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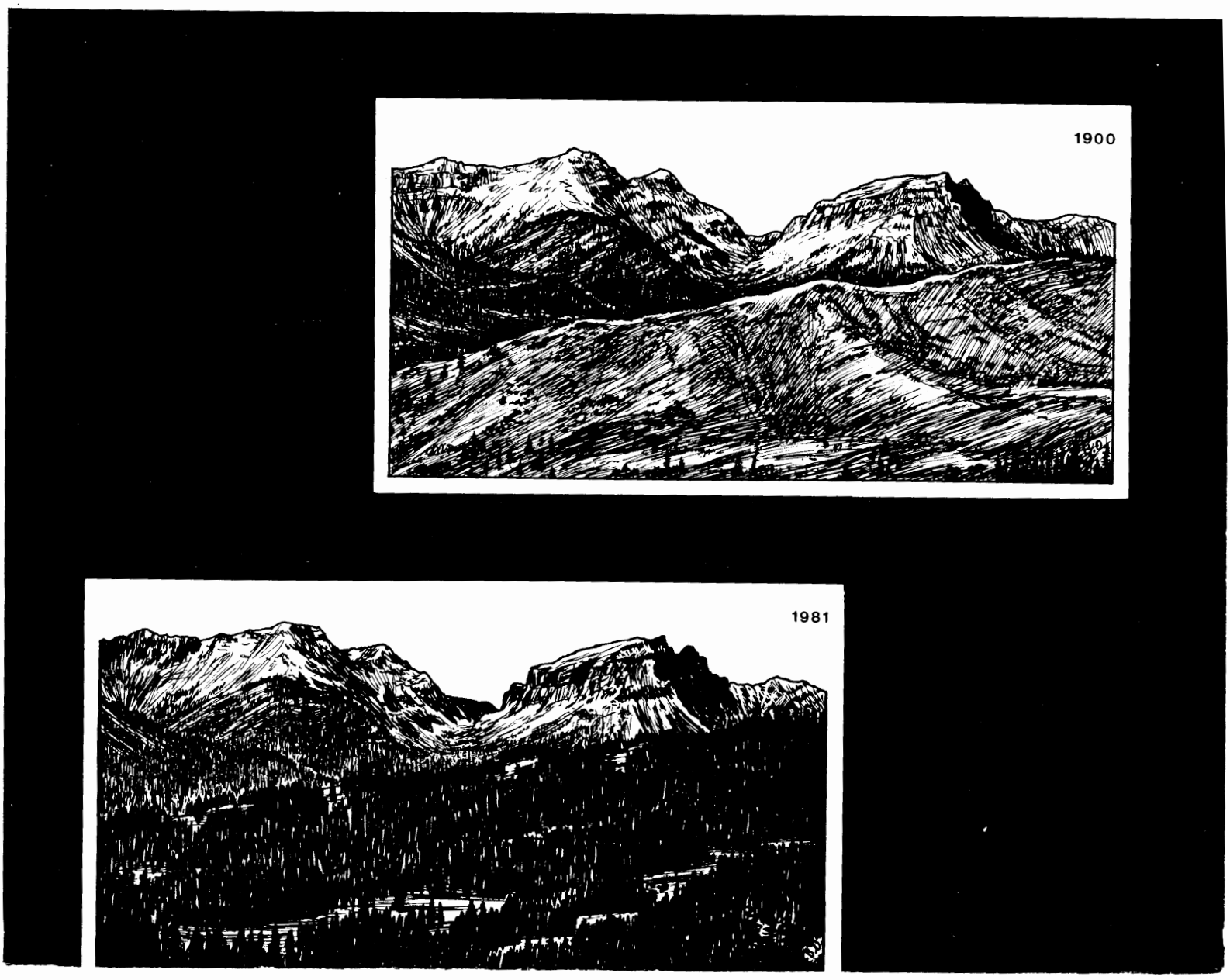
Fire and Vegetative Trends in the Northern Rockies: Interpretations from 1871-1982 Photographs

George E. Gruell



THE AUTHOR

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RESEARCH SUMMARY

This paper visually documents vegetative and cultural changes during the period 1871–1982 in a wide range of vegetative types in Montana and adjacent areas of Idaho. The baseline established can be utilized to determine how current wildlife habitats compare with those of the past. This facilitates an assessment of the kind of vegetation management needed to maintain specific habitats.

Prior to settlement, many biotic and abiotic factors influenced vegetative development. Of these, wildfire was of primary importance. Because of its past significance as a manipulator of vegetation, the influence of fire is treated in some detail in this report.

Vegetative succession and corresponding wildlife habitat conditions have been documented by rephotographing 86 scenes in Montana and Idaho. The early scenes were taken between 1871 and 1946 in geographical areas representative of major vegetative types. Four geographical subdivisions of Montana and Idaho designated "regions" are covered. These broad subdivisions provide an insight on climate, topography, and kind of vegetation. Interpretations of fire's influence on vegetation has been facilitated by stratifying habitat types (Pfister and others 1977) that respond similarly to fire into "fire groups" (Davis and others 1980; Fischer and Clayton 1983).

The photo record shows:

- Early stages of plant succession were more common on Montana and Idaho landscapes in the period 1870–1940 than today.
- Moist coniferous forests exhibited fire mosaics of young growth interspersed within mature trees.
- Drier forest types were quite open.
- Rangelands had a "smoother" appearance, with continuous grass cover and fewer shrubs and trees than in recent times.

Historically, vegetative patterns resulting from early fire were optimal for some wildlife species, while for others conditions were marginal or detrimental. European settlement ultimately resulted in a marked reduction in frequency and extent of wildfire's influence on the landscape. Differing habitat conditions resulting from early fires and subsequent absence of fire and implications on wildlife are discussed.

Ecologically, fire converts vegetation from old stages or decadency to an early stage. Prescribed fire can be utilized effectively to improve wildlife habitat and other resources.

Past use of prescribed fire has been primarily in the seral shrubfields of northern Idaho and sagebrush/grass vegetative types of southwestern Montana. Use of surface fire beneath conifers has also been effectively utilized in northwestern Montana. There are widespread opportunities to utilize logging and prescribed fire to improve wildlife habitat in noncommercial and commercial forest lands. Controlling growth of conifers by timber harvests and prescribed fire can be a powerful means of setting forest succession back and achieving productive wildlife habitat.

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INTRODUCTION

Retaking of early photographs has been shown to be an effective means of recording changes in vegetation (Gruell 1980; Hastings and Turner 1965; Houston 1982; Phillips 1963; Progulske 1974). This report documents photographically the changes in forest and grassland vegetation in Montana and adjacent areas of Idaho. These photo comparisons allow the reader to interpret changes in vegetation in a variety of ecosystems.

Previously, changes in eastern Montana vegetation were interpreted by the retaking of H. L. Shantz' post-1900 photographs (Phillips 1963). Post-1900 photographs have also been retaken in the Missouri Breaks and mountain foothills of the Dillon Resource Area (U.S. Department of the Interior, Bureau of Land Management 1979, 1980). The Bureau of Land Management photographs were almost entirely on State, private, or Natural Resource lands and were not interpreted ecologically. The early scenes in this report were taken between 1871 and 1946; retakes were made from 1979 through 1982.

PURPOSE

The primary purpose of this study is to establish a reference point or baseline that can be utilized by various management agencies and the public to determine how current wildlife habitats compare with those of the past. This facilitates an assessment of the kind of vegetation management needed to maintain specific habitats. The photographic comparisons also have wider application. They provide insight for silviculture and for management of fuels, grazing, watersheds, and scenic and cultural values.

Land managers and the public share a common interest in managing forests and rangelands to produce long-term multiple benefits. Oftentimes there is a difference of opinion on management objectives and how these should be accomplished. Disagreement may occur when information is lacking on long-term trends in vegetation. People need "yardsticks" to measure the direction and rate of change in their environments. This publication can aid those interested in resource management by providing a frame of reference on vegetative trend. It should also make people more aware of just how dynamic this vegetation is upon which we all depend.

FACTORS INFLUENCING VEGETATION

Many environmental factors including climate, insects and diseases, wind, severe windstorms, browsing by wild ungulates, domestic livestock grazing, and fire have influenced vegetative development. The influence of specific factors varies, depending upon the ecosystem and frequency of the disturbance. For example, climatic changes over the past several thousand years have influenced the latitudinal and elevational distribution of conifers (Mehringer and others 1977). The drought of the 1930's had profound effects on vegetation in eastern Montana (Ellison and Woolfolk 1937). Insects and diseases have apparently affected vegetation over millennia. Mountain pine beetle (*Dentroctonus ponderosae*) outbreaks have occurred periodically over vast areas of the Northern Rockies (Roe and Amman 1970). Wind is a recurring disturbing agent, breaking limbs and uprooting trees. Wild ungulates have had pronounced effects on vegetation in localized areas of concentrated use. Excessive livestock grazing has been responsible for widespread changes in native plant communities (Clapp 1936). Fire history studies (Arno 1980) and 1805-06 accounts by Lewis and Clark (Thwaites 1959) and other early day visitors indicate that wildfires have long been a major influence on vegetation.

Fire Perspective

Of all biotic and abiotic influences on vegetation, fires were the most prevalent major disturbances on the landscape prior to European settlement. Fire's influence varied with local weather patterns and fuels. Moist forests burned infrequently, while drier forest types and rangelands supporting continuous fuels were apparently swept by frequent, large fires (appendix III). The long history of fires set by lightning and by Indians was manifested in a fire-prone environment over much of the landscape. As reported in 1805 and 1806 by Lewis and Clark (Thwaites 1959) and in 1833 by Ferris (Phillips 1940), many early fires were set for purposes of communicating between scattered bands and for other purposes (Barrett 1980; Gruell 1983). Heavy grazing by bison (*Bison bison*) in central and eastern Montana (Raynolds 1868) probably limited fire spread on occasion.

Settlement by Europeans apparently brought about cultural changes that reduced the incidence and size of

wildfires. The breaking up of fuel continuity by livestock grazing and cultivation, coupled with fire suppression, and the elimination of the Indian as an ignition source by relocation to reservations are thought to be primary factors. Significant changes in vegetation (i.e., succession) have resulted from the absence of or greatly reduced incidence of fire. The successional changes that have occurred would have been improbable in the pre-European environment where frequent fires suppressed woody vegetation. Nevertheless, succession apparently has not been significantly altered in the more moist plant communities where human influences have been negligible over long periods of time.

INTERPRETING FIRE EFFECTS

Interpretation of fire effects has been facilitated by stratifying habitat types (Pfister and others 1977) that respond similarly to fire into fire groups (Davis and others 1980; Fischer and Clayton 1983). Fire ecology groups of habitat types have been utilized extensively.

Eleven fire groups are recognized in the Northern Region National Forests. The vegetation in eight of these groups is photographically documented in this report (table 1). Several nonforest scenes that do not fit into established fire groups (sagebrush/grass, mahogany, and juniper) have been included as separate fire groups (table 1). Fire groups are discussed in appendix I. These descriptions will help the reader evaluate the differing effects of fire discussed under the "Photo Record." Scientific names of plant species are listed in appendix II.

RETRIEVAL AND SELECTION OF PHOTOGRAPHS

Several thousand photographs were examined during the course of this study. Sources varied from prominent collections such as the National Archives in Washington, D.C., Montana Historical Society, and USDI Geological Survey in Denver, Colo., to obscure collections that had little if any record of date, location, or photographer. The purpose of taking the original photographs was usually to record people, scenery, livestock, structures, or geologic features. Few early scenes were taken expressly to document vegetation.

