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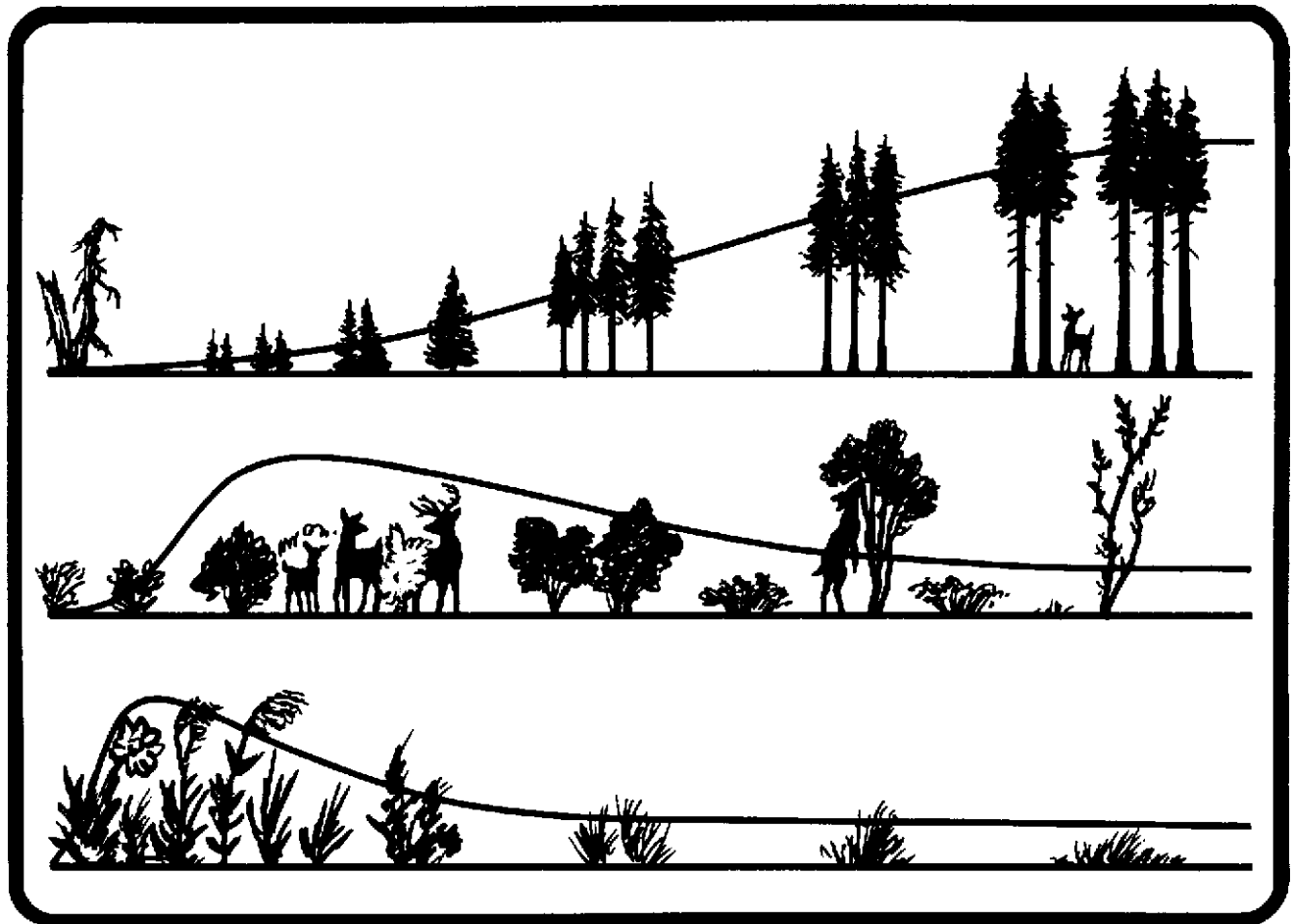
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Data Base for Early Postfire Succession in Northern Rocky Mountain Forests

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Stickney, Peter F.; Campbell, Robert B., Jr. 2000. Data base for early postfire succession in Northern Rocky Mountain forests. Gen. Tech. Rep. RMRS-GTR-61CD. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. One CD-ROM includes 21 pages of text plus electronic data for 55 succession sites including color plates, tables, and figures.

Provides data on quantitative postfire changes of plant species and forest vegetation components for up to the first 25 years of secondary plant succession for 55 forest sites in northern Idaho and northwestern Montana. Cover (aerial crown) and volume (aerial crown space occupied) data are presented as percent cover ($m^2/0.01$ ha) and $m^3/0.01$ ha to permit their direct application to the wide range of wildland management problems involving early postfire forest vegetation. These data can be applied either in terms of plant species response and development or as the development (recovery) of the major life-form components (herb, shrub, or tree) of forest vegetation. This data base incorporates extended versions of two previously published data bases. Color plates illustrate the visual change in forest succession on the 55 sites.

Keywords: secondary plant succession, successional pathway, seral brushfield development, seral forest development, postfire forest recovery, northern Idaho, western Montana, western cedar-western hemlock type, Douglas-fir-western larch type, forest succession modeling

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Research Summary

Baseline data on the seral development of herb, shrub, and tree species are provided for the first 6 to 25 years following overstory tree-killing wildfire (31 sites) and broadcast burned clearcuts (24 sites) in northern Idaho and western Montana. Early forest succession for western redcedar-western hemlock, western larch-Douglas-fir, and Douglas-fir-ponderosa pine forest types are represented for 55 study areas at five locations in the Northern Rocky Mountains. Descriptive site information includes location, prefire forest vegetation and type, and severity of disturbance. Study area sites range in elevation from 2,900 to 5,300 ft (844 to 1,616 m) and represent all cardinal exposures and a range of slopes from 10 to 60 percent. Succession data on canopy cover (percent) and volume of space occupied ($m^3/0.01$ m) standardized to 0.01 ha ($100\ m^2$) is presented by plant species and physiognomic life-forms, without interpretation, to provide a quantitative resource for application to wildlife habitat and forest and other wildland management problems. In addition, it can serve as a data source for modeling applications in research on forest succession and ecosystem management.

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Introduction

The development of burned forests in the Northern Rocky Mountains is a secondary plant succession process. This process of forest succession in the Northern Rocky Mountains has been found by Stickney (1986) and Lyon (1971, 1976), for the first 25 years, to be a progressive sequential change in predominant species and community structure keyed to the species composing the initial seral (postfire) plant community. Forest succession is reinitiated whenever the severity of a disturbance is of sufficient magnitude to return the community to an earlier developmental state. For a given forest community or stand, such an event terminates the current seral pathway (succession cycle) and initiates the next.

Prior to settlement of the Northern Rocky Mountains in the 1800's by European-Americans, fire constituted the principal disturbance agent of these forests both over time and area affected. Fire as an agent of disturbance has been an inherent and integral part of these forests for at least the last several thousand years (Hemphill 1983; Mehringer and others 1977; Mutch 1970). Studies documenting the recurrence of fire in these forests (Arno 1976, 1980; Arno and Davis 1980; Barrett and Arno 1982) indicate that most of the forest plant species evolved or at least existed in the presence of periodic disturbance by fire (Habeck and Mutch 1973; Howe 1976). In fact, many of these plant species possess features that permit them to survive burning (Bradley 1984; Lyon and Stickney 1976; Stickney 1990). The natural recovery and development of forest vegetation in the Northern Rocky Mountains following wildfire derives from plant species that either survive fire in place (regrowth) or are capable of colonizing the immediate postfire site (from either onsite [burned] or offsite [unburned] seed sources). The severity of fire disturbance (Rowe 1983; Ryan and Noste 1985; Viereck and Schandelmeier 1980) to the existing vegetation directly influences the species composition and amount of the survivor component that remains after the fire. This burning treatment also conditions the suitability of the site for the germination and establishment of seedlings.

Since settlement, logging has become an increasingly important disturbance agent for initiating succession in the forests of the Northern Rocky Mountains. Of the timber harvesting practices used, clearcutting followed by broadcast burning represents the cultural disturbance that most closely approximates the severest natural wildfire disturbance: the holocaustic forest fire or tree stand-killing fire.

Because succession is the natural and recurrent process of developing forest vegetation, understanding its basic features is essential to the effectual management of wildlands for desired vegetation conditions. This understanding must include the response and behavior of at least the preponderant plant species that compose the early postdisturbance forest communities. The establishment and development of early seral communities affects all aspects of forest management in which the composition and quantity of vegetation is important to the wildland resource. These include watershed cover, tree regeneration establishment and survival, creation and duration of big game browse ranges and other wildlife habitats (including small mammals and birds), and maintenance of sensitive species habitat and diversity among others.

