Initial Vegetal Development Following Prescribed Burning of Douglas-Fir in South-Central Idaho

by

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INTRODUCTION

Prescribed fires, particularly in logging slash, are not unusual in the forests of the northern Rocky Mountains. Burning is an effective means of reducing wildfire hazards and preparing timber sites for regeneration. Fires in standing timber, on the other hand, have become relatively uncommon in this age of smokejumpers, retardant bombers, and fast transportation. And, even though uncontrolled forest fires do occur occasionally, it is impractical to plan studies of specific forested areas that might be burned. The probability of a burned area large enough for study is low, and at best the occurrence of wildfire on areas marked for study would be extremely fortuitous. Thus when personnel of the Sawtooth National Forest intentionally burned 120 acres of standing Douglas-fir on the first day of August, 1963, the situation was virtually unique.

The basic objectives of this prescribed fire were sanitation and site preparation for silvicultural purposes. A stand of Douglas-fir in Neal Canyon on the Ketchum Ranger District had been logged over twice since 1950, and the remaining trees were mostly mistletoe-deformed saplings and poles. After the diseased trees were burned, parts of the area were planted and parts were direct-seeded to establish a new and healthy timber stand.

From a wildlife management viewpoint, the secondary effects of the fire were as significant as accomplishment of the primary objectives. Here, for example, was an opportunity to measure the heat output of a fire similar to an uncontrolled forest fire; to investigate the influence of a prefire plant community on postfire vegetal development; and to evaluate the postfire plant community as wildlife habitat. This paper is a report of the first 3 years of study on the Neal Canyon prescribed burn. Particular emphasis has been given to the relationship between big-game forage values in the forest community and the influence of fire on those values.

STUDY AREA

Neal Canyon is a small drainage off Eagle Creek and the Big Wood River about 6 miles north of Ketchum, Idaho. The 120-acre burned area is 1.5 miles east of U.S. Highway 93 in the northeast quarter of Section 13, Township 5 North, Range 17 East, Boise Meridian. Its general aspect is north-northeast, and the elevation is 6,500 to 7,000 feet. Since some parts of the area had been heavily disturbed during logging, the specific site selected for examination was a 20-acre patch of less-disturbed terrain on the lower middle slope (see fig. 1). The true aspect of the study site is N 10-20° E; the slope is 64 percent.

In this part of Idaho, summers are cool and winters rigorous. Annual precipitation at the Hailey and Sun Valley weather stations is 14 to 17 inches, most of which falls in the winter. Total snowfall at the respective stations averages 85 to 120 inches. The January mean minimums are within a few degrees of zero and the record minimums for the two stations are –36°

Figure 1.--A portion of the Neal Canyon prescribed fire area, July 1963.

F. and –46° F.[1] Forested sites usually are confined to north- and east-facing slopes, while the drier south slopes and valley bottoms are mostly sagebrush and grasslands. Soils in Neal Canyon are of limestone origin, rocky, poorly developed, and highly stable. Mechanical analyses of representative samples show at least 50-percent gravel and a shift from sandy loams on the surface to a sandy clay loam below 14 inches. Heavy overgrazing on a sheep driveway in Eagle Creek has caused plant community changes but very little surface erosion.

Wildlife use of Neal Canyon has not been studied in detail, but 50 elk were planted at Ketchum in 1934 to 1936 and the management unit for the Big Wood River herd currently supports about 600 animals.[2] In severe winters the range available to this herd and to the deer of the area is limited to about 30 square miles. Because of deep snow, Neal Canyon is probably not accessible during the critical winter period but it could be used throughout the rest of the year. In 1965, however, the observed use by big game was light.

METHODS

VEGETATION SAMPLING

In order to sample all components of the plant community, we divided the vegetation into five life-form groups. All herbaceous vegetation and woody plants under 18 inches in height were sampled with a series of twenty-five 2- by 2-foot quadrats. Plants were listed by species in each plot, and ground cover was estimated to the nearest quarterplot. For woody plants more than 18 inches high we used a modification of the quarter methods described by Cottam and Curtis[3] and Morisita.[4] From each of 20 points spaced at approximately 50-foot intervals we measured the distance in each quadrant to the nearest tree (over 4.5 feet tall), the nearest

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[1] U.S. Dep. Commerce, Weather Bureau. Climatography of the U.S. No. 86-8, 66 pp. Wash., D.C.: Government Printing Office. 1964.