The selection process included the following criteria:

1. Photographs taken before 1930 were preferred, but because of limited availability a few taken after this date were utilized.
2. The scene had to contain identifiable land features that could be used as points of reference to relocate the approximate camera point. Scenes were rejected where there appeared to be a high probability that tree growth had since screened the original view.
3. Good photo quality was essential. Nevertheless, a few very early photos of marginal quality were included because they were the only ones available for showing early conditions in prominent vegetative types.
4. Emphasis was placed on selection of photographs taken at lower to mid-elevations where plant communities are most conducive to supporting wildlife.

Photographs meeting the above criteria were retaken as available throughout the distribution of major plant communities. The retake process allowed evaluation of the effects of fire in many vegetative types. About 20 of the early photographs showed evidence of previous fires. These were selected for purposes of determining differences in vegetal response.

The selection process did not allow prior determination of current vegetative conditions before the retake photograph was made. Thus, the retake photographs are considered a relatively unbiased sample of vegetal change in the study area. Because the earliest photo records were from the early 1870's, no photographs depict presettlement conditions. But, several scenes were taken during the early stages of settlement when human impacts were minimal. Post-1900 scenes reflect human impacts, especially the effect of livestock grazing and in some instances logging, mining, and road construction.

Table 1.—*Identifiable fire group or vegetative type in photographs*

Plate No.	Primary fire group	Secondary fire group	Location	Township range and section	Region
83	Sagebrush/grass		Reno Crossing	3 S 35 E 34	Southeast
84			Custer Battlefield	3 S 35 E 17	Southeast
53			Pleasant Valley	13 N 36 E 16	South-Central
50			Rattlesnake Cliffs	8 S 9 W 19	South-Central
58			Henrys Lake-Wildrose River	16 N 43 E 33	South-Central
67			Boothill-Virginia City	6 S 3 W 22	South-Central
49	Mahogany		Bannack City	8 S 11 W 6	South-Central
31			Trout Creek	11 N 2 W 13	North-Central
33			Hellgate Canyon	10 N 1 E 3	North-Central
70			Madison River	3 S 1 E 2	South-Central
82			Big Horn River	6 S 30 E 8	Southeast
66	Juniper		Lower Alder Gulch	6 S 3 W 7	South-Central
64			Ruby Dam	7 S 4 W 8	South-Central
80			Coal Mine Rims	2 S 13 E 32	South-Central
19	Group 1: Dry limber pine		North of Sun River	22 N 8 W 16	North-Central
21			Castle Reef-Sun River	21 N 8 W 6	North-Central
17		Aspen	Two Medicine Lake	32 N 13 W 16	North-Central
69			Bradley Creek	4 S 1 W 2	South-Central
55			Prices Canyon	11 S 7 W 1	South-Central
81		Riparian	Rocky Creek	8 S 103 W 17	South-Central
7	Group 2: Warm-dry ponderosa pine		Clark Fork River	18 N 24 W 7	West-Side
27		Group 1	Sullivan Hill	18 N 3 W 28	North-Central
85			Ekalaka Hills	1 N 58 E 30	Southeast
86	Group 3: Warm-moist ponderosa pine		Lantis Sawmill	1 N 58 E 29	Southeast
12	Group 4: Warm dry Douglas-fir	Group 2	Lick Creek	4 N 21 W 30	West-Side
13			Wetzsteon's	1 N 19 W 8	West-Side
29			Beaver Creek	12 N 2 W 16	North-Central
30			Soup Creek	12 N 1 W 15	North-Central
32			Magpie Creek	11 N 1 E 31	North-Central
34		Groups 5 and 6	Whites Gulch	11 N 2 E 20	North-Central
35		Groups 5 and 6	Hassel, Mont.	6 N 1 W 1	North-Central
43			Fort Maginnis	16 N 20 E 1	North-Central
76			Fort Ellis	2 S 6 E 10	South-Central
26	Group 5: Cool dry Douglas-fir		Dearborn River	18 N 7 W 32	North-Central
18			Teton River	25 N 8 W 32	North-Central
37		Aspen	Haystack Springs	12 N 3 E 12	North-Central
47			Bighole Battlefield	27 N 17 W 24	South-Central
14		Grassland and Group 6	Fred Burr Creek	6 N 14 W 11	South-Central
15			Dirty Dick Gulch	6 N 14 W 1	South-Central
48		Riparian	Bannack Dredge	8 S 11 W 8	South-Central
54		Grassland	Blacktail Deer Creek	12 S 35 E 15	South-Central
63		Sagebrush/grass	Lewis Creek Bench	9 S 3 W 28	South-Central
65		Sagebrush/grass and Group 6	Sheridan	4 S 5 W 27	South-Central
68		Riparian	Upper Alder Gulch	6 S 3 W 35	South-Central
59			Henrys Lake-Staley's Springs	14 S 2 E 1	South-Central
75		Group 6	Mystic Lake	3 S 6 E 36	South-Central
78		Group 6	Yellowstone River	3 S 9 E 11	South-Central
79			Suce Creek	3 S 10 E 17	South-Central

(con.)

Table 1. *(con.)*

Plate No.	Primary fire group	Secondary fire group	Location	Township range and section	Region
	Group 6: Moist				
6	Douglas-fir	Group 4	Thompson River	21 N 28 W 5	West-Side
11			Evaro Hill	15 N 20 W 26	West-Side
8		Riparian	Daphnia Pond	26 N 19 W 18	West-Side
25		Aspen	Dearborn River-Bean Ranch	18 N 7 W 24	North-Central
23			Smith Creek-Crown Mountain	19 N 8 W 17	North-Central
		Grassland	Smith Creek-		
24			Cynide Mountain	19 N 8 W 17	North-Central
20			Sun River Game Range	21 N 8 W 6	North-Central
22			Home Gulch-Sun River	24 N 9 W 36	North-Central
28			Marysville	12 N 6 W 36	North-Central
	Group 6: Moist				
71	Douglas-fir		Elkhorn	6 N 3 W 14	South-Central
38		Group 5, sagebrush/grass	Smith River	15 N 3 E 1	North-Central
41		Sagebrush/grass, riparian, aspen	Sheep Creek	12 N 7 E 12	North-Central
40			Belt Creek Ranger Station	14 N 7 E 1	North-Central
39			Monarch Canyon	16 N 7 E 27	North-Central
36		Sagebrush/grass	Castle, Mont.	8 N 8 E 24	North-Central
42		Groups 2 and 5	Yogo Gulch	13 N 11 E 21	North-Central
44			Blake Creek, distance	11 N 18 E 7	North-Central
45			Blake Creek, close-up	11 N 18 E 7	North-Central
46			Half Moon Pass	11 N 19 E 4	North Central
16			South of Philipsburg	8 N 13 W 19	South-Central
51		Sagebrush/grass, Group 5, aspen	Snowline-Lima Peaks	14 S 34 E 20	South-Central
52		Sagebrush/grass	Deep Creek	14 N 33 E 1	South-Central
56		Sagebrush/grass, aspen	Redrock Pass	15 N 42 E 28	South-Central
57		Sagebrush/grass	Sawtell Peak	14 S 42 E 15	South-Central
60		Aspen	Papoose Creek	11 S 42 E 6	South-Central
61			Bear Creek	8 S 1 E 12	South-Central
62		Riparian	Romy Lake	8 S 3 W 26	South-Central
72		Group 5	Madison Canyon	11 S 3 E 15	South-Central
73			Squaw Creek	4 S 4 E 34	South-Central
74		Sagebrush/grass, aspen	Spanish Creek	4 S 3 E 21	South-Central
77			Bozeman Pass	2 S 7 E 20	South-Central
	Group 9: Moist lower subalpine				
2	fir		Granite Peak	42 N 8 E 4	West-Side
9			Hungry Horse	31 N 19 W 25	West-Side
10			Half Moon Lake	31 N 19 W 24	West-Side
	Group 11: Warm moist grand fir, western redcedar, and western				
3	hemlock		Wallace, Idaho	48 N 4 E 34	West-Side
4			Prichard Creek	49 N 5 E 6	West-Side
5			Reeder Gulch	49 N 5 E 4	West-Side
1			Clearwater River	39 N 9 E 22	West-side

THE PHOTO RECORD

Photographs in this report fall within four geographic subdivisions of Montana and Idaho that have been designated "Regions" (fig. 1). The Idaho photos represent a small area contiguous with western Montana. These subdivisions are an adaptation from Arno's (1979) "Forest Regions" of Montana, and the following descriptions follow that reference. Forest regions were developed to correlate the influence of climate and general topography on forest vegetation. The broad subdivisions in this report provide an insight on the climate, topography, kinds of vegetation, and the past influence of fire on vegetation. Interpretation of fire's influence on vegetation has been facilitated by reference to fire groups (appendix I). This has allowed discussion of fire in the context of differing fire environments.

West-Side Region

The West-Side Region is represented by plates 1-16 (fig. 2). This predominantly forested landscape of mountains and valleys includes all of western Montana in the Columbia River watershed, except the Little Blackfoot and upper Clark Fork Rivers. The upper watersheds of the Coeur d'Alene, St. Joe, and Clearwater Rivers in Idaho are also included in this region.

Northern Idaho and the northern portion of the West-Side in Montana are strongly influenced by maritime airmasses that provide abundant rain and snow. The mildest conditions are generally associated with the Coeur d'Alene, St. Joe, and Clearwater drainages in Idaho and the Kootenai drainage in Montana. Pacific airmasses also influence the southern portion of the West-Side, but are weaker there and thus conditions are drier. Except for midsummer, cloudy weather prevails much of the time on the West-Side.

Forest vegetation is more diverse than in other regions because of marked topographic and climatic differences. Many Pacific Coast species are present. Moist habitat types (h.t.'s) (Fire Groups 9 and 11) predominate in northern Idaho and on some north exposures and canyon bottoms in western Montana. Fire history studies in these types suggest presettlement mean fire intervals of 50 to 250 years on a given site (Arno and Davis 1980; Sneck 1977). Westerly exposures in certain areas of northern Idaho burned at more frequent intervals (Barrett 1982). Fires in Fire Groups 9 and 11, burning under extreme conditions, consumed tens of thousands of acres during the period 1889-1934. Examples of this are shown in plates 1, 2, and 10. Some were repeat burns that consumed standing dead fire-killed trees resulting from previous fires. On many sites these multiple burns retarded regeneration of conifers and resulted in shrubfields that have persisted for many decades (plate 1). Today, most of these burns are patchily stocked with young conifers. Herbaceous plants and shrubs in the understory have deteriorated because of senescence brought on by shading and competition from conifers.

