.7	21.1	1,087.2		
Mountain maple	1,376.2	3.9	154.7		
Serviceberry	7.9	0.5	7.4		
Snowbrush ceanothus	0.3	--	0.1		
Prickly currant	16.8	--	2.6		
Sticky currant	1.0	--	1.5		
Scouler willow	254.1	16.4	884.1		
Mountain ash	60.7	--	--		
Whortleleaf snowberry	11.7	0.1	8.9		
Black elderberry	--	0.3	27.9		

TABLE III

Percentage Ground Cover Under 18 Inches, Before and After Burning

Sleeping Child Area

Type of Cover	Before Burning	Years after Burning 1	2	3	4
Vegetation	67.5	4.1	17.7	31.8	35.7
Litter	32.5	29.5	23.4	19.6	22.0
Bare Ground	0.0	66.4	58.9	48.6	42.3
Neal Canyon Area					
Vegetation	37.0	27.0	69.0	--	--
Litter	57.0	1.0	5.0	--	--
Bare Ground	6.0	72.0	26.0	--	--

within the burn were selected to represent a number of sites. Thus, the postfire summary presentations in Tables I, II, and III are a composite of 11 samples but are probably not representative of any single area. Willow and alder, for example, are concentrated on a few sample plots but do not occur widely throughout the burn as do huckleberry and spiraea.

Two facts stand out in the succession picture described in these tables. First, vegetation on the Sleeping Child burn is developing very slowly. The total canopy cover of low vegetation after four years has barely reached half the level existing before the fire. This is extremely significant when it is recognized that approximately half of this cover is provided by seeded domestic grasses. Soil movement on the burned area has been substantial despite a rehabilitation program including aerial seeding, check dams and terracing. It seems probable that erosion could have been much worse if the burn had been allowed to recover naturally.

Second, the native plants present in the burned area include only those species present before the fire. Spiraea and huckleberry total over 90 per cent of the shrub density and more than half of the crown volume. Moreover, the recovery of these plants has been so slow that it was necessary to measure six-inch plants to obtain any estimate of crown volume at all. Thus, the shrub forage available to big-game animals is minimal and annual forage production, which was probably quite low before the fire, has been reduced substantially. There is every indication that it will remain low for many years.

The Neal Canyon Fire

Vegetation in Neal Canyon was more dense and included a considerably greater variety of species than the Sleeping Child area (Tables I, II, and III). There were nearly three times as many trees present, and despite lower numbers of shrubs, shrub volume was very much greater. Possibly because of this volume of taller plants, herbaceous ground cover was only 37 per cent while 63 per cent of the surface was litter covered or bare. The most important shrub species on the site were mountain maple (*Acer glabrum*) and Scouler willow (*Salix scouleriana*). Mountain ash (*Sorbus scopulina*), whortleleaf snowberry (*Symphoricarpos orephilus*) and serviceberry (*Amelanchier alnifolia*) were also present in significant volume.

Vegetal recovery on this burned site, by comparison with the Sleeping Child burn, was spectacularly fast. In a single year, shrub volume on Neal Canyon had almost reached the level attained on the Sleeping Child in four years (Table II). In the second year, two-thirds of the prefire volume was present. Live ground cover reached 27 per cent in the first year, and in two years it was 69 per cent--nearly double the cover before the fire (Table III).

At the same time, there were significant changes in the composition of the shrub community and in the availability of forage for big-game animals. Total crown volume of willow increased more than threefold. Mountain maple and willow were reduced from tree-like plants averaging seven and 16 feet in height to shrubs under seven feet tall. Snowbrush ceanothus (C. velutinus) which had nearly disappeared from the site, is now represented by hundreds of seedling plants. These are too small to appear in our shrub sample, but they will eventually be a very productive forage source on the Neal Canyon burn.

In summary, the prescribed burn in Neal Canyon was apparently successful in every aspect. Timber management objectives were achieved, wildlife habitat was markedly improved, and watershed protection was not compromised.

Discussion

In comparing the results of the fires described here, it seems probable that these samples must represent both extremes on a wide range of possible vegetal responses to fire. Following one of the fires, vegetal recovery was fast, soil erosion minimal and wildlife habitat greatly improved. After the other fire, recovery was slow, erosion significant and wildlife habitat virtually destroyed. Hindsight suggests that part of these results might have been predicted on the basis of differences existing before burning. The two sites were different in latitude, soil type, exposure and vegetation, but the vegetation differences alone supply abundant evidence that the results of the fires were not greatly deviant from logical expectations.