Quantitative data on changes in plant species over time following wildfire or clearcutting and broadcast burning provide the means for determining natural forest succession and allow opportunity to compare the effects of cultural and wildfire disturbances. As forest practices become directed to sustaining ecosystem management, some of the potential uses for information on forest succession include:

- Designing silvicultural and fire prescriptions to achieve future desired condition
- Assessing rehabilitation needs following wildfire and aiding in fire damage appraisals
- Evaluating probable vegetation recovery for escaped fire analysis
- Assessing effect of fire on vegetation for fuels management planning

- Developing fire management prescriptions to restore and maintain fire as a natural process in wilderness and other forest ecosystems
- Providing specific examples for understanding forest succession in regard to the management of natural areas and other wildland areas
- Constructing, testing, and improving models of forest succession

Studies of succession in Northern Rocky Mountain forests have, for the most part, been reconstructions of plant community change by sampling forest stands of different ages (Habeck 1968; Irwin and Peek 1979). The underlying assumption that each sampled stand of different age will succeed to the next older sample stand is not realistic. This is due to the inherent variability existing between sites as to the presence of plant species that will function as survivors and residual colonizers in the next seral pathway. Combining the fragmentary records of stand ages usually available for sampling can lead to unknown and possibly substantial errors. Such synthetic reconstructions will describe forest succession more as it is presumed to happen rather than as it is observed to occur. Such reconstructions, at best, can represent only the broadest generalization of succession. And importantly, the lack of a continuous record of change in composition prevents recognition of the emplacement, extirpation, and development patterns of species within the succession that collectively constitute the seral pathway.

Species present in the first postfire growing season constitute the initial plant community of the seral pathway and provide the floristic basis from which the development of early seral vegetation commences. For many areas this community determines the direction of the subsequent pathway. The species that compose this initial vegetation respond to fire either as survivors (regrowth or resprouts from burned plants) or colonizers (postfire seedlings). Both seral origins are indicated for those species that responded as regrowth and seedlings. In some instances the charred remains of herbaceous plants were identifiable, and where all plants of that species on a study area were killed, they are listed as a “nonsurvivor.”

The ability of a plant species to survive fire varies and is related to the plant's fire life-form interacted with the severity of the burning treatment. For this data base, those species classified “survivor” demonstrated the capability to survive the severest natural fire treatment, the holocaustic wildfire (stand-replacing fire).

The postfire or seral origin of initial community species derives from either burned plants (survivors) or postfire seedlings (colonizers). The seed for these colonizers may originate from either onsite (burned

site) or offsite (unburned site) sources. Seed dispersability can provide clues as to onsite and offsite origin of colonizer seed. The potential for secondary colonization of species from an onsite source is related to its capacity to mature (flower) early in succession.

This publication makes data on quantitative change in secondary plant succession available in this basic form—one not masked or obscured by analytical techniques or relative gradient abstractions. In its basic form these data have widespread application to wildland management problems involving the early stages of postfire forest succession. The data include area and volume on the development of major life-form groups (the herb, shrub, and tree community components) and for individual species. Cover (aerial crown area) and aerial crown volume (volume of space occupied) were sampled on permanent plots following prescribed broadcast burning of clearcuts or wildfire in undisturbed standing timber. Tabular presentation of data represents the first 6 to 25 years of secondary plant succession on 55 forest sites, termed study areas, in northern Idaho and western Montana. These data may serve as a basis for examining the occurrence, response, and early development of individual species. Both in the number of study areas and the years of postfire succession reported, the data base presented here expands and supersedes the two data bases previously published by Stickney (1980, 1985) on Northern Rocky Mountain forest succession. Because of the continuing nature of these studies, we amplified and extended the text, tables, and figures already embodied in the two preceding publications.

Methods

The successional development of vascular plants was measured on permanent plots using nondestructive sampling techniques. This approach attempts to quantify actual changes in vegetation as they occur in place over time, thereby minimizing extraneous variation in time-development of plant species inherent in nonpermanent plot methods. All sampling measurements were metric.

Vegetation Sampling

Each study area consisted of 10 blocks, each 5 by 5 m². To aid relocation, these blocks were contiguously arrayed in two groups of five blocks each with the blocks in each group referenced to a 25 m base line (fig. 1). Base lines were marked at each end with a bridge spike driven flush to the ground. Normal configuration of base lines were end to end on a common bearing that was neither parallel nor perpendicular to the contour. Where the terrain was confining due to changes in slope, exposure, or tree stand, the base lines were

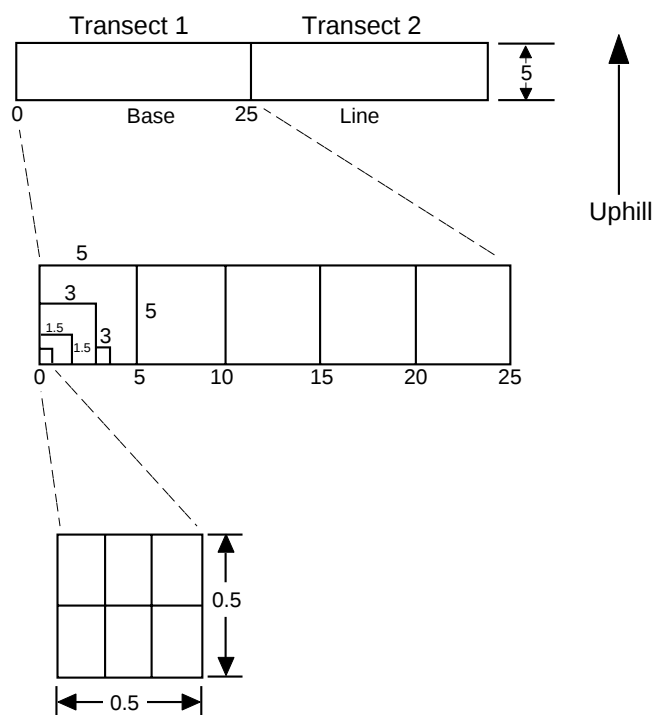


Figure 1—Field layout of permanent plots for each study area (dimensions in meters).

arranged parallel (one above the other) or in a “lazy V” (<) configuration.

Within each block the vascular vegetation was stratified by life-form and height class and sampled in four sizes of nested plots (fig. 2). The base point for all nested plots within a block was referenced to the whole 5 m point on the base line. Herbaceous and low woody plants were sampled in the smallest plot; shrubs and trees were sampled in the three larger plots. For this succession data base, a shrub is defined as an erect multistemmed woody plant without a bole and at least 0.5 m high. In contrast, a tree is an erect single-stemmed woody plant with a bole and at least 0.5 m high. Shrubs and trees in the height range of 0.5 to 1.4 m, 1.5 to 2.4 m, and 2.5 m and taller were sampled

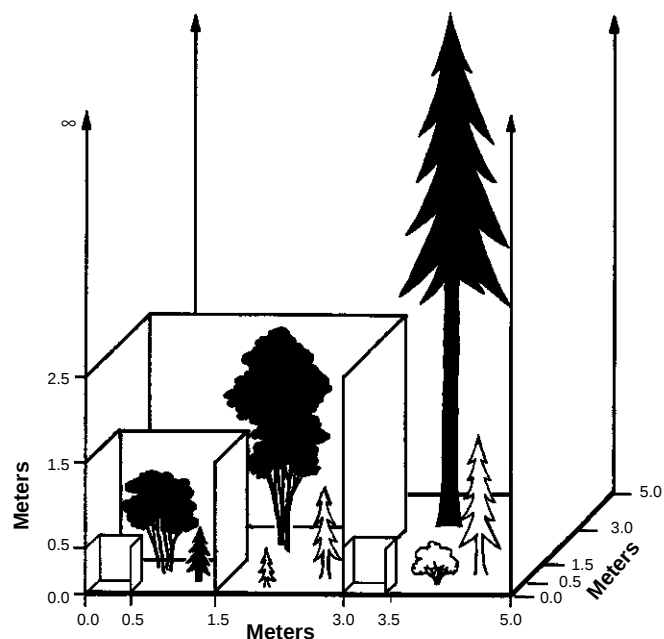


Figure 2—Nested plots within each block for sampling shrubs and trees stratified into three height classes (shaded plants sampled; outlined plants not sampled).

in the 1.5, 3, and 5 m² plots respectively (table 1). Each shrub and tree sampled was recorded by species and measured to the nearest decimeter for two horizontal dimensions of its aerial crown and the height above its rooted point. In addition, trees 0.5 to 1.4 m high were counted by species, trees 1.5 to 2.4 m high were counted by species and assigned an average diameter at breast height (d.b.h.) of 1.25 cm, and trees 2.5 m high and taller were measured at d.b.h. (1.4 m high) to the nearest centimeter and recorded by species. Tree crown dimensions were not measured in the preburn sample.

Within each block, herbaceous and low woody vegetation were sampled by species in two 0.5 m² plots. These two plots were located along the base line at the

Table 1—Summary of plots sampled on each study area.