An abundance of ponderosa pine (Pacific form, *Ponderosa ponderosa* var. *ponderosa*) and larch is found east of the Bitterroot Range (Montana-Idaho divide), a land mass that constitutes a significant barrier to Pacific Coast moisture. Here in Fire Groups 2, 4, 5, and 6, Douglas-fir is the indicated climax species as well as a vigorous member of most seral communities. Fire Group 6 h.t.'s burned more frequently than the generally more moist forests of north Idaho. Many of these fires were of light to moderate severity and did little damage to overstory trees. Some fires were hot and killed the overstory in large areas. Stand-replacing fires occurred infrequently on moist sites because fuels only dried out under extreme weather conditions. Abundant seral shrub

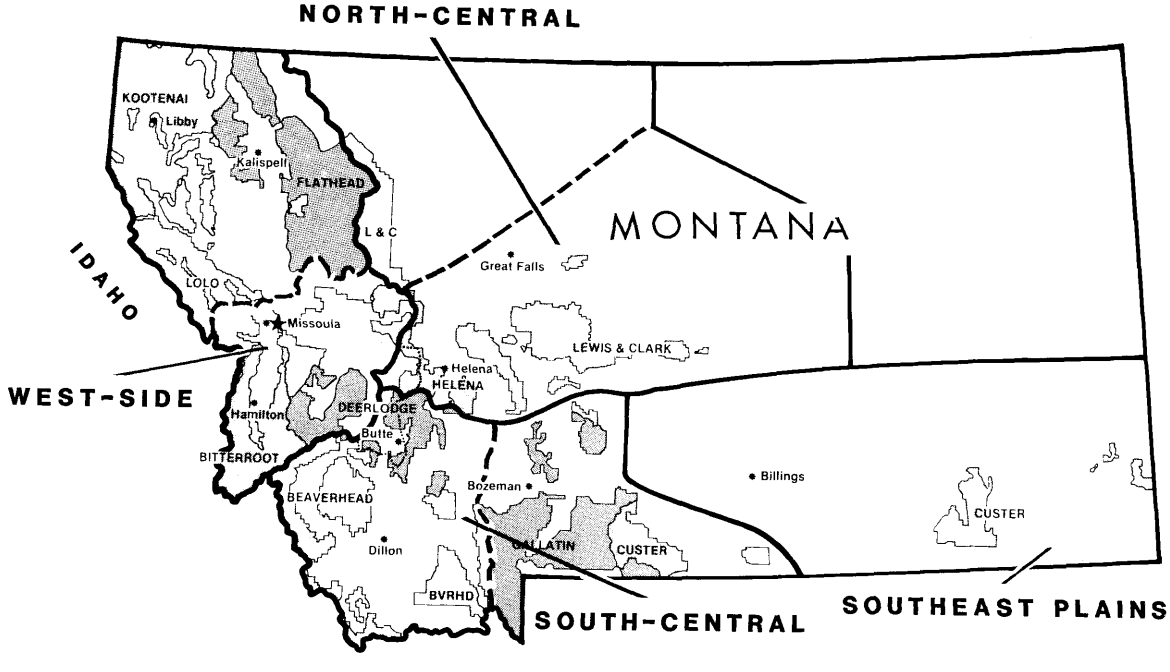


Figure 1.—The four regions in Montana and Idaho study area. National Forests are shaded. (Modified from Arno 1979.)

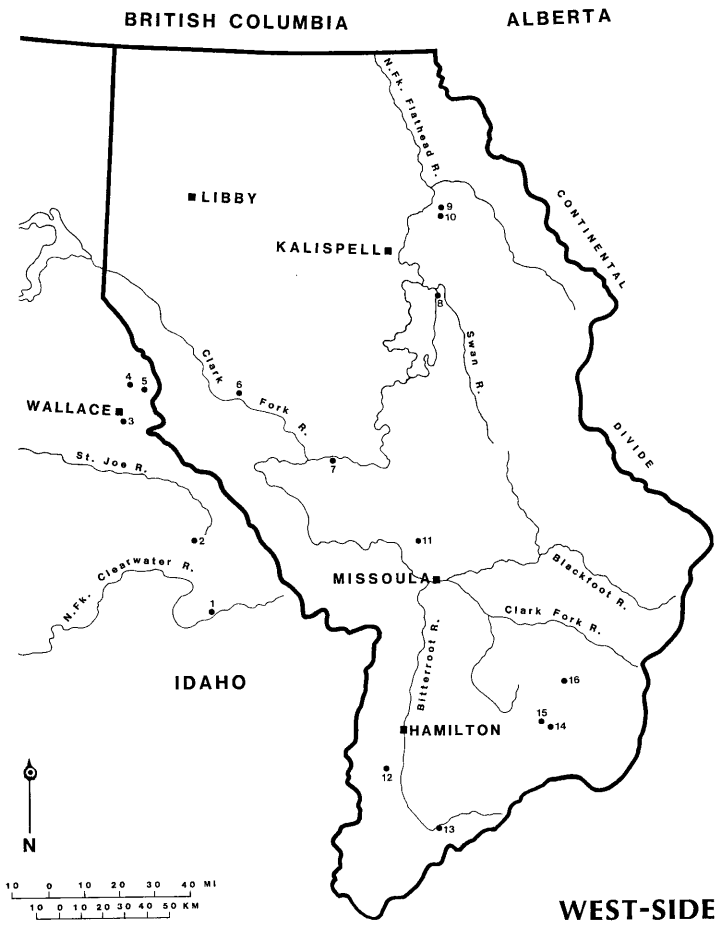


Figure 2.—West-Side Region.

vegetation that historically occupied these sites has been largely replaced by dense stands of conifers (plates 6 and 8). Logging slash and buildup of dead and living fuels following settlement also resulted in stand replacement fires. These fires brought about rejuvenation of seral shrubs that are now declining in vigor and dying out because of conifer competition (plate 11b).

Considerable areas at lower elevations are occupied by warm-dry Douglas-fir habitat types (Fire Group 4). Before European settlement these habitat types were dominated by fire-maintained ponderosa pine. This pine type was susceptible to recurrent fire because of the heavy annual needle cast that is highly flammable. Fire history studies in the Bitterroot Valley have shown a presettlement fire periodicity of 4 to 20 years on warm-dry Douglas-fir h.t.'s (Arno and Peterson 1983). Indian ignitions apparently accounted for many of these early fires (Barrett 1980; Barrett and Arno 1982).

Fires on these low elevation pine stands reduced fuels and maintained an open understory. On dry h.t.'s of limited shrub potential, fire enhanced herbs including pinegrass, lupine, and arrowleaf balsamroot, but suppressed shrubs (plate 13). Logging disturbance followed by the absence of fire for 70 to 90 years has resulted in regeneration of Douglas-fir and ponderosa pine (plate 12). The net effect of the absence of fire has been widespread proliferation of Douglas-fir on sites that were formerly maintained in ponderosa pine (Gruell and others 1982).

The West-Side also includes widely scattered warm-dry ponderosa pine h.t.'s (Fire Group 2). These h.t.'s are restricted to southerly exposures along the major rivers, including the Jocko, lower Flathead, Bitterroot, and Clark Fork. They were formerly occupied by open, fire-maintained ponderosa pine that were thinned by frequent ground fire. In the absence of fire, ponderosa pine has regenerated profusely (plate 7).

Cool-dry Douglas-fir h.t.'s (Fire Group 5) are represented near the eastern border of the region where the climate is heavily influenced by continental-polar air masses. Here Douglas-fir forests were kept open by fires that swept across valley grasslands and adjoining grassy slopes. Some of these fires were ignited by Indians (Mullan 1861; Phillips 1940; Phillips 1957). Livestock grazing and the absence of fire have resulted in conifer encroachment on sites that were formerly grasslands with scattered trees (plate 14) and in canyons (plate 15). Douglas-fir and lodgepole pine were apparently subjected to stand-replacing fires when burning weather was extreme. This set the stage for widespread regeneration of new stands during the later 1800's (plate 16). By 1935, a large portion of lodgepole pine stands on the Deerlodge National Forest was 40 to 60 years old and had little dead material in the understories (Lowell unpublished).

West-Side Region Plates

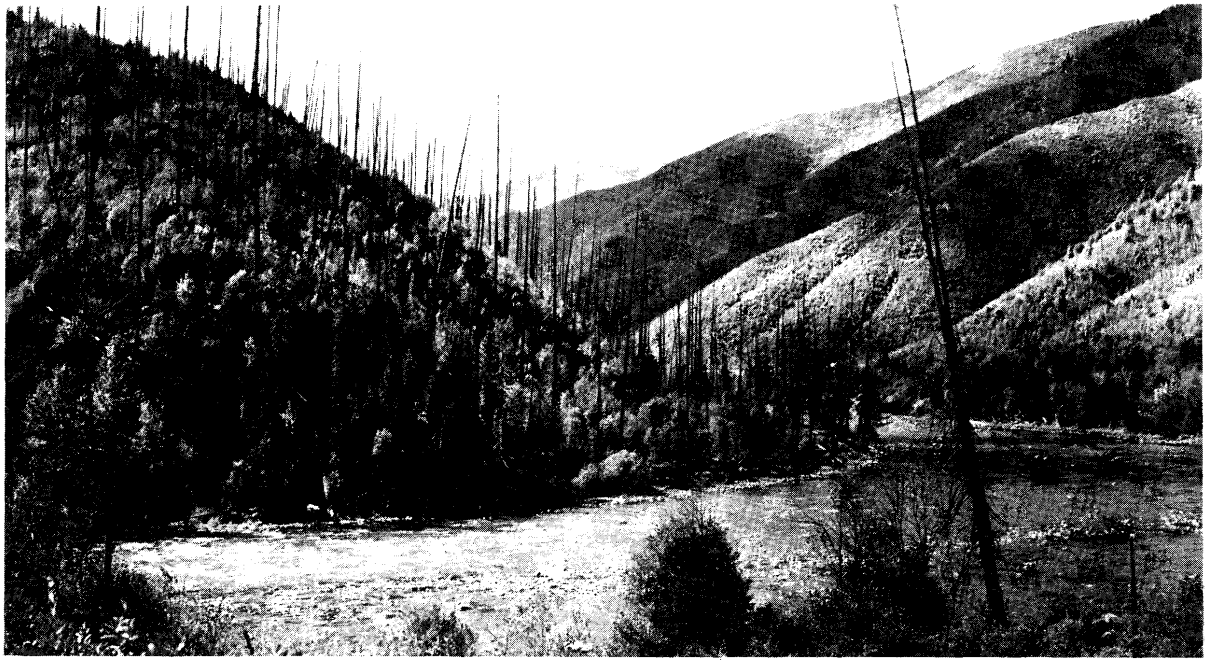


Plate 1a (August 1941) **Fire Group 11: Redcedar/grand fir.** **Elevation 2,700 ft (823 m)**

Looking northeast up the north fork of the Clearwater River from the outlet of Gilfillian Creek. Conifers and shrubs are in an early successional stage as a result of wildfires in 1910 and 1919.

USFS photograph, photographer unknown.

Plate 1b (September 1, 1982) **41 years later**

Camera point was moved about 30 feet to the left to avoid screening trees, while other trees were cut to obtain a less obstructed view. Conifers now dominate slope on the opposite side of the river, while far slopes at left retain shrub dominance except for localized stands of conifers. Some of these conifers were planted in the 1930's.

Photograph by G. E. Gruell.

Plate 2a (1924) **Fire Group 9: Moist lower subalpine fir.** **Elevation 5,900 ft (1 799 m)**

Looking south into the head of Timber Creek, a tributary of the St. Joe River. Camera point is on Granite Mountain, Red Ives Ranger District, Idaho Panhandle National Forests. Slopes in midground were burned in 1910. Scene shows many fire-killed snags. A variety of shrubs comprised the vegetative cover during this early stage of succession.

USFS photograph 190957 by J. A. Larsen.

Plate 2b (September 15, 1981) **57 years later**

Because of tree growth, camera point was moved, but photo approximates original coverage. Most snags in earlier photo have fallen and have partially decomposed. Conifers are mainly lodgepole pine, Douglas-fir, subalpine fir, and mountain hemlock. Understory includes beargrass, grouse whortleberry, blue huckleberry, smooth menziesia, willow, and snowberry.

Photograph by G. E. Gruell.

Plate 3a (1910) **Fire Group 11: Warm-moist grand fir, western redcedar, and western hemlock.** **Elevation 3,300 ft (1 006 m)**

Looking west-northwest over Wallace, Idaho, just before the 1910 forest fire burned the northwest section of town. Young conifers and the presence of snags provide evidence of wildfire in earlier years.