[2] Tanner, Dale. The Big Wood River elk herd. Idaho Wildlife Rev. 18(3): 3-6. 1965.

[3] Cottam, Grant, and J. T. Curtis. The use of distance measures in phytosociological sampling. Ecology 37(3): 451-460. 1956.

[4] Morisita, Masaaki. A new method for the estimation of density by the spacing method applicable to non-randomly distributed populations. Physiol. and Ecol. 7: 134-144 (in Japanese), 1957. U.S. Dep. Agr. Transl. (mimeo.) 1960.

subtree (18 inches to 4.5 feet), the nearest tall shrub (over 8 feet), and the nearest low shrub (18 inches to 8 feet). Quadrants were oriented with the contour so that two of the distance measurements in each set of four could be corrected for slope. Trees were categorized by diameter class, and shrub size was estimated by measuring two diameters and the height of the plant crown.

To supplement these measurements, we have taken representative black and white and color photographs each year, both within the study area and from a permanent photographic point on the cross-canyon slope facing the burn. No individual shrubs were marked prior to burning, but representative marked plants of each important shrub species have been measured and photographed annually since the fire.

Calculations.--Techniques for converting quadrant-distance measurements to estimates of plant density lack the mathematical proofs required for application to populations with unknown distribution. Several formulas can be used. To provide an empirical test of method, fieldwork in 1964 was expanded to include both the distance to the nearest shrub and a total count of all shrubs within 50 feet of sampling points. Since plant densities in the circular plots were similar to density estimates using the angle method, the angle-method formula[5] has been used throughout the study.

PREFIRE VEGETATION

Before the Neal Canyon site was burned, vegetation consisted of 54 species, including six types of trees and 12 kinds of shrubs[6] (listed in Appendix 1). A summary description of the plant community, based on average numbers of plants and plant sizes per 1,000 square feet, is presented in table 1. As a result of the two timber sales, the number of overstory trees is lower than might have been recorded in an undisturbed forest community. However, there was no evidence in the form of burned snags or charred material on the ground to suggest that the stand had been recently disturbed other than by logging. A few large stumps show that trees up to 36 inches in diameter were present at one time, and increment cores from four of the dominant Douglas-firs revealed ages ranging from 28 to 170 years. A cross section from the largest willow stem tested had 34 annual growth rings. Figure 2 is representative of the prefire vegetation.

THE FIRE

Firing of the Neal Canyon site began just after 8:00 a.m., August 1, 1963, and was completed before 5:00 p.m. the same day. Moisture content of fuel-moisture sticks examined at 3:30 p.m. each day during the week preceding the fire had been a relatively constant 5 to 6 percent. During the firing period, air temperatures rose from the mid-50's to nearly 80° F. and the relative humidity dropped from around 50 percent to 10 percent or less.[7] Surface winds were mostly under 5 m.p.h. during the day, but fire-induced gusts to 30 m.p.h. were recorded during the peak of burning and estimates of wind velocities within the fire were even higher.

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[5] Mean area per plant = $\frac{\Sigma \Pi r2}{4N}$, where r is the distance to the nearest individual in a quadrant and N is the number of sampling points.

[6] Hitchcock, C. Leo, Arthur Cronquist, Marion Ownbey, and J. W. Thompson. Vascular plants of the Pacific Northwest. Univ. Wash. Press. 1955.

[7] Data from U.S. Weather Bureau mobile stations at Eagle Creek and on the hilltop above the fire show generally warmer and drier conditions at the hilltop. These figures represent a broad summary from both stations.

Figure 2.--Representative vegetation within the prescribed fire area, July 1963.