Plot size	Height limits	Vegetation sampled	No./area
----- m -----			
5 by 5	2.5+	Trees and shrubs	10
3 by 3	1.5-2.45	Trees and shrubs	10
1.5 by 1.5	0.5-1.45	Trees and shrubs	10
0.5 by 0.5	<0.5	Trees and shrubs and all herbs and low woody plants irrespective of height	20

base or zero point (base line 5 m points) and the 3 m point for that block respectively (fig. 2). To avoid the disturbed herbaceous vegetation usually associated with each relocation and reestablishment of the base line, the first 0.5 m² plot in block 1 was referenced to the 1.0 m point of the base line (instead of the 0.0 m point). Aerial canopy coverage of herbaceous and low woody species was visually estimated in units to the nearest of one-sixth of a 0.5 m² plot (fig. 2). Species with coverages of less than one-sixth unit were recorded as miscellaneous vegetation for that plot if they collectively totaled at least one-sixth of the plot area. Each species receiving a cover estimate was also measured for its “representative height” within the plot to the nearest half-decimeter.

The remaining ground surface not covered by vascular herbaceous or low woody plants was similarly estimated in units of one-sixth of a 0.5 m² plot as: moss/lichen, litter (dead organic material), rock, or bare mineral ground. Snags, stumps, burned root crowns, and logs embedded in the ground were treated as litter. Suspended logs were not considered ground cover. Cover estimates for all categories sampled in the 0.5 m² plot were initially limited to account for 100 percent of ground surface. However, when it became apparent that moss/lichen and short stature plant species would be underrepresented when overtopped by taller vegetation, the sampling rule was modified to allow sampling the full cover present of any qualifying overtopped species. Consequently, multistoried vegetation sampled by the 0.5 m² plot can exceed 100 percent.

Prior to each sampling, visual documentation of vegetation was recorded with 35 mm color and 4 by 5 inch black and white photography made from the “zero point” of the transect base line viewing toward the end of the transect. The only exceptions to this photographic record were the study areas in the Sundance Burn Study (1802-16) wherein only the “zero point” for the first transect (T-1) was used.

Nomenclature for vascular plants follows Hitchcock and Cronquist (1973). Plant species identifications were made by Peter Stickney with verification of many of the species by Dr. Frederick J. Hermann or Dr. Charles Feddema, both from the former USDA Forest Service Herbarium at Washington, DC, and later Fort Collins, CO. Voucher specimens for most species are on file at the Forestry Sciences Laboratory Herbarium (MRC), Missoula, MT.

Vegetation Description

Five attributes descriptive of vegetation were derived from this sampling method (table 2). Of these, cover (aerial canopy area) and plant volume (space occupied by the plant) are considered to be the most

Table 2—Attributes describing vegetation development.

Vegetative life form	Attribute
Trees (1.5 + m ht)	Density (N/0.01 ha) Basal area (cm ² /0.01 ha)
Shrubs (0.5 + m ht) and Trees (0.5 – 2.5 m ht)	Density (N/0.01 ha) Cover (m ² /0.01 ha) Volume (m ³ /0.01 ha)
Herbs and low woody plants (including tree and shrub species <0.5 m ht)	Frequency (percent) Cover (m ² /0.01 ha) Volume (m ³ /0.01 ha)

descriptive for representing the quantified development of early seral vegetation. Cover for tree and shrub species was computed using the horizontal crown dimensions as axes of an ellipse. Crown area for herbs and low woody plants was visually estimated in units of cover equivalent to one-sixth of the 0.25 m² plot (0.04167 m²). Plant volume for trees and shrubs was determined for each individual plant from its crown area and height. The product of these values gives the volume of a cylindroid representing the space occupied by the plant in the community. Similarly, the volume of space occupied by herbs and low woody plants was calculated from the area and a representative height. Cover and volume were averaged by species for each plot size, converted to 0.01 ha area base, and totaled to produce the tabular value given in the data tables for each plant species and life-form group. Because this base equals 100 m², the values given for cover in the tables are percentage of ground covered that is equivalent to m²/0.01 ha. Tabular values for volume are expressed as m³/0.01 ha.

Height, while not presented as tabular information, may be obtained for any given plant species or life-form group from the quotient of its volume and cover values. The result is mean height in meters. This expression of vertical development can identify the periods required for various woody plant species to reach mature stature, thus providing information on structural patterns in the successional progression for life-form group or individual plant species.

Study Areas

All study areas are situated in the Northern Rocky Mountains of northern Idaho and northwestern Montana (fig. 3). The study of clearcut and broadcast burn succession was initiated by the Intermountain Research Station as Study 1802-13 in 1966. The designation of *study area* numbers were 05 to 09 for Priest River Experimental Forest, 10 to 23 for Miller Creek Demonstration Forest, and 24 to 30 for Newman Ridge.



Figure 3—Forest succession study locations in the Northern Rocky Mountains.

The wildfire portion of the data base was derived from two wildfire succession studies: Sundance Burn Study (1802-16) with study areas designated 01 to 21 and Plant Creek Burn Study (1802-19) with study areas designated 01 to 15. Three study areas at Miller Creek (1802-13) numbered 22-1, 22-3, and 23—which burned

in a wildfire prior to logging—also contributed to the wildfire data base. To facilitate communication for future users, the 1802- study number of Research Work Unit FS-INT-4201, Forestry Sciences Laboratory, Missoula, MT, is given in the header for each succession study. This study number and study area designation identify all field data sheets, plant specimens, photographs taken, time sequence summaries, and analyses of individual study areas made in the course of this work.

Broadcast Burn Study Areas

Priest River Experimental Forest, Selkirk Range, northern Idaho (1802-13, Study Areas 05, 08-09)

The three study areas at the Priest River Experimental Forest lie on the western flank of the Selkirk Range in the Benton Creek watershed (lat. 116° 49'N., long. 48° 22' 30"W.) 12 miles (19 km) northwest of Sandpoint, ID (fig. 4). Elevation range represented by the study areas is 2,600 to 2,900 ft (790 to 885 m). The climate is characterized by Finklin (1983) as transitional between the north Pacific coastal type and a continental type. The Pacific influence is most prominent in late fall and winter with maximal cloudiness and precipitation and moderate winter temperatures. Summer season is short (July and August), sunny, and dry. Depending on elevation, annual precipitation averages 32 to 50 inches (813 to 1,270 mm) of which 60 percent occurs from November through March with more than 50 percent falling as snow. Frost-free season averages 65 to 96 days depending on the elevation.

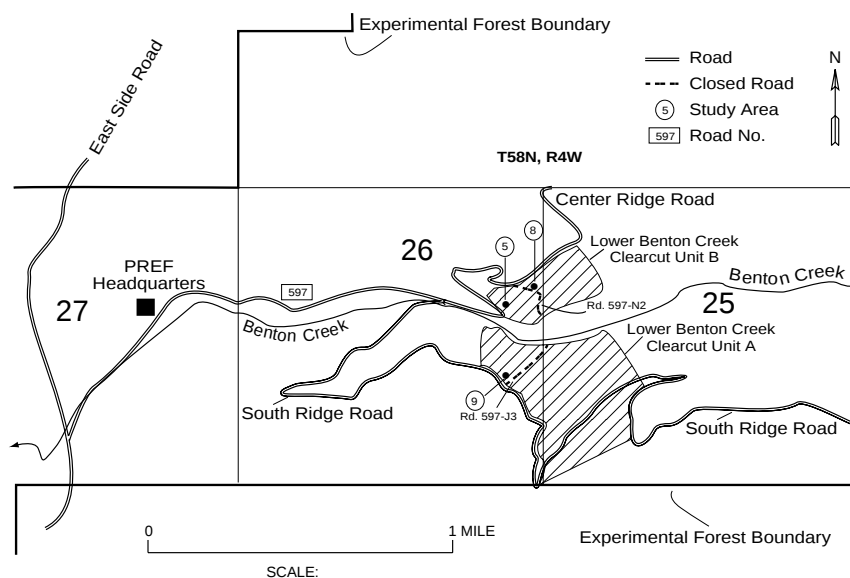


Figure 4—Forest succession study areas within clearcut units of the Lower Benton Creek Demonstration Forest, Salish Mountains, northwest Montana.

Miller Creek Demonstration Forest, Salish Mountains, northwestern Montana (1802-13, Study Areas 10-23)

The map displays the study area, including the 1967 Wildfire, study areas, and various units (W, E, S, N). The map is oriented with North at the top. A legend in the upper left corner defines the symbols used: a wavy line for a Ridge, a solid line for a Road, a box labeled 'S-12' for an Expt. Burning Unit, a line with cross-ticks for a Burn Edge, a circle with the number 17 for a Study Area, and a box with the number 9807 for a Road Number. The map shows a network of roads and ridges. Study areas are numbered 1 through 25. Units are labeled with letters and numbers: W-1 through W-15, E-1 through E-15, S-1 through S-15, and N-1 through N-15. The 1967 Wildfire is indicated by a shaded area on the right side of the map. The map is bounded by T 32 N and R 25 W on the left, and T 31 N and R 24 W on the right. A scale bar at the bottom indicates a distance of 1 mile.

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from 4,300 to 5,400 ft (1,310 to 1,645 m). The climate as characterized by DeByle and Packer (1972) has long, wet winters and short, relatively dry summers. Annual precipitation averages about 25 inches (635 mm), about two-thirds of which falls as snow. Gentle topography resulted as the slopes were rounded by cordilleran ice-sheet glaciation. Soils that were developed on glacial till, thinly mantled with loess, now support forests predominantly of western larch (*Larix occidentalis*) and Douglas-fir with an understory of subalpine fir (*Abies lasiocarpa*). Timber volumes were evenly divided between western larch, Douglas-fir, and Engelmann spruce (*Picea engelmannii*).