Barnard-Stockbridge photograph; courtesy of Idaho State Historical Society.

Plate 3b (July 1, 1980) **70 years later**

Douglas-fir regeneration screens part of the original view. Douglas-fir have filled in most of the openings on the distant slopes. Understory vegetation on the southeast-facing slopes directly behind town includes many shrubs such as willow, mountain maple, and ninebark.

Photograph by W. J. Reich.

Plate 4a (1897) **Fire Group 11: Warm-moist grand fir, western redcedar, and western hemlock.** **Elevation 2,800 ft (854 m)**

Looking west-southwest down Prichard Creek from mouth of Dream Gulch. Location is west of Murray, Idaho, on the Wallace Ranger District. Cottonwood, willow, and other deciduous trees and shrubs predominate following wildfire and cutting of timber for mining purposes.

Barnard-Stockbridge Photograph; courtesy of Idaho State Historical Society.

Plate 4b (June 30, 1980) **83 years later**

Highway construction altered landscape in foreground. Camera point is approximate. Cottonwood and conifer regeneration screens view of Prichard Creek. Distant slope at right is now covered by Douglas-fir.

Photograph by W. J. Reich.

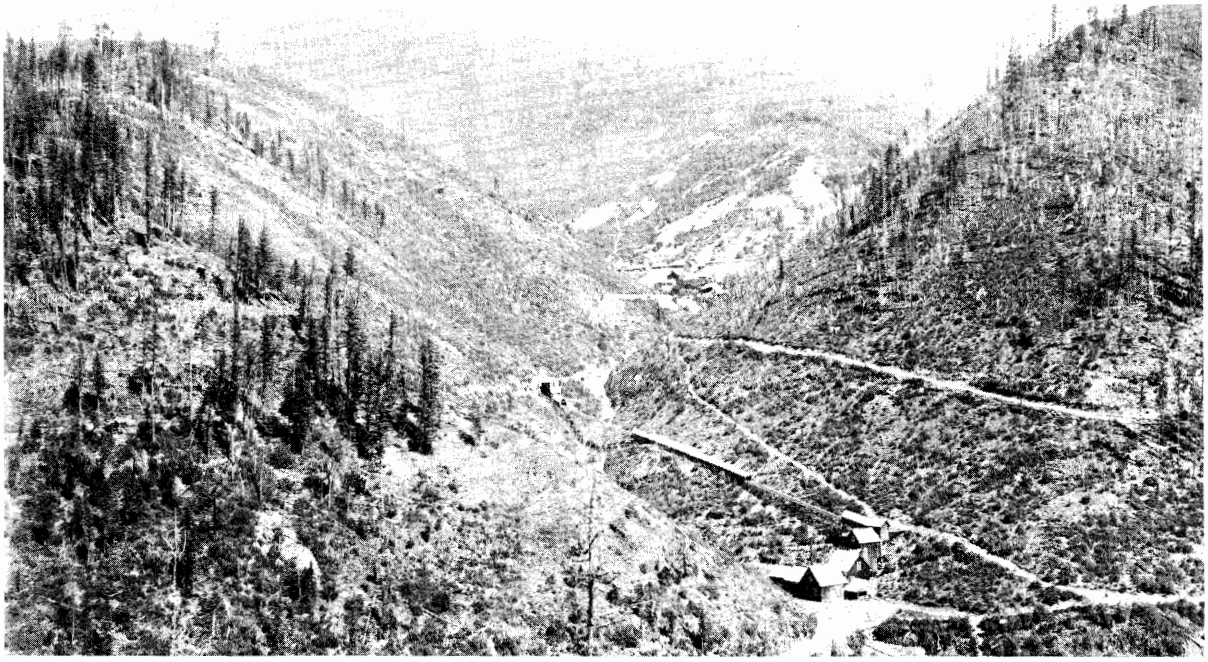


Plate 5a (1897) **Fire Group 11: Warm-moist grand fir, western redcedar, and western hemlock.** **Elevation 3,300 ft (1 006 m)**

Camera faces northeast across Prichard Creek into Reeder Gulch near Murray, Idaho, on Wallace Ranger District. The vegetative cover on slopes is in an early succession stage following wildfire and cutting of timber.

Barnard-Stockbridge photograph; courtesy of Idaho State Historical Society.

Plate 5b (July 1, 1980) **83 years later**

Growth of conifers necessitated placement of camera at lower position. A road now runs along the Prichard Creek bottom. Increased cover of conifers is typical of postfire succession in northern Idaho.

Photograph by W. J. Reich.

Plate 6a (July 9, 1928) **Fire Group 6: Moist Douglas-fir.** **Elevation 2,500 ft (762 m)**

Looking west-northwest up Goat Creek from the H. J. Corley homestead 2 miles above the mouth of the Thompson River in Montana. Slopes behind homestead apparently burned in 1910. Scattered stumps suggest that light cutting had also occurred.

USGS photograph 1924 by W. C. Alden.

Plate 6b (September 9, 1981) **53 years later**

State Highway 200 now runs through foreground. Closure of Douglas-fir and ponderosa pine forest canopy on slope at left has resulted in decline in condition of deciduous shrubs including mountain maple, chokecherry, and willow. Conifer densities have increased on rocky southwest-facing slope (opposite), but not as dramatically because of dry rocky site conditions. Widely spaced stumps and remnants of snags indicate that presettlement conifer stands were quite open in this locality.

Photograph by G. E. Gruell.

Plate 7a (July 5, 1928) **Fire Group 2: Warm-dry Douglas-fir.** **Elevation 2,800 ft (854 m)**

Camera faces north-northwest toward Knowles Creek, a tributary to the Clark Fork River about 6.5 miles west of Perma on State Highway 200. Ponderosa pine and Douglas-fir in foreground had regenerated after wildfire. Some cutting had also occurred. Distant southerly exposures support an open stand of ponderosa pine and Douglas-fir. Antelope bitterbrush comprises predominate shrub cover on alluvial fan.

USGS photograph 1915 by W. C. Alden.

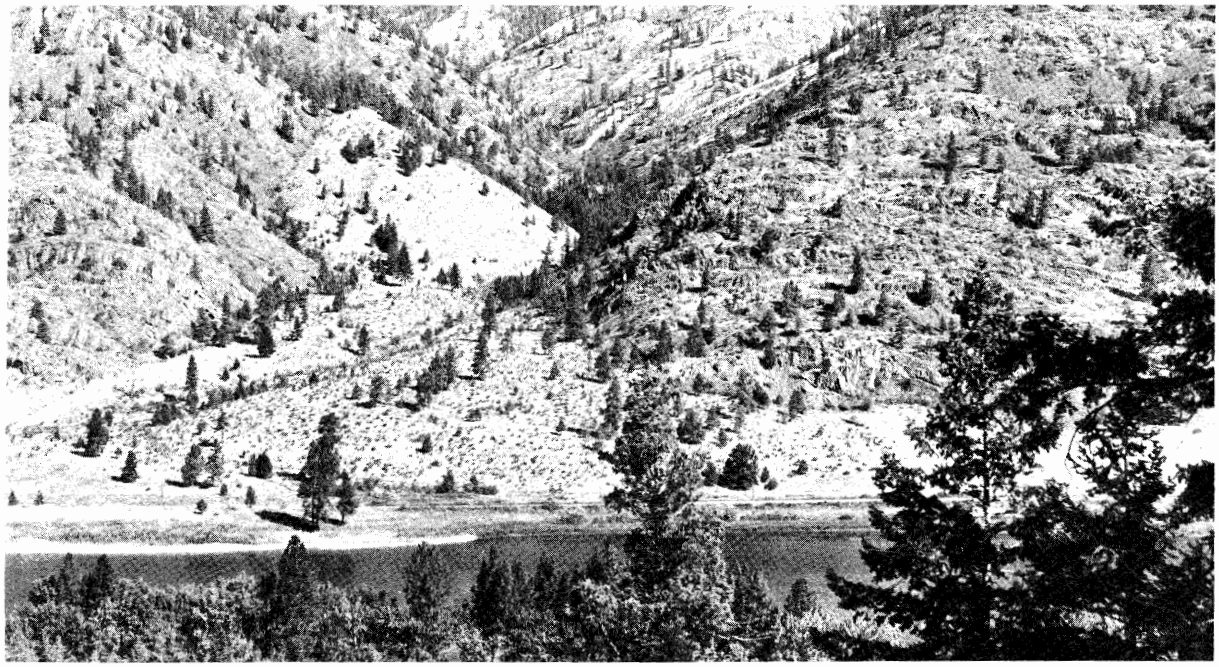


Plate 7b (September 15, 1981) **53 years later**

Dense conifer growth made it necessary to move camera several hundred yards to an elevated position. Widely scattered stumps in midground (some showing scars from eight different fires) showed that frequent fires kept presettlement stands very open on the south side of the Clark Fork River. The drier distant slopes show a slower increase in conifer density. Logging has also restricted conifer development. Heavy livestock use has apparently been a factor in reducing bitterbrush cover on the alluvial fan.

Photograph by G. E. Gruell.

Plate 8a (1902) **Fire Group 6: Moist Douglas-fir.** **Elevation 3,100 ft (945 m)**

Camera faces north toward Daphnia Pond and Swan Range on the east side of Flathead Lake, 3 miles north of Woods Bay. Snags attest to a fire in the late 1800's that killed most of the coniferous forest around the pond. Removal of conifers stimulated heavy growth of herbs and shrubs.

Photograph by M. J. Elrod, courtesy University of Montana Archives and Special Collections.

Plate 8b (September 28, 1981) **79 years later**

Fall haze obscures Swan Range in distance. Cattail growth now obscures pond surface. Dense conifers including ponderosa pine, Douglas-fir, larch, and spruce have regenerated on near slope at right. Cottonwood and dogwood flourish along pond edge, while shade-intolerant shrubs are on the decline beneath the conifer canopy.

Photograph by G. E. Gruell.

Plate 9a (August 24, 1935) **Fire Group 9: Moist lower subalpine fir.** **Elevation 6,400 ft (1 951 m)**

Looking southwest toward Columbia Mountain (left) and Teakettle Mountain (right) from fire lookout tower on Desert Mountain, Coram Experimental Forest, Flathead National Forest. Scene shows mosaic of burned and unburned terrain following an intense wildfire that swept the valley between Columbia Falls and Lake McDonald on August 14-17, 1929.

USDI photograph by E. Bloom.

Plate 9b (August 28, 1981) **46 years later**

Photograph taken from ground level through haze caused by wildfires. Valley floor and mountains in distance are now largely covered by dense stands of lodgepole pine and Douglas-fir.

Photograph by G. E. Gruell.