Shrub Volume

Before burning, the Neal Canyon area had nearly 17 times as much shrub crown volume as the Sleeping Child area. The dominant shrub on Sleeping Child was a small plant with high tolerance for shade, while the Neal Canyon community contained a number of large, fast-growing and essentially intolerant species. For most shrubs we do not know enough about fire tolerance, resprouting and growth rates to make absolute predictions of recovery rates, but precision hardly seems important when differences are as great as those between huckleberry and willow or spiraea and mountain maple. We do know that woody plants normally have root systems as large as their crowns (Holman and Robbins 1946). Logically, if the plant is not killed by fire, initial regrowth will be a function of the root system and eventual growth can only reach the normal maximum for the species. Thus, the differences in shrub volume alone suggest a regrowth potential which is confirmed by the recovery rates on the two burns.

As a secondary function of the large shrub volume in Neal Canyon, most of the forage was out of reach of browsing animals, and the useful production level was well below the apparent potential of the site. Sleeping Child, on the other hand, had a relatively low shrub volume which was mostly available to wildlife. If it is assumed that fire would cause no change other than a reduction in shrub size, the plant community in Neal Canyon offered much room for improvement while the Sleeping Child community was probably already near the production peak for wildlife.

Shrub Species

In fact, however, reduction in size was not the only modification recorded. Both fires produced significant changes in the composition of shrub vegetation as abundant species were replaced by secondary species in the postfire communities. At Neal Canyon, the prefire community contained about a dozen species, none of which is totally worthless as big-game forage. Without adding new shrub species, it is hard to conceive a vegetal recovery pattern that would not have produced a valuable big-game range. Moreover, at least one new species did appear (snowbrush), and it is, like the other species on the site, a palatable forage plant.

By contrast, the Sleeping Child shrub community contained fewer species, and at least half of those recorded are considered unpalatable for deer and elk. Of the theoretically possible recovery patterns, only an increase in willow and serviceberry or the appearance of a new plant species could have improved browse production for big game.

Thus, the shrub species lists for each prefire community also provide evidence suggesting unlike recovery patterns on the two sites.

Herbaceous Cover

A third difference between the two sites is of somewhat less practical value in predicting probable recovery from burning and is, in fact, a little hard to interpret in the light of the results obtained. Sleeping Child had 67.5 per cent vegetal ground cover and no bare ground before burning while Neal Canyon had only 37.0 per cent cover and 6.0 per cent bare ground. Litter made up the remainders, but in both cases watershed protection appeared to be adequate.

After the respective fires, root sprouting and germination of seeds stored in the soil restored 73 per cent of the vegetal cover on Neal Canyon in one growing season and nearly doubled the cover by the second season (Table III). Sleeping Child had only reached 50 per cent of preburn cover values after four recovery seasons.

Excluding the protection provided by resprouting shrubs, the major cover contribution on both burns came from seeds germinating after the burn. The preburn cover values do not appear to be of much utility in prediction, but properly collected soil samples would certainly have shown the tremendous seed reservoir in Neal Canyon and the lack of seeds in the Sleeping Child.

Conclusions

Comparison of the two fires described here leads to a number of conclusions about the potential use of fire as a wildlife-habitat management tool in the northern Rockies. Neal Canyon demonstrates, first, that fire can be successfully employed to restore or improve a declining shrub range. At the same time, Sleeping Child demonstrates the possibility of disastrous failure. Somewhere between these two extremes is a wide variety of sites on which perceptible improvement in wildlife habitat might be achieved without significant damage to other resources.

At this point, we do not have sufficient information to identify all such sites. Moreover, our information is inadequate to allow prediction of the useful life of any new habitat created by controlled burning. On the other hand, current information is adequate for identification of sites on which either extreme of possible results might occur. Given only four kinds of information, it should be possible to recognize sites on which prescribed fire can be successfully employed:

1. Shrub crown volume, as an indicator of current production and potential recovery rate, should be high on areas to be rehabilitated.
2. Species composition should indicate a potential for success. Species with high resprouting vigor should appear on areas to be rehabilitated.
3. If both crown volume and species composition suggest a poor potential result, samples of duff and soil may provide indications of stored seed, particularly of ceanothus, that will insure success.
4. Soils should be investigated for high erodibility. This may not make the use of fire impossible, but unstable soils will require greater care in the use of fire.

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