Forest succession study areas were superimposed on experimental burning units of a broadcast burning study (Beaufait and others 1977). This burning study related burn character and accomplishment to fuels and weather. Burning treatments were designed to determine the effects of slope, exposure, and season of burning on gentle (Miller Creek) and steep (Newman Ridge) terrain. Parameters sampled in the fire study were those concerned with preburn and postburn fuels, atmospheric conditions, and burning characteristics of the fire. The 10 acre (4 ha) experimental burning units were clearcut-logged and then slashed to provide a uniform fuel bed. Most units were broadcast burned within a year or two after timber harvest. The usual pattern of firing was to ignite a strip across the upper edge of the block, then the sides, and finally the lower edge. This produced an uphill-heading fire

over most of the area. Most units were burned in the late afternoon or early evening.

Experimental prescribed burns were conducted on 13 of the Miller Creek study areas. Two study areas were clearcut, but the logging slash was never burned. The undisturbed forests of three study areas burned in a wildfire. Habitat type designations follow Pfister and others (1977). Field sampling was conducted most years during late July.

Newman Ridge, Coeur d'Alene Mountains, western Montana (1802-13, Study Areas 24-29)

The six study areas at Newman Ridge on the Superior Ranger District, Lolo National Forest (lat. 47° 15' N., long. 115° 20' W.) are 7 miles (11 km) west of St. Regis, MT (fig. 6). Study area elevations range from 4,900 to 5,300 ft (1,495 to 1,615 m). Long, cool wet winters and short, relatively dry summers are typical for this climate (DeByle and Packer 1972). Annual precipitation averages nearly 40 inches (1,016 mm) of which about two-thirds falls as snow. Newman Ridge is characterized by steep slopes with silt-loam soils developed on colluvium with a mantle of loess. The most recent addition of loess mantle was a light dusting of volcanic ash contributed by the 1980 eruption of Mount St. Helens in the Cascade Range. Forests are predominantly of the western larch and Douglas-fir type. The experimental burning units in which study areas were superimposed were 21 to 58 acres (8 to 23 ha).

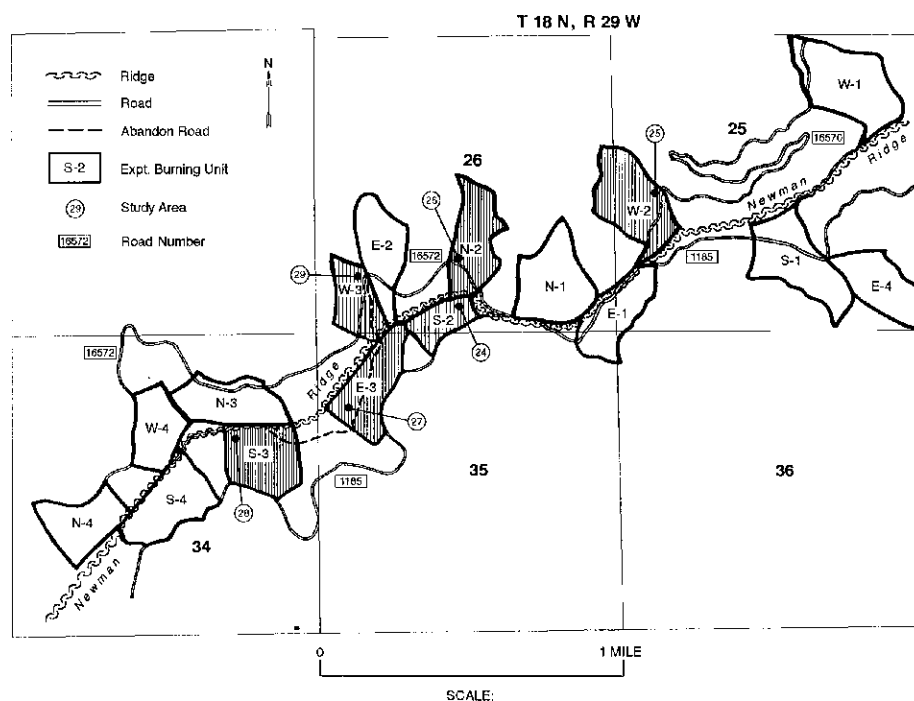


Figure 6—Forest succession study areas within the experimental burning units at Newman Ridge, Coeur d'Alene Mountains, western Montana.

Because Newman Ridge and Miller Creek were part of the same study, other information about study areas and design given for Miller Creek applies here also. Habitat type designations follow Pfister and others (1977). Field sampling for most years was done in August.

Wildfire Study Areas

The study of the cultural use of fire and the response of forest vegetation to that treatment had just begun when in 1967 severe wildfires burned areas in the Selkirk Range and at Miller Creek. These natural fire (lightning-ignited) disturbances provided an unusual opportunity for obtaining data that could be used to compare and contrast the response of plant species in forest succession between wildfire and clearcutting with broadcast burning. Because methodology was already in place, the same field methods were used to sample plant species response and seral development following wildfire.

Miller Creek Demonstration Forest, Salish Mountains, northwestern Montana (1802-13, Study Areas 22-23)

Three study areas in the eastern portion of the Miller Creek watershed (fig. 5) burned August 23 at the height of the 1967 fire season. Two study areas (22-1 and 22-3) burned in the early afternoon as a crown fire. The third study area burned that evening as a surface fire that killed all but three of the overstory trees. This burning treatment resulted in the nearest live-tree seed source being 1,300 ft away for study areas 22-1 and 22-3 and onsite to 300 ft away for study area 23. Other aspects of these three study areas are as described for the broadcast burned study areas at Miller Creek.

Sundance Burn, Selkirk Range, northern Idaho (1802-16, Study Areas 01-21)

On September 1, 1967, the Sundance Fire burned a 5 by 16 mile (8 by 26 km) swath northeastward across the central portion of the Selkirk Range in northern Idaho. The study location is centrally situated within this burn where the fire reached "fire storm" proportions (Anderson 1968). This burn is on the Sandpoint Ranger District, Idaho Panhandle National Forest (lat. 48° 34' N., long. 116° 37' W.) 20 miles (32 km) north of Sandpoint, ID. Locations within the Pack River drainage of the 18 study areas are shown in figure 7. Elevations of these study areas ranged from 2,950 to 4,300 ft (900 to 1,310 m).

Similar to Priest River Experimental Forest 18 miles (29 km) to the southwest, the climate is characterized by long, cool but not cold, moist winters and short, warm, and dry but not particularly droughty summers (Finklin 1983). Annual precipitation is

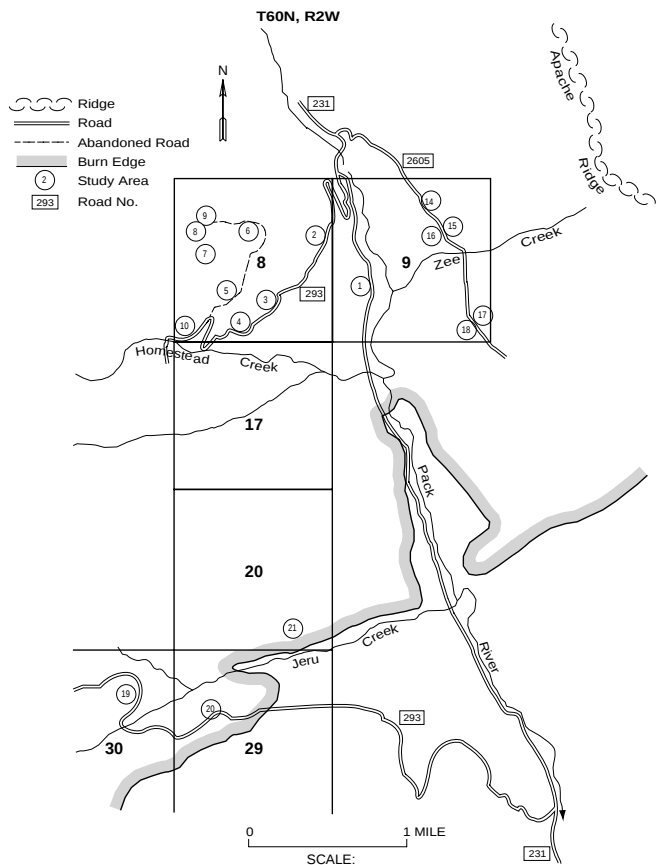


Figure 7—Forest succession study areas in the Sundance Burn, Selkirk Range, northern Idaho.

estimated between 40 to 60 inches (1,010 to 1,500 mm) (Rice 1971) with about three-fourths falling as snow. Topography of the mid- and lower slopes of the Pack River Valley has been rounded and smoothed by mountain glaciation (Alden 1953). Soil is regosolic in character with silt loam texture developed from granitic tills overlain by a loess mantle 6 to 30 inches (15 to 76 cm) thick (USDA Forest Service 1967).