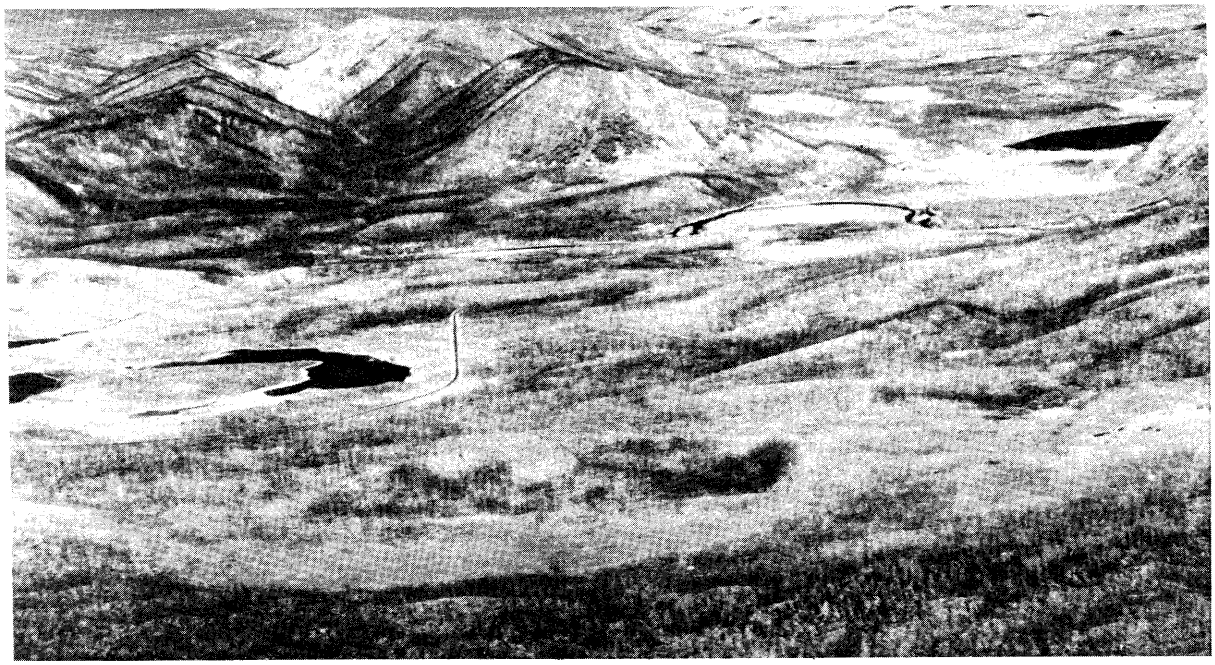


Plate 10a (August 24, 1935) **Fire Group 9: Moist lower subalpine fir.** **Elevation 6,400 ft (1 951 m)**

From Belton Point the view is northwest toward Flathead River and Apgar Mountain at left center. This scene shows the northern extension of August 14-17, 1929, fire pictured in previous plate. This fire literally denuded sites such as those adjacent to Halfmoon Lake (left center) and Lake McDonald (upper right). Many conifers survived the fire (below) where fuels were discontinuous.

USDI photograph by E. Bloom.

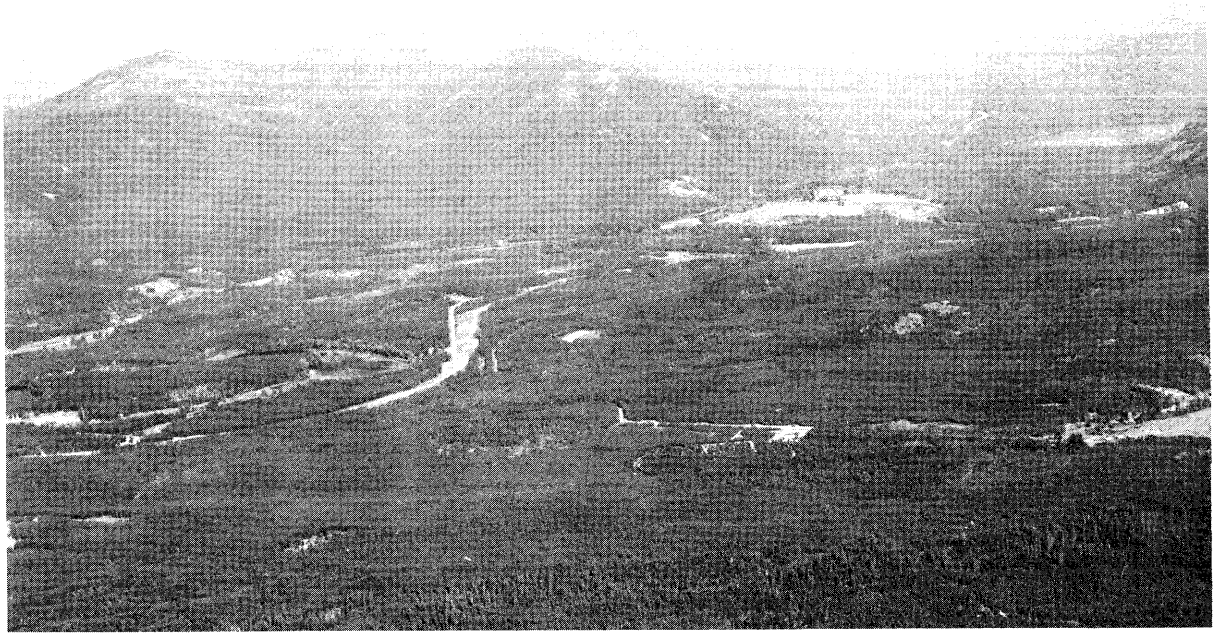


Plate 10b (August 28, 1981) **46 years later**

Valley bottom and adjacent slopes in distance are now densely covered by lodgepole pine, Douglas-fir, subalpine fir, spruce, and larch. The rich subalpine fir habitat types in this valley have a high potential for producing an assortment of deciduous shrubs and trees that flourish after fire.

Photograph by G. E. Gruell.

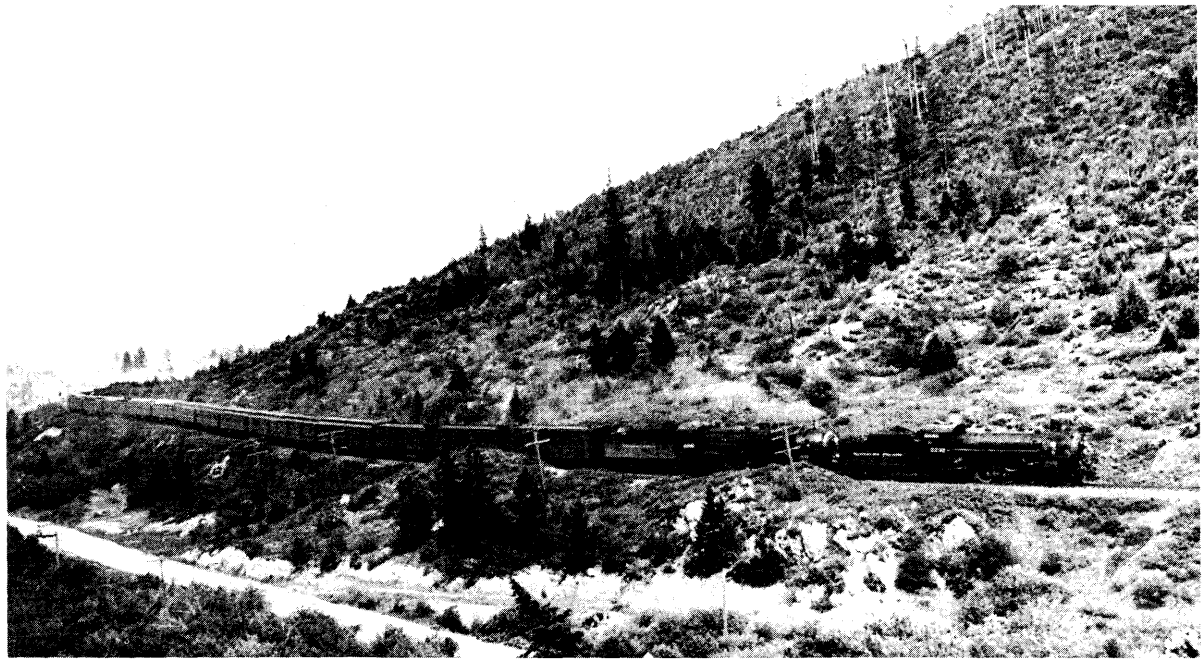


Plate 11a (June 5, 1941) **Fire Group 6: Moist Douglas-fir.** **Elevation 3,900 ft (1 889 m)**

Camera faces east-northeast across Evaro Hill toward the Jocko Mountains from a point 0.5 miles below Evaro, Mont. Shrub cover on near slope regenerated following a 1919 wildfire. Conifer regeneration includes ponderosa pine, Douglas-fir, western larch, and lodgepole pine.

Photograph courtesy W. R. McGee; W. R. McGee photographer.

Plate 11b (October 5, 1979) **38 years later**

Camera was offset approximately 300 feet south and 200 feet above original position to avoid screening conifers. Slope is now covered by a dense stand of conifers dominated by Douglas-fir. Shrub understory includes ninebark, snowberry, willow, mountain maple, white spiraea, and pinegrass.

Photograph by W. J. Reich.

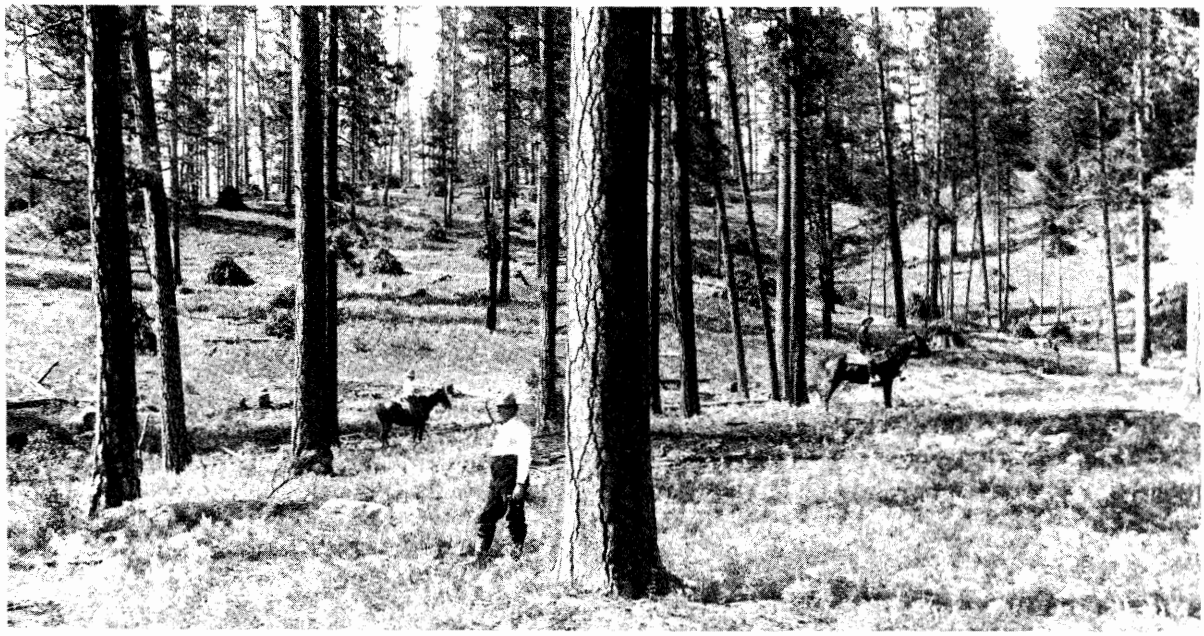


Plate 12a (1909) Fire Group 4: Warm-dry Douglas-fir. Elevation 4,400 ft (1 341 m)

A northwesterly view showing cleanup operations on the Lick Creek timber sale, Bitterroot National Forest near Como Lake (see Gruell and others 1982 for other photo comparisons in this locality). The number of stumps and slash piles suggests that this was an open ponderosa pine stand, a condition typical of the Bitterroot Valley where stands had been subjected to frequent ground fires. Fire scar samples showed a mean fire interval of 7 years between 1600 and 1900 (Gruell and others 1982). The understory appears to have a high incidence of lupine, but few shrubs are evident. Forest Service "lumberman" C. H. Gregory stands in foreground.