Table 1.--Average numbers of plants, by class, per 1,000 square feet Neal Canyon, before prescribed burn, July 1963

Plant class	Number	Size				
		D.b.h. (inches)				
Trees		0	0-1	1-3	3-8	8-15
Douglas-fir	31.4	3.3	10.2	10.2	7.0	0.7
Shrubs		Crown volume (cu.ft.)				
Acer glabrum	4.27	1,376.2				
Amelanchier alnifolia	.22	7.9				
Ceanothus velutinus	.06	.3				
Ribes lacustre	.89	16.8				
Ribes viscosissimum	.28	1.0				
Salix scouleriana	.33	254.1				
Sorbus scopulina	.11	60.7				
Symphoricarpos oreophilus	2.11	11.7				
Total	8.27	1,728.7				
Ground cover	Square feet					
Vegetation[1]	370					
Litter	570					
Bare ground	60					

[1] Frequencies of occurrence for common species in the ground layer were: Carex geyeri (52 percent), Arnica cordifolia (48 percent), Senecio cymbalaroides (44 percent), Calamagrostis rubescens (24 percent), seedlings of Pseudotsuga menziesii (20 percent), Ribes lacustre (20 percent), Epilobium angustifolium (20 percent), Poa nervosa (20 percent), and Potentilla glandulosa (20 percent).

Figure 3.--Firing the Neal Canyon site, August 1, 1963.

Firelines were burned out first, after which the major fire was started with a flame thrower on a pickup truck passing once across the middle of the site and again across the lower edge (fig. 3). With minor variations, the fire swept into the tree crowns almost immediately; and at progressive intervals the entire area was covered by running flame.

The intensity of the fire was measured by integrating devices described by Beaufait.[8] These consist of 1-gallon cans painted flat black and containing 3 liters of water at ambient temperature. The weight of water released as steam through a 1-cm. hole in the can lid is a measure of heat absorbed.

Eighteen pairs of these water-can analogs were placed on mineral soil (fig. 4) in six evenly spaced vertical lines within the 20-acre study area. Rolling rocks and logs destroyed 14 cans, but only four of the 18 pairs were lost. Water loss from the remaining 22 cans ranged from 340 to 1,765 grams, with a mean loss of 939.8 grams (table 2). According to Beaufait's unpublished data, this water loss is comparable to losses during a hot broadcast fire in deep, dry slash.

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[8] Beaufait, William R. An integrating device for evaluating prescribed fires. Forest Sci. 12(1): 27-29. 1966.

Figure 4.--Water-can heat integrating device.

Figure 5.--Representative photographs within the burned area immediately after the fire, August 1, 1963.

Table 2.--Grams of water lost from pairs of 3-liter water cans, August 1, 1963

Pair	Line 1	Line 2	Line 3	Line 4	Line 5	Line 6	Mean
A	1,340	250	1,045	([1])	675	([1])	783.3
	([1])	325	([1])	([1])	1,065	([1])	
B	1,550	([1])	1,345	([1])	1,765	340	1,281.7
	1,340	([1])	([1])	([1])	1,350	([1])	
C	1,025	1,530	985	1,990	815	1,670	1,204.5
	625	435	([1])	([1])	1,365	1,605	
Mean	1,176.0	635.0	1,125.0	1,990.0	1,172.5	1,205.0	939.8

[1] Cans destroyed by rolling rocks or logs.

Measured losses of water (table 2) indicate that the fire may have been slightly less intense on line 2 and along the upper edge than in other parts of the plot. However, visual observations following the fire did not reveal any variation of fire effects. In general, all the litter and herbaceous material, all logs on the ground less than 3 inches in diameter, and all live stems smaller than 2 inches at the base were completely consumed (figs. 5 and 6). Interestingly, there was no conclusive evidence that the heat in small grassy openings (Table 2, pairs 3A and 3C) was any less intense than the heat beneath a dense clump of small trees (2A and 3B) or adjacent to large shrubs (5A and 6B).

Figure 6.--Panoramic view of the burned area on August 2, 1963, 1 day after the fire.