Prefire forests on the study areas were composed of immature trees of pole size timber, 5 to 9 inches (12.7 to 22.6 cm) d.b.h., of the western larch and Douglas-fir timber types. Most tree crown canopy coverage ranged from 40 to 70 percent (USDA Forest Service 1962). Other timber types represented include mature sawtimber, more than 9 inches (more than 22.6 cm) d.b.h., of western redcedar and western hemlock in the 70 to 100 percent tree canopy cover class. Postfire approximation of forest habitat types suggests that study areas were in the *Thuja-Tsuga* climax forest zone (Daubenmire 1952), and all but the most xeric sites represent the *Tsuga heterophylla-Pachistima myrsinites* habitat type (Daubenmire and Daubenmire 1968).

Disturbance by holocaustic burning treatment created the conditions from which forest succession commenced. Fire intensity data from Anderson's (1968) reconstruction of the Sundance Fire provide a measure of the intensity of fire disturbance to the forest vegetation. All values reported by Anderson greatly exceed the minimum limit for a high intensity fire defined by Sando (1978) as average intensity greater than 1,200 Btu/sec/ft. From postfire observation, prefire overstory appeared undisturbed by cutting or logging except in two instances. For these two study areas, the time since cutting was undetermined. Field sampling for most years was done during early August.

Study areas are designated SD-01 through SD-10 and SD-14 through SD-21. The early successional development (first 20 years) of vegetation on the 18 study areas encompassed a wide range of survivor and colonizer combinations. The extremes of this compositional spectrum range from communities composed largely of survivors (SD-17 and SD-21) to those formed predominantly of colonizers (SD-06 and SD-07). The first decade of plant succession following the Sundance Fire has been described by Stickney (1986).

Plant Creek Burn, Sapphire Range, western Montana (1802-19, Study Areas 01-05, 09-12,15)

Ignited by lightning on August 29, 1972, a forest fire burned 730 acres (295 ha) in the Plant Creek watershed on the west side and in the northern end of the Sapphire Range. The study areas are in the eastern portion of the burn, which burned as a holocaustic wildfire on August 30. This succession study was on the Missoula Ranger District, Lolo National Forest (lat. 46° 44' 30"N., long. 113° 52' 30"W.) 10 miles (16 km) southeast of Missoula, MT. Location in the Plant Creek drainage of the 10 study areas is shown in figure 8. Elevation of these study areas ranged from 4,800 to 5,200 ft (1,460 to 1,580 m). Habitat type designations follow Pfister and others (1977). Field sampling for most years was done during early July.

Forest Succession Data Base

The data base documents the initiation and development of early seral vegetation for 21 study areas in northern Idaho and 34 study areas in northwestern Montana. For each study area a descriptive section precedes the data tables for cover and volume development. The descriptive section provides information on site location, predisturbance vegetation, and disturbance treatment. Cover and volume tables quantify seral development of individual plant species and major life-form groups. The floristic composition and seral origin of the successional flora appear in table 3. The disturbance treatments represented in the data

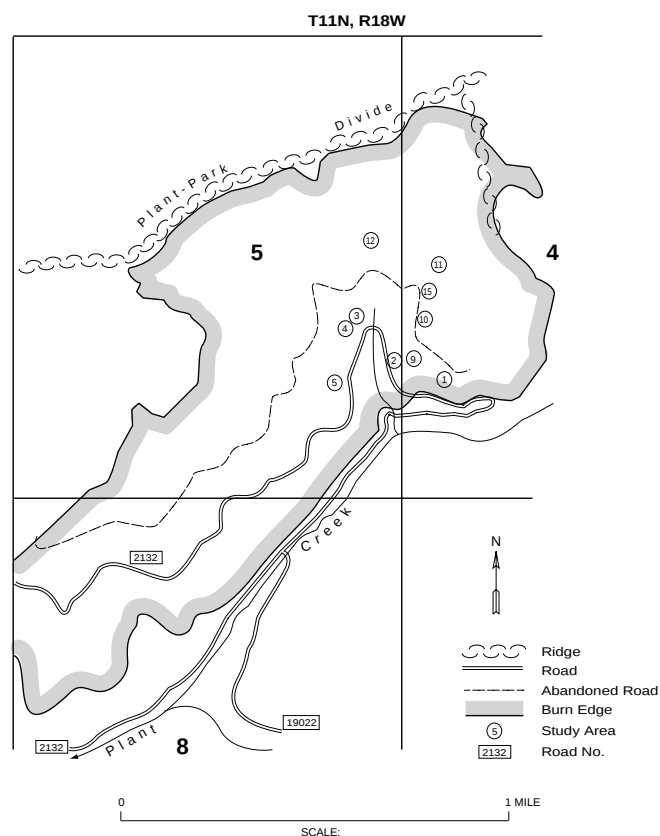


Figure 8—Forest succession study areas in the plant Creek Burn, Sapphire Range, western Montana.

base are holocaustic wildfire or broadcast burning following clearcut logging.

Site Description

In addition to location, descriptive site features include elevation, and slope exposure and steepness. Information on predisturbance forest vegetation varies with the succession study. For the broadcast burn study areas, undisturbed forest vegetation was sampled in the permanent plots prior to disturbance. Predisturbance overstory is characterized in terms of stand and species basal area. The composition and abundance of understory shrub and herb cover species may be obtained from the "PRE" column in the data tables. Excepting the three Miller Creek wildfire study areas, such information on predisturbance vegetation is not available for the wildfire study areas. However, timber inventory maps (USDA Forest Service 1962) can provide a general characterization of composition, size, and coverage of the predominant or potential prefire tree overstory. In some cases a partial reconstruction of predisturbance vegetation is possible

Table 3—Floristic composition and seral origin of cover species (species attaining at least 1 percent cover on at least one study area for at least 1 year) in early succession in Northern Rocky Mountain forests.

	Acronym ^a	Botanical name ^a	Study area ^b						Seral origin ^c
			PR	MC	NR	MCW	SDW	PCW	
1	ABGR	<i>Abies grandis</i>	x	x	x	x	x		Offsite colonizer
2	ABLA	<i>Abies lasiocarpa</i>		x		x	x		Offsite colonizer
3	ACGL	<i>Acer glabrum</i>	x	x	x	x	x	x	Survivor, rootcrown
4	ACMI	<i>Achillea millefolium</i>	x	x				x	Offsite colonizer
5	ADBI	<i>Adenocaulon bicolor</i>	x	x	x		x		?Nonsurvivor
6	AGAL	<i>Agrostis alba</i>					x	x	Adventive offsite colonizer, rhizome
7	AGCR	<i>Agropyron cristatum</i>						x	Introduced offsite colonizer
8	AGEL	<i>Agropyron elongatum</i>						x	Introduced offsite colonizer
9	AGSC	<i>Agrostis scabra</i>		x					Offsite colonizer
10	ALCE	<i>Allium cernuum</i>						x	Survivor, bulb
11	ALSI	<i>Alnus sinuata</i>		x	x	x	x		Survivor, rootcrown
12	AMAL	<i>Amelanchier alnifolia</i>	x		x	x	x	x	Survivor, rootcrown; offsite colonizer
13	ANAR	<i>Angelica arguta</i>						x	Survivor, caudex
14	ANMA	<i>Anaphalis margaritacea</i>	x	x	x	x	x		Offsite colonizer
15	ANMI	<i>Antennaria microphylla</i>	x						Offsite colonizer
16	ANPI	<i>Anemone piperi</i>			x				Survivor, caudex
17	ANRA	<i>Antennaria racemosa</i>		x					Offsite colonizer
18	APAN	<i>Apocynum androsaemifolium</i>			x		x	x	Survivor, rhizome
19	ARCO	<i>Arnica cordifolia</i>						x	Survivor, rhizome
20	ARHO	<i>Arabis holboellii</i>						x	?Offsite colonizer
21	ARLA	<i>Arnica latifolia</i>		x	x	x	x		Survivor, rhizome
22	ARMA	<i>Arenaria macrophylla</i>	x		x				?Offsite colonizer
23	ARNU	<i>Aralia nudicaulis</i>					x		Survivor, rhizome
24	ASCA	<i>Astragalus canadensis</i>						x	Survivor caudex
25	ASCO	<i>Aster conspicuus</i>	x	x		x	x	x	Survivor, rhizome
26	ASEA	<i>Aster eatonii</i>	x						Survivor, rhizome (wet site)
27	ASEN	<i>Aster engelmannii</i>					x		Survivor, rhizome
28	ASLA	<i>Aster laevis</i>						x	Offsite colonizer
29	ASMI	<i>Astragalus miser</i>						x	Survivor, caudex
30	ASOC	<i>Aster occidentalis</i>				x			Offsite colonizer
31	BASA	<i>Balsamorhiza sagittata</i>						x	Survivor, caudex
32	BEPA	<i>Betula papyrifera</i>	x				x		Survivor, rootcrown; residual colonizer
33	BERE	<i>Berberis repens</i>	x	x	x	x	x	x	Survivor, rhizome
34	BRTE	<i>Bromus tectorum</i>	x					x	Offsite colonizer
35	BRVU	<i>Bromus vulgaris</i>	x	x					?Nonsurvivor
36	CACO	<i>Carex concinnoides</i>	x	x	x	x		x	Survivor, rhizome, residual colonizer
37	CADE	<i>Carex deweyana</i>					x		?Survivor, loose tussock
38	CAGE	<i>Carex geyeri</i>			x		x	x	Survivor, rhizome, ?residual colonizer
39	CAMI	<i>Castilleja miniata</i>					x	x	Offsite colonizer; ?survivor, caudex
40	CARO	<i>Carex rossii</i>	x	x	x		x	x	Residual colonizer
41	CARU	<i>Calamagrostis rubescens</i>			x	x	x	x	Survivor, rhizome
42	CATW	<i>Calamagrostis tweedyi</i>			x				Survivor, rhizome
43	CEMA	<i>Centaurea maculosa</i>						x	Adventive offsite colonizer
44	CESA	<i>Ceanothus sanguineus</i>	x		x		x		Residual colonizer; survivor, rootcrown
45	CEVE	<i>Ceanothus velutinus</i>			x	x	x	x	Residual colonizer; survivor, rootcrown
46	CHLE	<i>Chrysanthemum leucanthemum</i> x							Adventive offsite colonizer
47	CHUM	<i>Chimaphila umbellata</i>		x		x			Nonsurvivor
48	CIAR	<i>Cirsium arvense</i>	x	x			x		Adventive survivor, rhizome
49	CIVU	<i>Cirsium vulgare</i>	x	x				x	Adventive offsite colonizer, biennial
50	CLCO	<i>Clematis columbiana</i>						x	Survivor, rootcrown
51	CLUN	<i>Clintonia uniflora</i>	x	x	x		x		Nonsurvivor (infrequent survivor, rhizome)
52	COCA	<i>Cornus canadensis</i>		x					Nonsurvivor, mat-forming
53	COLI	<i>Collomia linearis</i>	x					x	Residual colonizer, annual
54	COOC	<i>Coptis occidentalis</i>			x				Survivor, cuadex
55	COPA	<i>Collinsia parviflora</i>	x				x	x	Residual colonizer, annual