USFS photograph 86476 by W. J. Lubken.

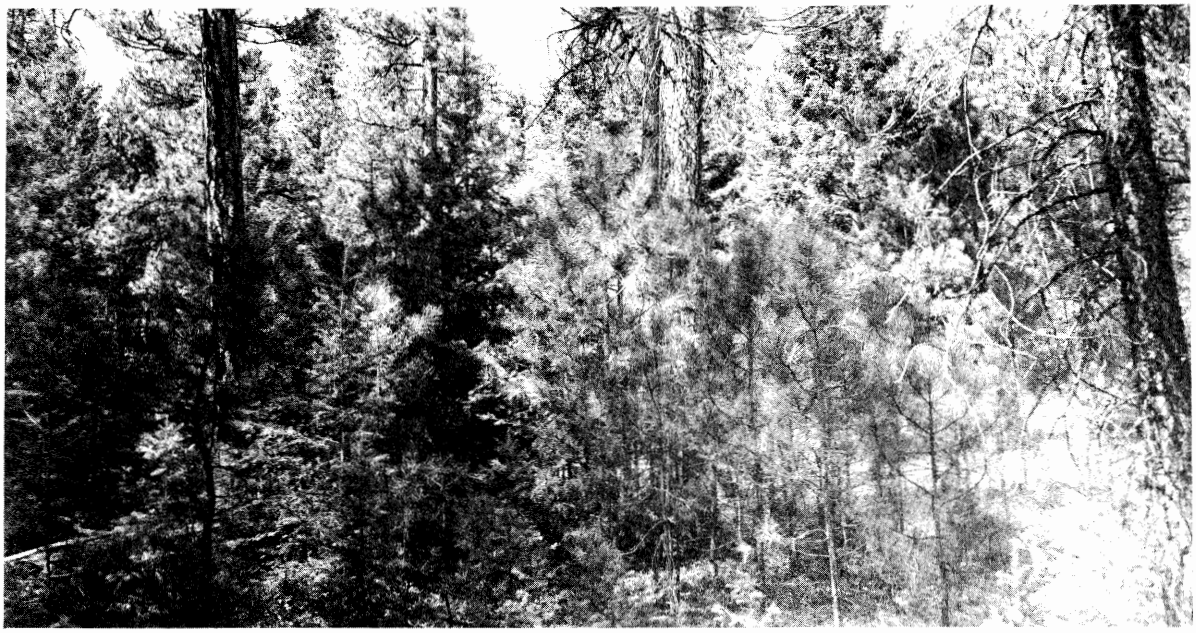


Plate 12b (September 1979) 70 years later

Camera point replicated original position. Soil disturbance during logging and exclusion of wildfire allowed ponderosa pine and Douglas-fir seedlings to become established and develop into a dense understory. The large ponderosa pine in center-foreground in the 1909 view as well as others were cut during shelterwood and selection harvests in 1952 and 1962.

Photograph by W. J. Reich.

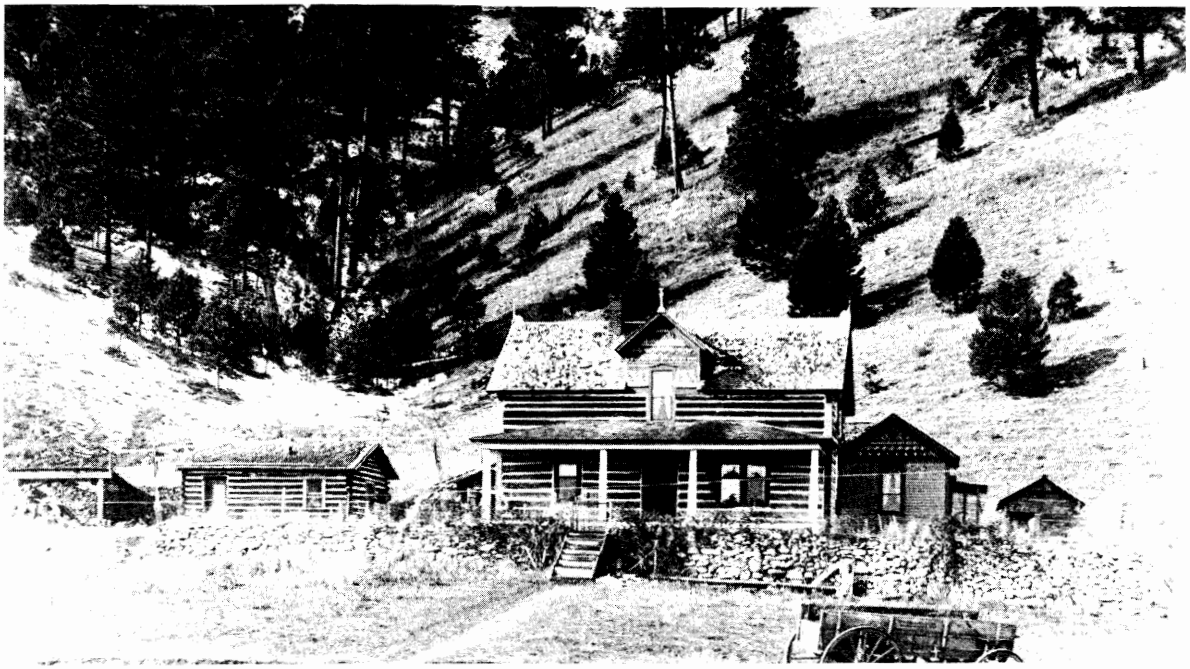


Plate 13a (ca. 1895) **Fire Group 4: Warm-dry Douglas-fir.** **Elevation 4,400 ft (1 341 m)**

Looking west at the Jake Wetzsteon residence in Ross' Hole 0.7 miles north of Highway 472-State Highway 93 junction. The drier southwest-facing slope on right is a ponderosa pine climax site. Perennial grasses predominate in understory. The cooler Douglas-fir climax northeast slope and draw support more conifers. The absence of fire for several decades has allowed regeneration of ponderosa pine and Douglas-fir.

Photograph courtesy Darby Historical Society.

Plate 13b (June 17, 1980) **About 85 years later**

New road alignment necessitated placement of camera at lower position. Fire exclusion and no logging have allowed unrestricted development of conifers. Fire scar sampling of ponderosa pine in this locality (Arno 1976) showed a mean fire interval of 10 years prior to settlement.

Photograph by G. E. Gruell.

Plate 14a (ca. 1906-08) **Fire Group 5: Cool-dry Douglas-fir.** **Elevation 5,500 ft (1 677 m)**
Looking east toward Flint Creek Range from bench between Fred Burr Creek and Summer Gulch. Grassland in foreground and midground has been grazed heavily by livestock. Douglas-fir are regenerating on moraine in midground. Fire mosaics are evident in distance.
USGS photograph 14 by F. C. Calkins.

Plate 14b (July 21, 1981) **About 73 to 75 years later**
Perennial grasses had not been utilized by livestock as of July 21, 1981. Dense Douglas-fir now occupy the formerly open moraine in midground. Dense lodgepole pine and Douglas-fir cover distant slopes.
Photograph by G. E. Gruell.

Plate 15a (ca. 1906-08) **Fire Group 5: Cool-dry Douglas-fir.** **Elevation 5,600 ft (1 707 m)**

The camera faces west down Dirty Dick Gulch approximately 2 miles north of Philipsburg, Mont. Ground cover on south-facing slope on right is predominantly bluebunch wheatgrass. A few Douglas-fir and Rocky Mountain juniper have regenerated on the south slope, while the north slope is occupied by an open stand of Douglas-fir.

USGS photograph 98 by F. C. Calkins.

Plate 15b (July 21, 1981) **About 73 to 75 years later**

Production of bluebunch wheatgrass has declined because of encroachment of Douglas-fir and Rocky Mountain juniper. A dense Douglas-fir stand now occupies canyon bottom and north slope. Conifers have increased in density in background.

Photograph by G. E. Gruell.

Plate 16a (ca. 1906-08) **Fire Group 6: Moist Douglas-fir.** **Elevation 5,000 ft (1 524 m)**

Looking northeast from point now occupied by U.S. Highway 10A, 8 miles northeast of Philipsburg, Mont. Deciduous shrubs, herbs, and young aspen are evident in foreground and midground. Conifers on benchlands include Douglas-fir, ponderosa pine, lodgepole pine, and Rocky Mountain juniper. Open slope in distance was swept by a crown fire around the turn of the century.

USGS photograph 29 by F. C. Calkins.

Plate 16b (July 21, 1981) **About 73 to 75 years later**

Except for the portion of clearcut visible at right midground, the landscape above highway right-of-way is now covered by a dense stand of conifers dominated by Douglas-fir. Aspen have matured along edge of conifers, while those in competition with conifers are dying out. Shrubs, including buffaloberry and snowberry, are also deteriorating.

Photograph by G. E. Gruell.

North-Central Region

This region is mostly Great Plains prairie, but also includes the east slope of the Rockies and some isolated mountain ranges. Plates 17-46 are located in the North-Central Region (fig. 3). It includes the Blackfoot Indian Reservation, the Helena National Forest east of the Continental Divide, and the Lewis and Clark National Forest. It extends east from the Rocky Mountain Front to the Missouri River Breaks and north to the Canadian border.

The northern portion of this region is influenced by a severe continental climate—arctic air masses and desiccating winds in winter (Arno 1979). The vegetation has mostly a prairie grassland potential that is broken by intermittent hills or a few isolated mountains. Forest vegetation is largely confined to the east slope of the Rockies. Douglas-fir and subalpine fir h.t.'s predominate here, while ponderosa pine (Rocky Mountain form, *Ponderosa ponderosa* var. *scopulorum*) is apparently absent because of the severe climate. Limber pine occupies the lower elevations and extends eastward through the foothills to the edge of the Great Plains. Soil and moisture conditions for aspen and other deciduous trees and shrubs are ideal along the Rocky Mountain Front. The most extensive aspen stands in Montana are located on the Blackfoot Indian Reservation and the east side of Glacier Park (Lynch 1955).

To the south, climatic conditions are less severe. This part of the region is more mountainous, but the landscape is broken by extensive low-lying valleys. Forests extend from valley base levels or from lower timberlines on the principal mountain ranges at 4,000 to 5,000 ft (1 200 m to 1 524 m) and cover all but the highest peaks. Ponderosa pine occupy dry sites in the valleys, on the lower mountain slopes, and in the Missouri River Breaks. Limber pine and Rocky Mountain juniper grow independent of, and in association with, ponderosa pine on dry sites. Douglas-fir is widely distributed from 4,000 ft (1 220 m) up to about 6,500 ft (1 982 m). Extensive stands of lodgepole pine occur between 5,500 ft (1 677 m) and 8,000 ft (2 439 m). Subalpine fir and Engelmann spruce are present on moist sites.

Photo interpretation, field inspection, and early narratives suggest that, prior to European settlement, the combination of abundant grass cover, extreme fire weather, and Indian and lightning ignitions predisposed the North-Central Region to recurrent wildfires (Moore 1972). Disturbance to vegetation continued for several decades following settlement. For example, Leiberg (1904) reports heavy cutting of trees for fuel and mining needs at various locations in the Little Belt Mountains. Wildfires caused by miners and homesteaders were common during this period.