POSTFIRE VEGETATION

Shortly after the Neal Canyon prescribed fire, the new tree crop was planted and the roads were seeded with a domestic grass mixture, but no attempt was made to rehabilitate the burned slopes. To date, no overland soil movement has been recorded, and the rocks that rolled downhill during the fire probably represent the bulk of surface disturbance on the site.

Natural vegetation recovered rapidly following the fire (fig. 7). In 1 year, live ground cover returned to 27 percent, and in the second year it reached 69 percent--nearly double the live cover before the fire (tables 3 and 4). Of more significance perhaps is the fact that the three plant species most important in this resurgence (Moldavica parviflora, Ceanothus velutinus, and Iliamna rivularis) were either uncommon or not even recorded in the prefire plant community. None of these species have windborne seeds, and it must be concluded that new plants came from seeds buried deep enough in the soil to survive a fire.

In the second year, three species with light windborne seeds (Lactuca serriola, Epilobium paniculatum, and E. alpinum) appeared in great numbers, and resprouts from Arnica cordifolia and Ribes viscosissimum were recorded in nearly half of the quadrats. Surprisingly, the common fireweed (E. angustifolium) did not increase significantly, although the brilliant flowers were obvious in both the prefire and postfire communities.

Initial recovery of the shrub layer was dominated by plants resprouting from root systems that survived the fire. Comparison of tables 1, 3, and 4 reveals that some species are considerably more vigorous in this respect than others. Within 2 years, total density of shrubs had nearly doubled the prefire density, although no seedlings had reached the 18-inch height required for inclusion in the shrub-sampling category. Several species, notably mountain maple (Acer glabrum), serviceberry (Amelanchier alnifolia), Ribes viscosissimum, willow (Salix scouleriana), and elderberry (Sambucus racemosa) apparently increased in density because root crowns of single plants produced multiple sprouts.

A

B

Figure 7.--Prefire and sequential postfire vegetation on a representative photo plot. A. July 1963; B. August 1963; C. July 1964; D. July 1965.

Table 3.--Average numbers of plants, by class, per 1,000 square feet, Neal Canyon, 1 year after the fire

Plant class	Number	Crown volume (cu.ft.)
Shrubs		
Acer glabrum	0.63	3.9
Amelanchier alnifolia	.05	.5
Salix scouleriana	.15	16.4
Sambucus racemosa	.02	.3
Symphoricarpos oreophilus	.02	.1
Total	0.87	21.2

Ground cover	Square feet
Vegetation [1]	270
Litter	10
Bare ground	720

[1] Frequencies of occurrence for common species in the ground layer were Moldavica parviflora (96 percent), Ceanothus velutinus (92 percent), Iliamna rivularis (52 percent), Ribes viscosissimum (24 percent), Arnica cordifolia (24 percent), and Pseudotsuga menziesii (20 percent).

C

D

Table 4.--Average numbers of plants, by class, per 1,000 square feet Neal Canyon, 2 years after the fire

Plant class	Number	Crown volume (cu.ft.)
Shrubs		
Acer glabrum	0.57	15.47
Amelanchier alnifolia	.11	.74
Artemisia tridentata	.02	.01
Ceanothus velutinus	.02	.01
Ribes lacustre	.06	.26
Ribes viscosissimum	.15	.15
Salix scouleriana	.28	88.41
Sambucus racemosa	.07	2.79
Symphoricarpos oreophilus	.26	.89
Total	1.53	108.73

Ground cover	Square feet
Vegetation[1]	690
Litter	50
Bare ground	260

[1] Frequencies of occurrence for common species in the ground layer were Moldavica parviflora (100 percent), Lactuca serriola (96 percent), Ceanothus velutinus (92 percent), Epilobium paniculatum (88 percent), Arnica cordifolia (48 percent), Epilobium alpinum (48 percent), Ribes viscosissimum (44 percent), Iliamna rivularis (36 percent), Epilobium angustifolia (28 percent), Penstemon fruticosa (24 percent), Taraxicum officinale (24 percent), Aster conspicuus 20 percent), Calamogrostis rubescens (20 percent), and Phacelia hastata (20 percent).