(con.)

Table 3 (Con.)

	Acronym ^a	Botanical name ^a	Study area ^b						Seral origin ^c
			PR	MC	NR	MCW	SDW	PCW	
56	COST	<i>Cornus stolonifera</i>			x				Survivor, rootcrown; offsite colonizer
57	CRAF	<i>Cryptantha affinis</i>	x				x	x	Residual colonizer, annual
58	CRAT	<i>Crepis atrabarba</i>						x	Survivor, caudex
59	DAGL	<i>Dactylis glomerata</i>					x	x	Adventive offsite colonizer
60	DEEL	<i>Deschampsia elongata</i>	x	x					Offsite colonizer
61	DIAR	<i>Dianthus armeria</i>						x	Adventive offsite colonizer
62	DIHO	<i>Disporum hookeri</i>	x		x		x		Survivor, rhizome
63	DITR	<i>Disporum trachycarpum</i>						x	Survivor, rhizome
64	DRPA	<i>Dracocephalum parviflorum</i>						x	Residual colonizer, biennial
65	ELCI	<i>Elymus cinereus</i>						x	Survivor, tussock
66	ELGL	<i>Elymus glaucus</i>	x	x				x	Survivor, tussock
67	EPAN	<i>Epilobium angustifolium</i>	x	x	x	x	x	x	Offsite colonizer; survivor, rhizome
68	EPPA	<i>Epilobium paniculatum</i>	x	x	x	x	x	x	Offsite colonizer
69	EPWA	<i>Epilobium watsonii</i>		x	x				Offsite colonizer
70	ERAC	<i>Erigeron acris</i>		x			x		Offsite colonizer
71	ERGR	<i>Erythronium grandiflorum</i>						x	Survivor, bulb
72	FEAR	<i>Festuca arundinacea</i>					x	x	Introduced offsite colonizer
73	FEOC	<i>Festuca occidentalis</i>	x	x					?Survivor, tussock
74	FEOV	<i>Festuca ovina</i>						x	Introduced offsite colonizer
75	FIAR	<i>Filago arvensis</i>	x						Adventive offsite colonizer, annual
76	FRVE	<i>Fragaria vesca</i>	x	x			x	x	?Survivor, caudex
77	FRVI	<i>Fragaria virginiana</i>						x	?Survivor, caudex
78	GAAP	<i>Galium aparine</i>	x					x	?Residual colonizer, annual
79	GATR	<i>Galium triflorum</i>	x		x			x	?Nonsurvivor, delicate rhizome
80	GEAM	<i>Gentiana amarella</i>		x					?Residual colonizer, annual
81	GEBI	<i>Geranium bicknellii</i>	x	x	x		x	x	Residual colonizer, annual
82	GEMA	<i>Geum macrophyllum</i>	x						Offsite colonizer
83	GNMI	<i>Gnaphalium microcephalum</i>			x		x		Offsite colonizer
84	GNVI	<i>Gnaphalium viscosum</i>	x	x					Offsite colonizer
85	GOOB	<i>Goodyera oblongifolia</i>		x					Nonsurvivor
86	GYDR	<i>Gymnocarpium dryopteris</i>		x					?Nonsurvivor
87	HADI	<i>Habenaria dilatata</i>						x	Survivor, caudex (wet site)
88	HASA	<i>Habenaria saccata</i>					x		Offsite colonizer
89	HAL	<i>Hieracium albiflorum</i>		x	x	x	x	x	Offsite colonizer
90	HICY	<i>Hieracium cynoglossoides</i>					x	x	?Survivor, caudex
91	HODI	<i>Holodiscus discolor</i>	x				x	x	Survivor, rootcrown
92	HYPE	<i>Hypericum perforatum</i>	x						Adventive offsite colonizer
93	ILRI	<i>Iliamna rivularis</i>	x				x	x	Residual colonizer, biennial
94	LAOC	<i>Larix occidentalis</i>		x	x	x	x		Residual colonizer, (fire-killed crowns)
95	LAPU	<i>Lactuca pulchella</i>	x						Survivor, rhizome (adventive)
96	LASE	<i>Lactuca serriola</i>	x					x	Adventive offsite colonizer, annual
97	LIBO	<i>Linnaea borealis</i>		x		x			Nonsurvivor, mat-forming
98	LICO	<i>Lilium columbianum</i>					x		Survivor, bulb
99	LIRU	<i>Lithospermum ruderales</i>						x	Survivor, caudex
100	LOMU	<i>Lolium multiflorum</i>						x	Introduced offsite colonizer
101	LOUT	<i>Lonicera utahensis</i>	x	x	x	x	x	x	Survivor, rootcrown; offsite colonizer
102	LUAR	<i>Lupinus argenteus</i>	x				x		Survivor, caudex
103	LUCA	<i>Luzula campestris</i>	x						Residual colonizer
104	MEFE	<i>Menziesia ferruginea</i>		x	x				Survivor, rootcrown
105	MELI	<i>Melampyrum lineare</i>				x			Offsite colonizer
106	MEOF	<i>Melilotus officinalis</i>						x	Introduced offsite colonizer
107	MESU	<i>Melica subulata</i>	x						?Survivor, tussock
108	MIST	<i>Mitella stauropetala</i>			x				?Survivor, caudex
109	MYMI	<i>Myosotis micrantha</i>	x						Offsite colonizer
110	OSCH	<i>Osmorhiza chilensis</i>	x		x			x	Survivor, caudex
111	PAMY	<i>Pachistima myrsinites</i>	x	x	x	x	x		Survivor, rootcrown; residual colonizer

(con.)

Table 3 (Con.).