The role of fire in limber pine (Fire Group 1) along the Rocky Mountain Front is not clearly understood. It appears that the dry, windy climate and presence of grassy fuels combined to facilitate frequent wildfire. An 1889-99 survey of conditions here on the Flathead Forest Reserve (predecessor of the Lewis and Clark National Forest) reported extensive, almost continuous burns on the foothills along the east slope of the Rocky

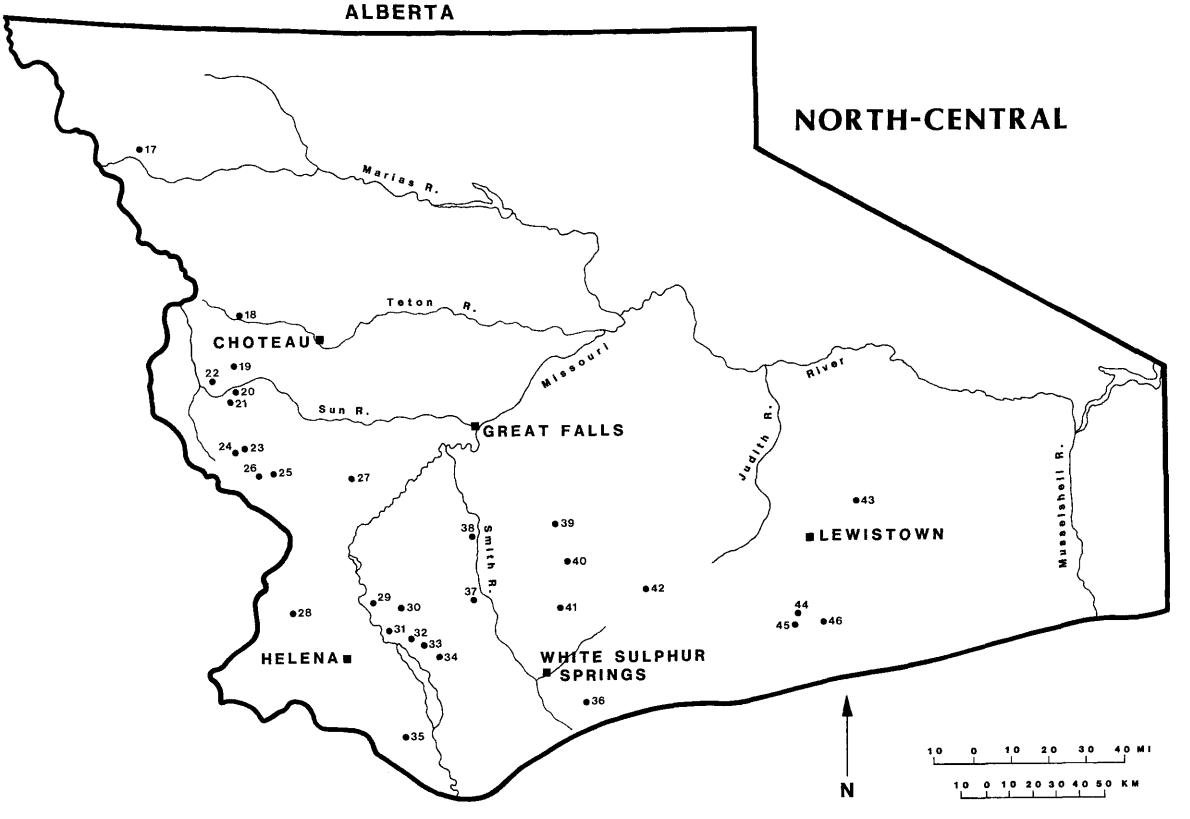


Figure 3.—North-Central Region.

Mountains (Ayres 1901). Ayres estimated that the latest of these fires (1889) covered about 530 square miles. Photographic evidence a few miles north of the Sun River suggests that foothills were formerly a grassland with scattered patches of limber pine (plate 19a). Trees occurring in open stands and groves were mostly restricted to ridges and rock outcrops where fuels were sparse. Few trees occupied sites where the grassy fuels were sufficient to carry fire. The absence of fire for 90 years or more has allowed limber pine to regenerate on these grassy sites. This has resulted in a marked increase in tree density (plate 19b).

There is abundant evidence of past fires in cool-dry and moist Douglas-fir h.t.'s (Fire Groups 5 and 6, respectively) on the lower slopes of the Rockies both on and adjacent to the Lewis and Clark National Forest. The frequency and intensity of these fires varied. Photographic evidence and on-site inspection suggests that tree cover in presettlement times was sparse on smooth, unbroken southerly and easterly slopes (plate 23a). Since the turn of the century, aspen and other deciduous vegetation that had regenerated on more productive sites following stand-replacing fires have reached advanced stages of succession (plates 18, 20, and 25). In the absence of fire, these species have died out or are deteriorating where conifer canopies have closed.

At the higher elevations (Fire Groups 8 and 9) fire was evidently less frequent on north slopes and canyon bottoms, which received abundant moisture. These stands were also less susceptible to fire because of the buffering effect of stream courses and rocky terrain (plates 22, 23, and 24).

Ponderosa pine dominated areas (Fire Group 4) in the southeastern part of this region show evidence of frequent fire. Here, fire inhibited encroachment of trees into grasslands at forest/grassland ecotones (plates 32, 43). These fires perpetuated open ponderosa pine stands where grasses had a competitive advantage over fire-sensitive shrubs including big sagebrush, curlleaf mountain-mahogany, and bitterbrush. Mahogany was largely confined to rocky sites where loss from fire was unlikely and opportunities for regeneration were better. Since about the turn of the century, mahogany has proliferated on deeper soils that formerly were exposed to frequent fire (plates 31 and 33).

Fire played a major role in successional development of Douglas-fir climax forests that are interspersed in the extensive grasslands. Prior to the introduction of livestock, these areas were frequently swept by prairie wildfires (Havard 1878). Fire restricted development of Douglas-fir forest and allowed grasses a competitive advantage over sagebrush. It appears that the absence of fire has resulted in significant increases in Douglas-fir and sagebrush on sites having a sagebrush potential (plates 35 and 36).

Douglas-fir on cool-dry and moist habitat types (Fire Groups 5 and 6, respectively) were evidently subjected to surface and stand-replacement fires (plates 28, 44, and 46). Plant response following stand replacing fires was optimal on sites having good potential for herb and shrub growth (plate 38a). Shrub production was lower on sites covered by thin soils (plate 45). Coniferous forest cover now dominates sites that formerly supported tall shrubs such as aspen, willow, chokecherry, and serviceberry. Shrub condition on these forested sites varies with site capability and amount of crown closure (plates 37 and 40). Where tree canopies are closed, shrubs are mostly decadent.

Lodgepole pine was subjected to both surface and stand-replacing fires depending upon fuels, fuel moisture, and fire weather. In localities where aspen was seral to lodgepole pine, fire removed the competing conifers and allowed regeneration of aspen and other deciduous shrubs (plates 37 and 41).

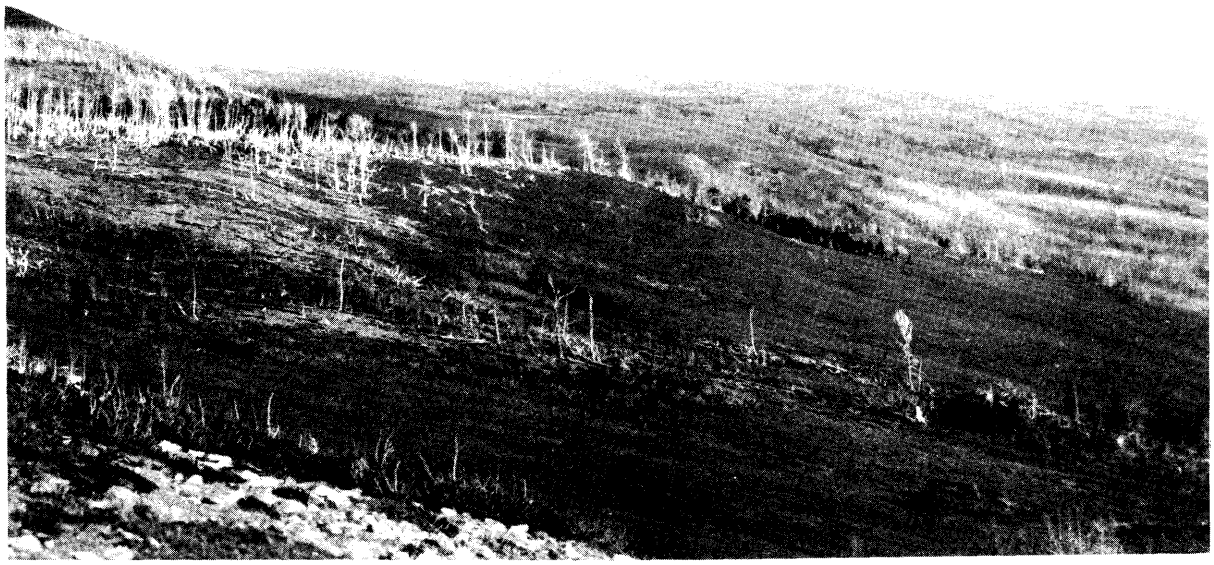


Plate 17a (July 6, 1921) Fire Group 1: Dry limber pine. Elevation 6,200 ft (1 890 m)

Camera faces east from a position on Two Medicine Ridge about 6 miles northeast of East Glacier, Mont. The many snags resulted from a wildfire in 1910. Scattered stumps show evidence of early timber cutting. Dark tone of open slopes reflects condition of herbaceous vegetation before curing.

USGS photograph 1101 by W. C. Alden.

Plate 17b (September 27, 1981) 60 years later

Conifers include whitebark pine, lodgepole pine, subalpine fir, and Douglas-fir. The dry slopes dominated by perennial grass appear unchanged. Aspen have regenerated on deeper soils (lower right) that supported conifer before the fire. Aspen stands growing in association with conifer (right in distance) regenerated following the 1910 wildfire.

Photograph by G. E. Gruell.

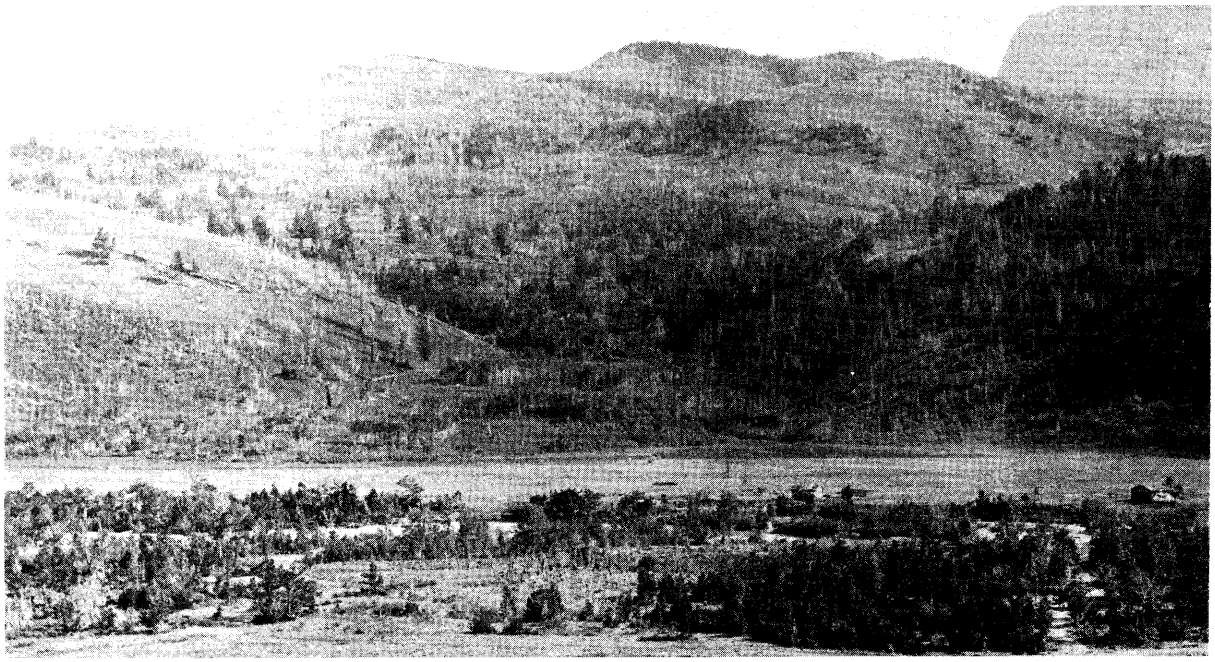


Plate 18a (July 19, 1899) **Fire Group 5: Cool-dry Douglas-fir.** **Elevation 5,100 ft (1 555 m)**

Looking south-southeast across the south fork of the Teton River at a point opposite the Circle 8 Guest Ranch about 35 miles west of Choteau, Mont. When this photograph was taken, the photographer noted that the foothills had been "repeatedly overrun by fire." Snags are well distributed over the landscape and young aspen occupy the toe of the slope. The valley bottom shows signs of having been heavily grazed by domestic livestock.