These changes in density seem much less significant, however, than the changes in dominance brought about by different recovery rates and indicated by crown volume estimates (table 5). Note, for instance, that an average mountain maple shrub had recovered only 8 percent of prefire volume after 2 years, while a willow recovered to 14 percent in the first year and 42 percent in the second year. In terms of total shrub volume in the community, maple was reduced from nearly 80 percent to about 14 percent, and willow increased from 15 percent to more than 80 percent. Representative development of these two species is illustrated in figures 8 and 9.

Table 5.--Mean crown volumes of shrubs[1]

Shrub species	Prefire	Postfire	
	1963	1964	1965
	Cubic feet		
Acer glabrum	322.0 (77)	6.1 (41)	27.1 (31)
Amelanchier alnifolia	35.8 (4)	10.3 (3)	6.7 (6)
Ribes lacustre	18.9 (16)	--	4.7 (3)
Ribes viscosissimum	3.8 (5)	--	1.0 (8)
Salix scouleriana	763.0 (6)	105.9 (10)	320.3 (15)
Symphoricarpos oreophilus	5.6 (38)	4.7 (1)	3.4 (14)

[1] Numbers of shrubs measured are in parentheses.

Samples of other shrub species in the burned area are smaller than samples for willow and maple but nevertheless demonstrate important changes. The two Ribes species, for example, are very obviously and differentially affected by fire. Before the area was burned, R. lacustre was represented by more and larger plants than R. viscosissimum. Both are recovering crown volume at about the same rate, but R. viscosissimum has increased tremendously in density, whereas R. lacustre is only slowly approaching prefire densities. In addition, R. viscosissimum seedlings have become one of several important components of the groundcover layer.

Figure 8.--Mountain maple (A. glabrum) resprouting 1 and 2 years after fire.

Figure 9.--Scouler willow (S. scouleriana) resprouting 1 and 2 years after fire. Note the dense growth of Moldavica in the ground layer vegetation.

One shrub species from the prefire community has evidently disappeared, but two others are increasing in importance. Mountain ash (Sorbus scopulina) was eliminated by burning and probably will not reappear until birds bring in new seeds. On the other hand, snowbrush (C. velutinus) is not now a dominant species because it did not resprout, but 92 percent of the frequency quadrats contain snowbrush seedlings. Finally, elderberry (Sambucus racemosa) was present before the fire but was not recorded in the shrub layer sample. Two years after the fire, quick resprouting had raised elderberry to the third largest volume component of the shrub stand.

Two shrub species demonstrated peculiar regrowth patterns that appear to be artifacts of sampling but may in fact be normal. Although the small number of samples precludes a meaningful statistical test, measurements of both serviceberry and snowberry (Symphoricarpos oreophilus) indicate a loss of crown volume between the first and second postfire periods. Photographs of representative plants confirm a thin, spreading crown of vigorous shoots in the first year followed by twig growth to a more compact and dense-leafed crown in the second year.

Trees on the Neal Canyon site are not yet large or dense enough to be detected in the samples. However, the few lodgepole pines on the site have abundantly spot-seeded limited areas, and the planted Douglas-fir has survived well and has made very satisfactory growth.

DISCUSSION

The first 2 years following a fire are a relatively insignificant part of the time required for development of a forest community. Yet these years are extremely important, because so many irreversible patterns are established by an initial surge of plant growth on a bare mineral seedbed. In the Neal Canyon site, some early developments, particularly the appearance of new herbaceous species, were surprising. Other unexpected occurrences are certainly possible, but barring another major disturbance it appears that the vegetal evolution and wildlife habitat potential of this forest site have been established.

Perhaps the most important result of this fire was the rehabilitation of big-game forage plants. Although shrubs in the second year had reached only 63 percent of the total crown volume recorded before the fire, forage values had at least doubled. Maple and willow accounted for about 95 percent of shrub volume before the fire, but the average maple was more than 7 feet high and willow averaged nearly 16 feet. Most of the annual growth was well out of reach of big-game animals. After the fire, maple and willow were still dominant, but maple averaged less than 4 feet in height and willow less than 7 feet. All of the annual growth was available, and most of it was succulent and presumably highly nutritious. In addition, shrub dominance was dramatically shifted from maple, which has only medium palatability, to the more palatable and productive willow. This postfire combination of greater availability and improved composition has vastly improved big-game habitat in Neal Canyon.