	Acronym ^a	Botanical name ^a	Study area ^b						Seral origin ^c
			PR	MC	NR	MCW	SDW	PCW	
112	PECO	<i>Penstemon confertus</i>		x					Offsite colonizer
113	PERA	<i>Pedicularis racemosa</i>		x					?Survivor, caudex
114	PEWI	<i>Penstemon wilcoxii</i>						x	?Survivor, caudex
115	PHHA	<i>Phacelia hastata</i>	x					x	Survivor, caudex
116	PHLE	<i>Philadelphus lewisii</i>	x						Survivor, rootcrown
117	PHMA	<i>Physocarpus malvaceus</i>	x					x	Survivor, rootcrown
118	PHPR	<i>Phleum pratense</i>					x	x	Adventive offsite colonizer
119	PICO	<i>Pinus contorta</i>		x	x	x	x	x	Residual colonizer
120	PIEN	<i>Picea engelmannii</i>		x		x	x		Offsite colonizer
121	PIMO	<i>Pinus monticola</i>			x		x		Offsite colonizer
122	PIPO	<i>Pinus ponderosa</i>	x		x		x	x	Offsite colonizer
123	PODO	<i>Polygonum douglassii</i>	x						Residual colonizer, annual
124	POGL	<i>Potentilla glandulosa</i>	x						?Survivor, caudex
125	PONO	<i>Potentilla norvegica</i>					x		Adventive offsite colonizer, biennial
126	POPA	<i>Poa palustris</i>	x						Adventive offsite colonizer, stolonous
127	POPR	<i>Poa pratensis</i>	x						Adventive offsite colonizer, rhizome
128	POTRE	<i>Populus tremuloides</i>	x	x		x	x		Offsite colonizer; survivor, rootcrown
129	POTRI	<i>Populus trichocarpa</i>	x	x		x	x		Offsite colonizer; survivor, rootcrown
130	PREM	<i>Prunus emarginata</i>	x				x		Survivor, rootcrown; offsite colonizer
130	PRVI	<i>Prunus virginiana</i>	x					x	Survivor, rootcrown; offsite colonizer
132	PRVU	<i>Prunella vulgaris</i>	x						?Offsite colonizer
133	PSME	<i>Pseudotsuga menziesii</i>	x	x	x	x	x	x	Offsite colonizer
134	PTAQ	<i>Pteridium aquilinum</i>			x		x		Survivor, rhizome
135	PYAS	<i>Pyrola asarifolia</i>					x		Nonsurvivor
136	PYCH	<i>Pyrola chlorantha</i>		x					Nonsurvivor
137	PYPI	<i>Pyrola picta</i>					x		Nonsurvivor
138	PYSE	<i>Pyrola secunda</i>		x	x		x	x	Nonsurvivor
139	PYUN	<i>Pyrola uniflora</i>				x			Nonsurvivor
140	RHPU	<i>Rhamnus purshiana</i>	x						Survivor, rootcrown; offsite colonizer
141	RILA	<i>Ribes lacustre</i>		x	x				Residual colonizer
142	RIVI	<i>Ribes vicosissimum</i>	x	x	x		x		Residual colonizer
143	ROGY	<i>Rosa gymnocarpa</i>	x	x	x	x	x	x	Survivor, rootcrown
144	RUID	<i>Rubus idaeus</i>		x			x		?Residual colonizer
145	RULE	<i>Rubus leucodermis</i>	x				x		?Residual colonizer
146	RUPA	<i>Rubus parviflorus</i>	x	x	x		x		Survivor, rhizome; residual colonizer
147	SACE	<i>Sambucus cerulea</i>	x						?Offsite colonizer
148	SARA	<i>Sambucus racemosa</i>	x	x	x		x		Residual colonizer
149	SASC	<i>Salix scouleriana</i>	x	x	x	x	x	x	Survivor, rootcrown; offsite colonizer
150	SHCA	<i>Shepherdia canadensis</i>				x			Survivor, rootcrown; offsite colonizer
151	SIME	<i>Silene menziesii</i>	x						Survivor, rhizome
152	SMRA	<i>Smilacina racemosa</i>			x			x	Survivor, rhizome
153	SMST	<i>Smilacina stellata</i>	x		x		x	x	Survivor, rhizome
154	SOCA	<i>Solidago canadensis</i>					x		Offsite colonizer
155	SOMI	<i>Solidago missouriensis</i>						x	Survivor, rhizome
156	SOSC	<i>Sorbus scopulina</i>		x					Survivor, rootcrown
157	SPBE	<i>Spiraea betulifolia</i>	x	x	x	x	x	x	Survivor, rhizome
158	SPDO	<i>Spiraea douglasii</i>	x						Offsite colonizer
159	SYAL	<i>Symphoricarpos albus</i>	x	x		x	x	x	Survivor, rhizome
160	TABR	<i>Taxus brevifolia</i>		x		x			Nonsurvivor
161	TAOF	<i>Taraxacum officinale</i>	x					x	Adventive offsite colonizer
162	THOC	<i>Thalictrum occidentale</i>	x	x	x		x	x	Survivor, caudex
163	THPL	<i>Thuja plicata</i>	x			x	x	x	Offsite colonizer
164	TITR	<i>Tiarella trifoliata</i>		x			x		Nonsurvivor
165	TRAG	<i>Trifolium agrarium</i>	x						Adventive offsite colonizer, annual
166	TRCAN	<i>Trisetum canescens</i>	x				x		?Nonsurvivor
167	TRCAR	<i>Trautvetteria caroliniensis</i>	x				x		Survivor, rhizome

(con.)

Table 3 (Con.)

Acronym ^a	Botanical name ^a	Study area ^b						Seral origin ^c
		PR	MC	NR	MCW	SDW	PCW	
168	TRCE	<i>Trisetum cernuum</i>				x		?Nonsurvivor
169	TRDU	<i>Tragopogon dubius</i>	x					Adventive offsite colonizer, biennial
170	TRHY	<i>Trifolium hybridum</i>	x					Introduced offsite colonizer
171	TROV	<i>Trillium ovatum</i>			x			Survivor, corm
172	TRRE	<i>Trifolium repens</i>				x		Introduced offsite colonizer
173	TSHE	<i>Tsuga heterophylla</i>	x			x		Offsite colonizer
174	URDI	<i>Urtica dioica</i>					x	Survivor, caudex
175	VAGL	<i>Vaccinium globulare</i>		x	x	x		Survivor, rhizome
176	VAME	<i>Vaccinium membranaceum</i>	x			x		Survivor, rhizome
177	VAMY	<i>Vaccinium myrtillus</i>		x	x			Survivor, rhizome
178	VETH	<i>Verbascum thapsus</i>	x	x			x	Adventive offsite colonizer
179	VIAD	<i>Viola adunca</i>	x				x	?Survivor, rhizome
180	VIGL	<i>Viola glabella</i>				x		Survivor, caudex; residual colonizer
181	VIOR	<i>Viola orbiculata</i>		x	x	x		?Survivor, caudex
182	XETE	<i>Xerophyllum tenax</i>		x	x	x		Survivor, stout surface-rhizome

^aSpecies designation is by four- or five-letter acronym for botanical name.

^bStudy area locale: PR = Priest River Experimental Forest; MC = Miller Creek Demonstration Forest; NR = Newman Ridge; MCW = Miller Creek Demonstration Forest Wildfire; SDW = Sundance Burn (wildfire); PCW = Plant Creek Burn (wildfire).

^cSeral origin: Nonsurvivor plant species = Established plants that typically do not survive burning; Survivor plant species = Established plants that typically survive burning; Colonizer plant species = Plants present as postfire seedlings; Residual colonizer plant species = Seedlings that originate from a prefire onsite (burned) seed source; Offsite colonizer plant species = Seedlings that originate from a postfire offsite (unburned) seed source; Adventive = Nonnative plant species; Introduced = Nonnative plant species seeded (postfire) by man; ? = denotes uncertain seral origin (too few occurrences encountered to establish a definitive pattern).

from the charred remains of shrubs and trees evident in the first postfire growing season. For some study areas the predisturbance tree density and stand basal area were approximated from a first postfire year sample of fire-killed trees present in the 5 m² plots.

Relative density of surviving shrub species was determined by a count of all resprouting shrubs at least 0.5 m high in the 5 m² plots. Prefire shrub species composition was further extended by noting those species regrowing within but not sampled by the 5 m² plots as well as those in the vicinity immediately adjacent to these plots. This latter group of shrub species are listed as “other species present.” Charred nonresprouting shrub remnants were not identified; thus, the reconstruction provides only a minimal representation of the prefire shrub community. Species composition for the prefire herbaceous component was not possible, but a minimal approximation of the prefire composition can be obtained by noting the survivor and nonsurvivor species and comparing that to the cover development table for each study area.

Disturbance Treatment

Information on results of the fire treatment and the immediate postfire conditions vary with the succession study. Fire disturbance information is unavailable for the Priest River Experimental Forest study areas. For the study areas at Miller Creek and Newman Ridge,

burning characteristics were measured (Beaufait and others 1977). These measurements included duff moisture content, postfire duff depth, and fire intensity (as heat pulse to site). Downward heat pulse to site was measured by a water-can analog and expressed as “grams of water loss” (Beaufait 1966; George 1969). Water loss values near 1,000 g and greater were characterized as “hot” burns; lower values represent “cool” burns (Beaufait and others 1977). The greater the water loss, the greater the downward heat pulse, and hence the severer the fire treatment sustained by the surface vegetation, seeds stored in the forest floor, and stem bases and roots of overstory vegetation.

Moisture content of the duff layer—lowermost of the ground fuels and therefore most important to the fire treatment of ground layer vegetation—is presented in terms of upper and lower halves immediately prior to burning. Duff depth remaining after burning is another indicator of the severity of the burning treatment. This indicator has implications for both mortality of ground-layer vegetation and the condition or character of the postfire ground surface that is the germination substrate. Postfire duff depth is given in centimeters and as a percent of prefire depth. Since the Priest River Experimental Forest succession study areas were not a part of the prescribed fire broadcast burn study, similar disturbance treatment information is not available.

Results of fire treatment and immediate postfire condition for wildfire burned study areas are given as fire severity and condition of stand components. Fire severity is more indicative of the disturbance treatment to forest vegetation than fire intensity (Rowe 1983) because severity incorporates the downward heat pulse to the ground-layer vegetation and propagules on the forest floor (Ryan and Noste 1985), as well as the upward heat pulse (fire intensity) to the overstory vegetation. Ryan and Noste's fire severity matrix provides a relative standard that permitted post-fire assessment of severity drawn from the degree of ground char and flame length. The matrix comprises four ground-char classes: unburned (U), light (L), moderate (M), and deep (D). It comprises five flame-length classes: 0-2 ft (1), 2-4 (2), 4-8 (3), 8-12 (4), and greater than 12 (5). Their fire severity index (R-N index) ranges from 1-U (least severe) to 5-D (most severe). For example, a fire rated at a severity index 5-M (R-N index: 5-M) represents a burning treatment with a flame length exceeding 12 ft and moderate ground char (litter and duff consumed, woody debris largely consumed, logs deeply charred). Observed immediate postfire condition of the forest floor (litter and duff layers) (USDA Forest Service 1956) and tree or shrub overstory are included to permit reference with other indices of fire severity. Additional descriptors of fire treatment, fire intensity, rate of heat release at the fire front (Albini 1976; Viereck and Schandelmeier 1980), and rate of spread (Anderson 1968) are given for the Sundance Burn study areas.

Succession Tables and Graphs

The data base represents forest succession for a study area in a set of six tables. For each set, a series number (table 3, column 1) designates all data tables and associated graphs for that study area. The series number designating each study area is given in table 4. Within each set, tables -1 and -2 present cover and volume (respectively) for major life-form groups; tables -3 and -4 present cover for species in each life-form group; similarly, tables -5 and -6 present volume for species. The graph accompanying each table illustrates the important elements in that table and serves to aid in the visualization of its successional development. Prominent predisturbance species are graphed only if they were also important in early succession. Identity of species listed in these tables and graphs as four- or five-letter acronyms of genus and species appear in table 3.

A few species included in the herb data base tables have generally been treated as shrubs. They are, in fact, "low woody plants" and lack all the physiognomic traits characteristic of shrubs save one, the presence of perennial stems above ground in the dormant season.

Their life-form relegates them to the ground-layer vegetation rather than the shrub strata above the forest floor. Species often regarded as shrubs, but more accurately treated as low woody plants for the purpose of forest succession, are included in the herb life-form group. They include *Berberis repens*, *Pyrola secunda*, *Chimaphila umbellata*, *Linnaea borealis*, and *Arctostaphylos uva-ursi*.

Organization and Presentation

Study areas are presented in the order of their establishment. The data base series number assigned to each study area is given in table 4. For example, as the first study area established, PR-05 is assigned the series number 1-. In like manner PR-08 is assigned as series 2- and PR-09 as series 3-. Table 4 also shows the chronology and duration of the data record available for each study area. An index guide to study areas in terms of their (1) disturbance treatment, (2) elevation, (3) exposure, (4) slope, or (5) forest habitat type appears after the References section.

Color Plates

Color plates convey a visual dimension of the successional change in developing vegetation as viewed from a permanent photo point for the data tables and their respective graphic figures. The sequence order and plate number match that of their respective data tables and graphic figures. The number appearing in the lower left corner of each photograph designates the number of growing seasons (equivalent to years for most study areas) since burning or other disturbance if unburned. Caption information denotes the type of disturbance, the calendar-year range of the succession illustrated, and the kind of succession (seral origin pathway). The succession for each study area is characterized in terms of the seral origin group(s) providing the principal vegetative cover during the time the pathway was sampled.

Seral origin groups are defined by their postfire source of their species as either (1) established plants that survived the disturbance (survivors) or (2) new plants established from seed since the disturbance (colonizers). Seed sources for colonizer plant species derive from (1) seeds on the site that survived the burning treatment or other disturbances for unburned sites (residual colonizers), (2) seeds dispersed onto the site following the disturbance (primary and secondary offsite colonizers), or (3) seeds derived from the regrowth of survivor or initial colonizer plants (secondary onsite colonizers).

The importance of species illustrated in the seral vegetation can be ascertained by referring to the respective table for that plate and then consulting tables

Table 4—Study area chronology and duration of forest succession data base record.

Serial number	Area	Year																												
		1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992		
1	PR-05	P	—	L	—	BB	—	2	—	4	5	6	7	8	9	—	11	12	13	—	15	16	17	18	19	20				
2	PR-08	P	—	L	—	BB	—	2	—	4	5	6	7	8	9	—	11	12	13	14	15	16	—	18	19	20				
3	PR-09	P	—	L	—	BB	—	2	—	4	5	6	7	8	9	—	11	12	13	14	15	16	17	18	19	20				
4	MC-10	P	L	BB1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	—	22	—	24	25		
5	MC-11	P	LBB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	—	24	25		
6	MC-12	P	L	BB1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		
7	MC-141	P	L	—	2	—	—	—	—	7																				
8	MC-143	P	L	BB1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18									
9	MC-15	P	—	LBB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	—	—	—	24		
10	MC-16	PL	BB—	2	3	4	—	—	—	7																				
11	MC-171	PL	BB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	—	18	—	20							
12	MC-173	P	LBB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			
13	MC-18	PL	BB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	—	17										
14	MC-191	PL	—	—	—	—	—	—	—	7	—	—	—	—	—	—	—	—	—	—	19									
15	MC-193	PL	BB	1	2	3	—	—	—	6																				
16	MC-20	PL	BB	1	2	3	4	5	6	7	8	9	10	11	12	13	14													
17	MC-211	PL	—	—	BB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	—	16	—	18	19	20					
18	MC-213	PL	—	—	BB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	—	—	17	18	19	20				
19	MC-221	PWF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25			
20	MC-223	PWF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25			
21	MC-23	PWF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25			
22	NR-24		PL	BB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21					
23	NR-25		PL	BB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21					
24	NR-26		PL	BB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21					
25	NR-27		P	LBB	1	2	—	—	4	5	6	7	8	9	10	—	12	13	14	—	16	17								
26	NR-28		P	L	BB	1	—	—	3	4	5	6	7	8	9	10	11	12	13	—	15	—	17	18	19	20				
27	NR-29		P	L	BB	1	—	—	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20				
28	SD-01		WF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	—	18	19	20	—	22					
29	SD-02		WF	1	2	3	4	5	6	7	8	9	10	11	12	—	—	—	16	—	18									
30	SD-03		WF	1	2	3	4	5	6	7	8	9	10	11	12															
31	SD-04		WF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20							

(con.)

Table 4—Study area chronology and duration of forest succession data base record.

Serial number	Area	Year																										
		1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
32	SD-05	WF		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	—	22			
33	SD-06	WF		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20					
34	SD-07	WF		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	—	22			
35	SD-08	WF		1	2	3	4	5	6	7	8	—	10	11	12	13	14	15	16	17	18	19	20					
36	SD-09	WF		1	2	3	4	5	6	7	8	—	10	11	12	13	14	15	16	17	18	19	20	—	22			
37	SD-10	WF		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	—	18	—	20					
38	SD-14	WF		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	—	22			
39	SD-15	WF		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	—	18	—	20					
40	SD-16	WF		1	2	3	4	5	6	7	8	9	10	11	12													
41	SD-17	WF		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	—	22			
42	SD-18	WF		1	2	3	4	5	6	7	8	9	10	11	12	—	—	—	—	—	18							
43	SD-19	WF		1	2	3	4	5	6	—	8	9	10	11	12	13	14	15	16	17	18	19	20	—	—	23		
44	SD-20	WF		1	2	3	4	5	6	—	8	9	10	11	12	—	14	15	16	17	18	19	20					
45	SD-21	WF		1	2	3	4	5	6																			
46	PC-01							WF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
47	PC-02							WF	1	2	—	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
48	PC-03							WF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
49	PC-04							WF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
50	PC-05							WF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
51	PC-09							WF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
52	PC-10							WF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
53	PC-11							WF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
54	PC-12							WF	1	2	3	4	5	6	7	8	9	10	11	—	13	—	—	16	—	18	19	20
55	PC-15							WF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

with suffix numbers -3 (cover) or -5 (volume) for tree and shrub species and tables 4 (cover) or 6 (volume) for herbaceous and low woody plant species. The terms “seeded” and “planted” denote colonization of species intentionally introduced from offsite sources due to postdisturbance rehabilitation activities.

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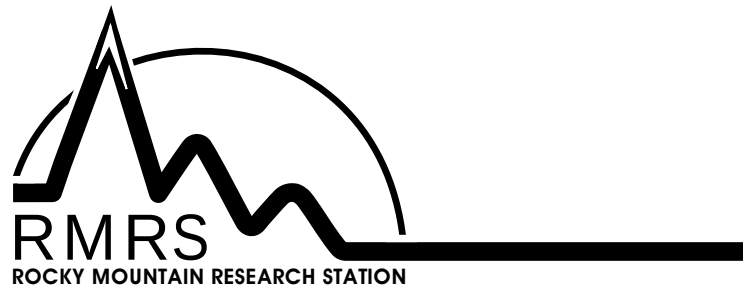
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