For the future, sudden regrowth of large shrubs may not be desirable. At present increment rates, willow will grow out of reach in a few years and maple could follow in a short period. Continuation of wildlife values will eventually devolve on plant species currently subdominant in the stand.

Unless there is an unforeseen deviation in vegetal development, snowbrush will become the most important forage shrubs on this study site. Already present in more than 90 percent of the frequency quadrats, snowbrush seedlings are large and vigorous throughout the burned area (fig. 10). On a nearby similar site burned by wildfire in 1950, snowbrush has increased in the plant community to the virtual exclusion of other species (fig. 11). Since snowbrush is usually rated a desirable forage plant, the big-game habitat potential of the prescribed fire area promises to remain high even after the tall shrubs have grown out of reach.

It is doubtful that the study site will be as totally smothered by snowbrush as the older wildfire area. Serviceberry, snowberry, and Ribes viscosissimum have all increased in density since the prescribed fire, and their crown volumes should considerably exceed prefire volumes before snowbrush reaches maturity. Thus the habitat will probably have a desirable diversity of forage as well as a high production potential. The mixture of species also demonstrates one way in which the Neal Canyon shrub community may be atypical. Of the dozen woody shrubs recorded, none is totally worthless as big-game forage, and the beneficial changes reported here are simply shifts in dominance from less palatable or productive species to more valuable shrubs. It is notable, however, that the immediate improvement in forage production and the potential for continuing production were both determined by plant responses to fire.

Figure 10.--Snowbrush (Ceanothus velutinus) seedlings 2 years old, Neal Canyon study area, 1965.

The long-term development of the forest community on this site can also be predicted. Considering the spacing of the planted Douglas-fir, overstory shade could begin to influence the snowbrush within as few as 10 years. By reputation, and as evidenced by its meager showing in the prefire vegetation, snowbrush is intolerant to shade. These shrubs will deteriorate, and conceivably will disappear within 20 years--leaving only a blanket of seeds to lie dormant until the next fire. When the snowbrush disappears so will most of the wildlife-production potential of this stand, because the two tall shrub species will already be out of reach and other species are thinly scattered.

Willow and maple will again reverse dominance: willow will decline and maple will increase because of their differential tolerance to overstory competition. We can also expect the two Ribes species to switch positions; the less tolerant R. viscosissimum will lose any comparative advantages it gained following the fire. At this point, the response of snowberry and serviceberry cannot be predicted, and the samples of other shrub species may be too small to provide valid behavioral information.

If succession is uninterrupted, the vegetation in this stand will probably be similar to the prefire vegetation (table 1) in about 40 years. Wildlife habitat values will reach a maximum during the first 15 years and then begin a slow decline to the poor forage production usual in a mature timber stand. As these changes occur, studies will be continued to determine rates of plant development and habitat values for each stage of forest succession. This information will be extremely helpful in planning long-term maintenance of wildlife populations in Neal Canyon and in other areas having similar vegetation. All things considered, the Neal Canyon prescribed fire should provide information pertinent to wildlife management that will have far more dollar value than the cost of the fire or the worth of the eventual crop of timber.

Figure 11.--A site near the Neal Canyon Study area, burned by wildfire in 1950. Note how snowbrush dominates.

CAUTION

Effects of prescribed burning in Neal Canyon were exceptionally favorable. Timber management objectives were achieved, wildlife habitat was markedly improved, and watershed protection was not compromised. However, it is important to recognize that fire would produce vastly different results in other ecological situations.

As an example, figure 12 contrasts vegetal ground cover that has developed in Neal Canyon with cover that has become established following the Sleeping Child wildfire (1961) in western Montana. After 4 full years of recovery, the Sleeping Child burn had only 36-percent ground cover--about 60 percent of the cover existing before the fire. Moreover, much of this vegetation is domestic grasses that were seeded to prevent erosion. Shrub recovery has been equally slow, and the present wildlife habitat values of the area are insignificant when compared to the losses from timber destruction and watershed damage. Fire can be useful as a management tool for improving wildlife habitat only when we can predict and fully understand the results it will produce in specific locations.

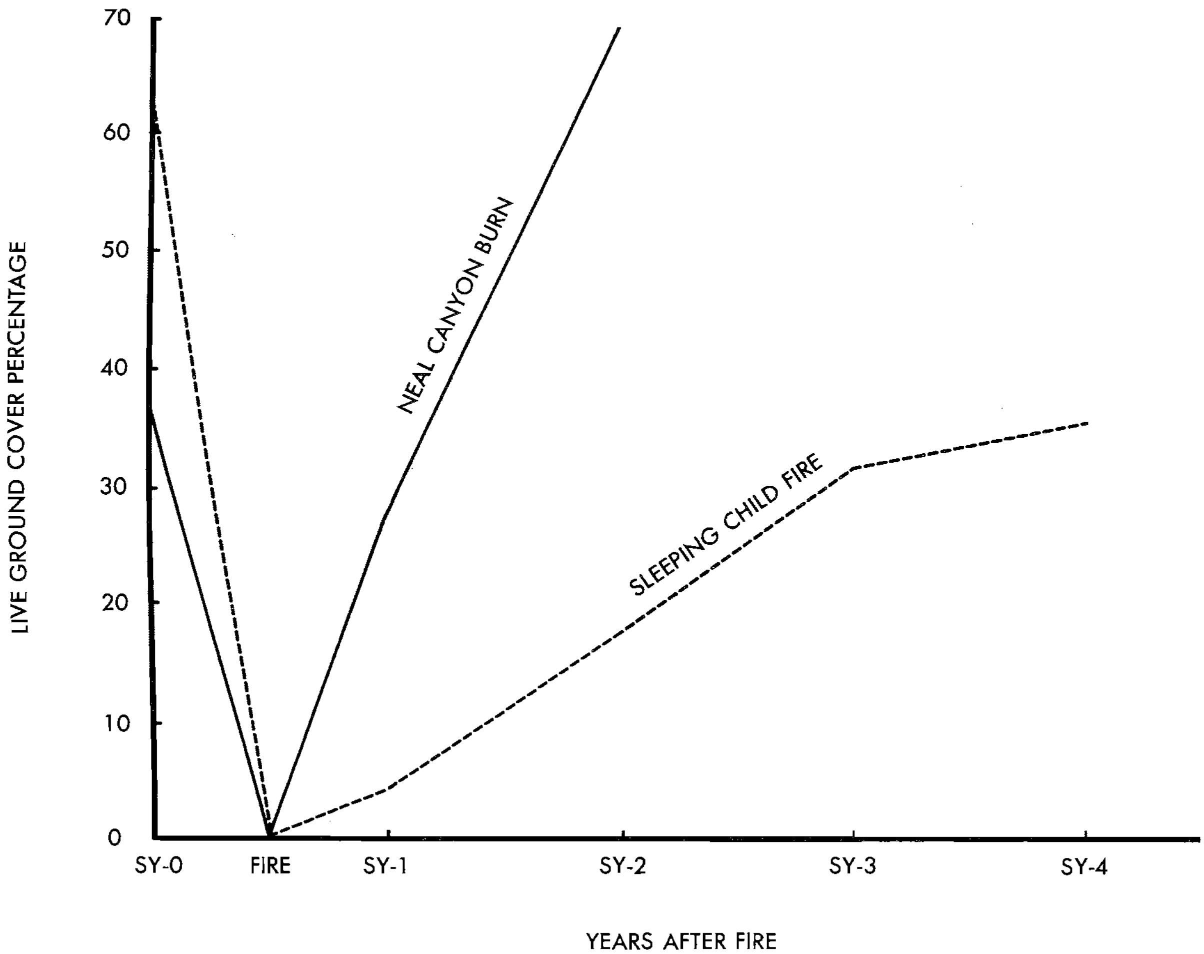

Figure 12.--Development of vegetal cover after the Neal Canyon burn and the Sleeping Child wildfire.

APPENDIX 1

PLANT SPECIES PRESENT ON NEAL CANYON PRESCRIBED FIRE SITE, 1963-65[1]

(Nomenclature follows Hitchcock et al.)

Species	Prefire	Postfire	
	1963	1964	1965
Trees			
Abies lasiocarpa*	x		
Picea engelmannii*	x		
Pinus contorta*	x		
Pinus flexilis*	x		
Populus tremuloides*	x		
Pseudotsuga menziesii	20	20	4
Shrubs			
Acer glabrum	12	4	x
Amelanchier alnifolia	x	x	x
Artemisia tridentata	x	x	
Ceanothus velutinus	x	92	92
Cornus stolonifera*	x		
Penstemon fruticosus	8	4	24
Ribes lacustre	20	x	x
Ribes viscosissimum	4	24	44
Salix scouleriana	x	x	x
Sambucus racemosa	x	x	x
Sorbus scopulina*	x		
Symphoricarpos oreophilus	12	x	x
Herbaceous and low woody plants			
Agropyron inerme	8	x	
Antennaria rosea*	x		
Arabis drummondi[2]	x		x
Arabis holboellii*	4		
Arnica cordifolia	48	24	48
Aster conspicuus	8	12	20
Berberis repens	x	4	
Bromus tectorum**		4	4
Calamagrostis rubescens	24	x	20
Capsella bursa-pastoris**		x	x
Carex spp.	4	12	-
Carex geyeri	52		12
Carex rossii**			12
Castilleja miniata*	8		
Cirsium vulgare	12	4	4
Clematis columbiana	4	x	x
Collinsia parviflora	8	x	4

(continued next page)

PLANT SPECIES PRESENT ON NEAL CANYON PRESCRIBED FIRE SITE, 1963-65 (con.)

(Nomenclature follows Hitchcock et al.)

Species	Prefire	Postfire	
	1963	1964	1965
Herbaceous and low woody plants (con.)			
Conzya canadensis**		x	
Corydalis aurea**		4	4
Cryptantha affinis	4	x	4
Descurainia richardsonii	x	x	x
Epilobium alpinum[2]	-	x	48
Epilobium angustifolium	20	12	28
Epilobium paniculatum**		8	88
Frasera speciosa	16	-	4
Galium sp.*	x		
Heuchera parviflora*	x		
Iliamna rivularis**		52	36
Lactuca serriola**		12	96
Lithospermum ruderale	x		x
Moldavica parviflora**		96	100
Osmorhiza sp.*	x		
Phacelia hastata	x	8	20
Poa nervosa*	20		
Potentilla spp.	20		
Potentilla arguta	x		
Potentilla glandulosa	x		x
Potentilla gracilis*	x		
Pyrola secunda*	12		
Pyrola virens*	x		
Senecio cymbalarioides	44	4	4
Smilacina racemosa[2]	x	x	4
Spergularia rubra**			4
Taraxacum officinale	8	4	24
Tragopogon dubius**		x	x
Trisetum spicatum*	12		
Triticum aestivum**		x	8
Valeriana acutiloba[2]*	x		
Verbascum thapus**			4
Viola adunca[2]	12	8	12

[1] "x" indicates species was present in the stand but not detected in sample quadrats. Numerical designations are percentage frequency of occurrence in twenty-five 2- by 2-foot quadrats.

[2] Tentative identification pending collection of a flowering specimen.

* Present in prefire community but not in the postfire community.

** Not present in the prefire community.

Headquarters for the Intermountain Forest and Range Experiment Station are in Ogden, Utah. Project headquarters are also at:

- Boise, Idaho
- Bozeman, Montana (in cooperation with Montana State University)
- Logan, Utah (in cooperation with Utah State University)
- Missoula, Montana (in cooperation with University of Montana)
- Moscow, Idaho (in cooperation with the University of Idaho)
- Provo, Utah (in cooperation with Brigham Young University)