Photograph 95-FRD-2068 by H. B. Ayres, courtesy of the National Archives.

Plate 18b (September 8, 1981) **82 years later**

Mature aspen stands are conspicuous along the forest ecotone. Slopes above support dense conifer cover, mostly Douglas-fir. Canopy closure has resulted in loss of early successional herbs and shrubs.

Photograph by R. F. Wall.

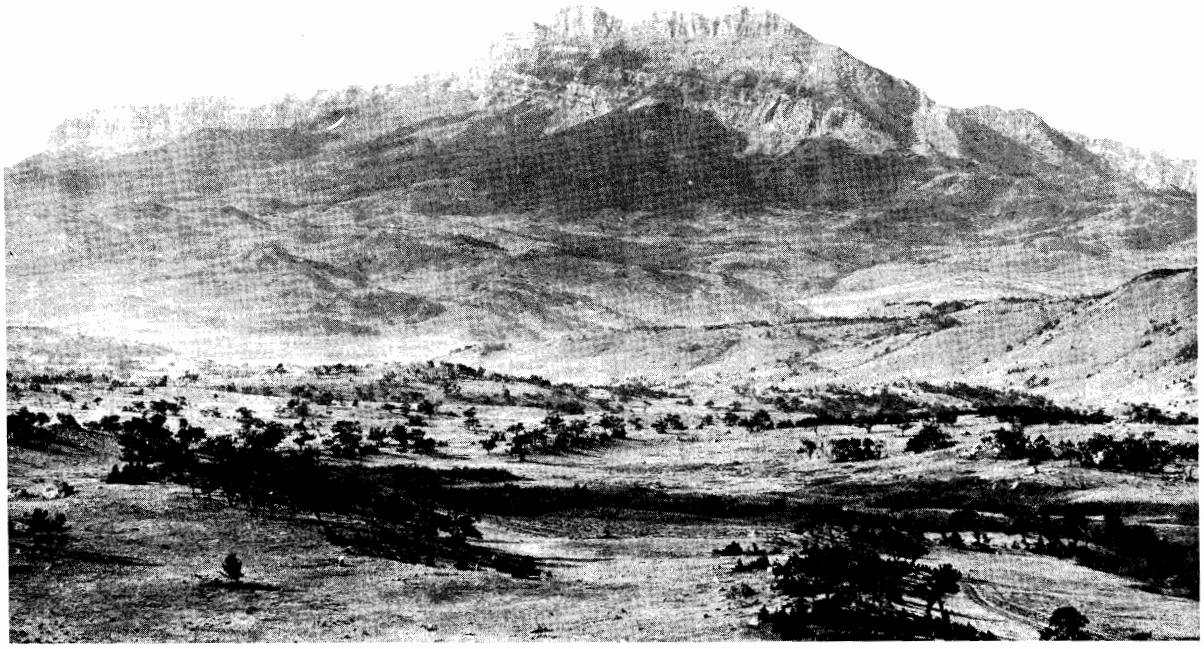


Plate 19a (1900) **Fire Group 1: Dry limber pine.** **Elevation 4,900 ft (1 494 m)**

From the foothills east of Castle Reef on Rocky Mountain Front the view is south across an open limber pine type toward Sawtooth Ridge on Sun River Game Range. Limber pine is largely confined to ridges and rocky sites where fine fuels were sparse. Fire-scarred snags and scarred living trees indicate wildfires had a significant influence on this landscape prior to settlement. Following settlement, trees were lightly harvested in the immediate area.

USGS photograph 663a by C. D. Walcott.

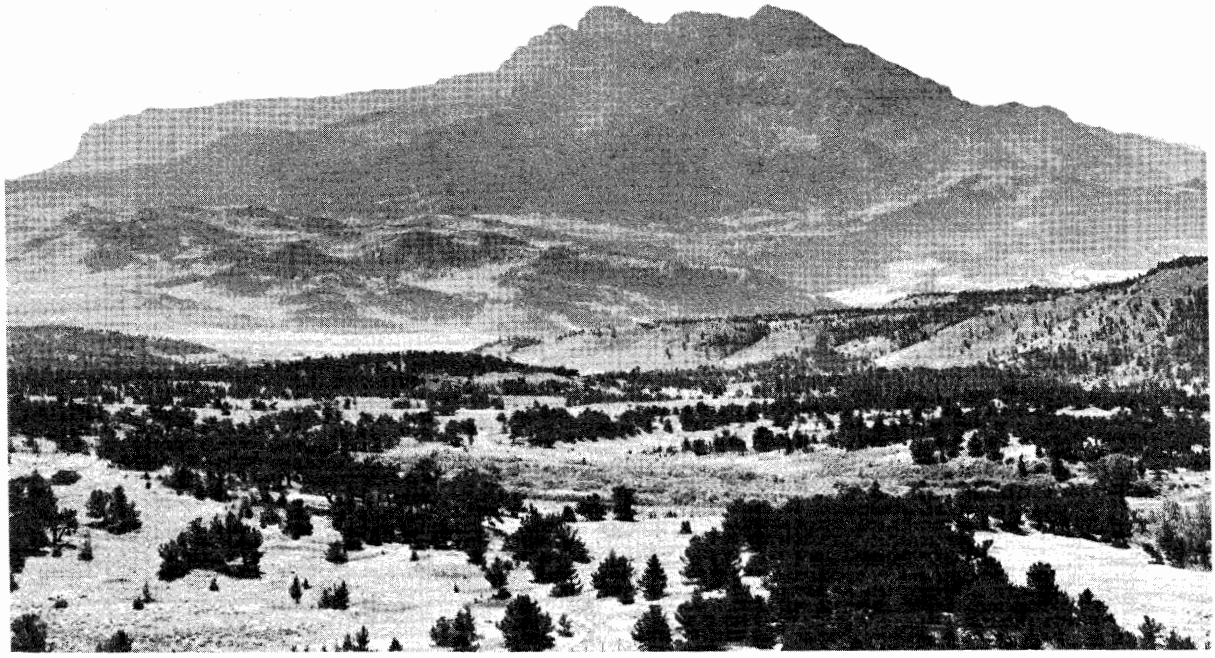


Plate 19b (September 17, 1981) **81 years later**

Limber pine are more dense along ridges and have become established on concave slopes and bottomlands. Distant slopes show extent of conifer regeneration south of the Sun River pictured in plate 13b.

Photograph by G. E. Gruell.

Plate 20a (1909) **Fire Group 6: Moist Douglas-fir.** **Elevation 4,600 ft (1 402 m)**

Looking south from a point that today is just outside of the northwest corner of the Sun River Game Range. Basin and adjacent slopes show effects of past wildfires in rejuvenating aspen and influencing vegetative mosaics. Distant northwest-facing ridge at left shows evidence of having been swept by fire. Note mature Douglas-fir stand on steep north-facing slope (arrow) that did not burn.

USFS photograph, photographer unknown.

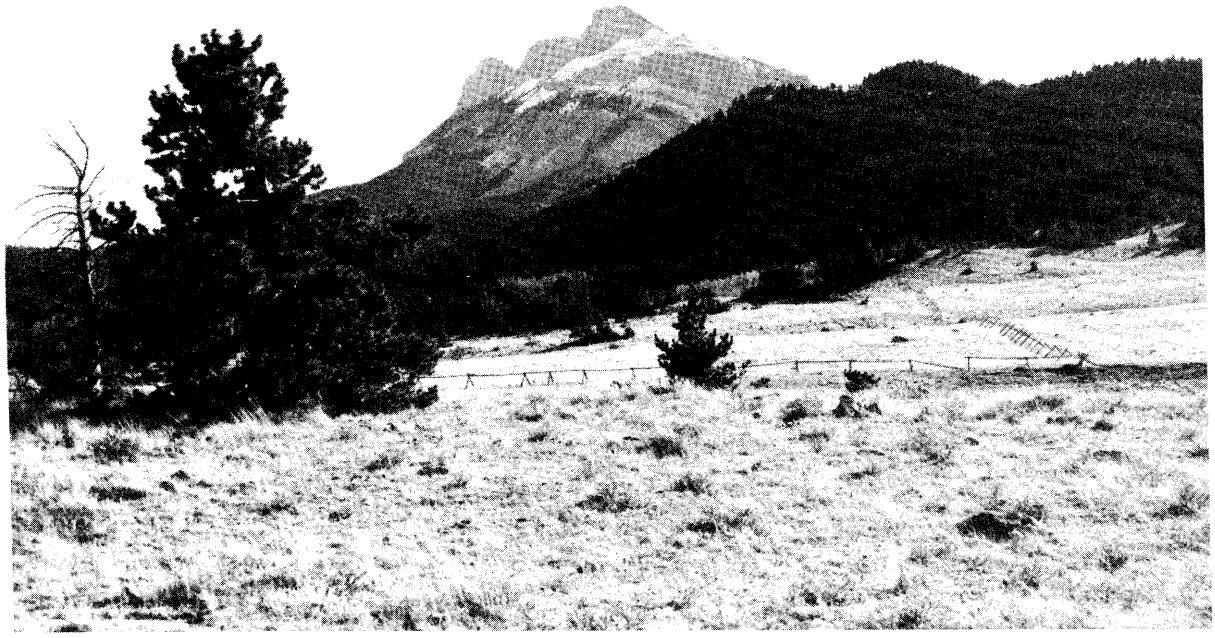


Plate 20b (October 9, 1979) **70 years later**

Nearest ridge at right is now largely covered by Douglas-fir. Aspen stands have matured, and where competition with conifers has been intense, aspen are declining in condition or have died out. Limber pine regeneration at left screens view of distant slope that supports a closed stand of Douglas-fir.

Photograph by W. J. Reich.

Plate 21a (1909) **Fire Group 1: Dry limber pine.** **Elevation 4,600 ft (1 402 m)**

The camera faces north toward the Sun River Canyon from a point 30 to 50 yards north of previous camera point. Castle Reef is at left. Conifers in midground and on far slopes are predominantly limber pine. A large aspen stand occupies the middle portion of larger draw at left in distance (arrow).

USFS photograph; photographer unknown.

Plate 21b (October 10, 1979) **70 years later**

Slopes in midground and in distance (left) burned in 1919. Limber pine on near slope were thinned by this fire. The large stand of limber pine at upper left of photo also burned (closed arrow). This fire apparently carried through large stand of aspen in distance (open arrow) that has since deteriorated.

Photograph by W. J. Reich.

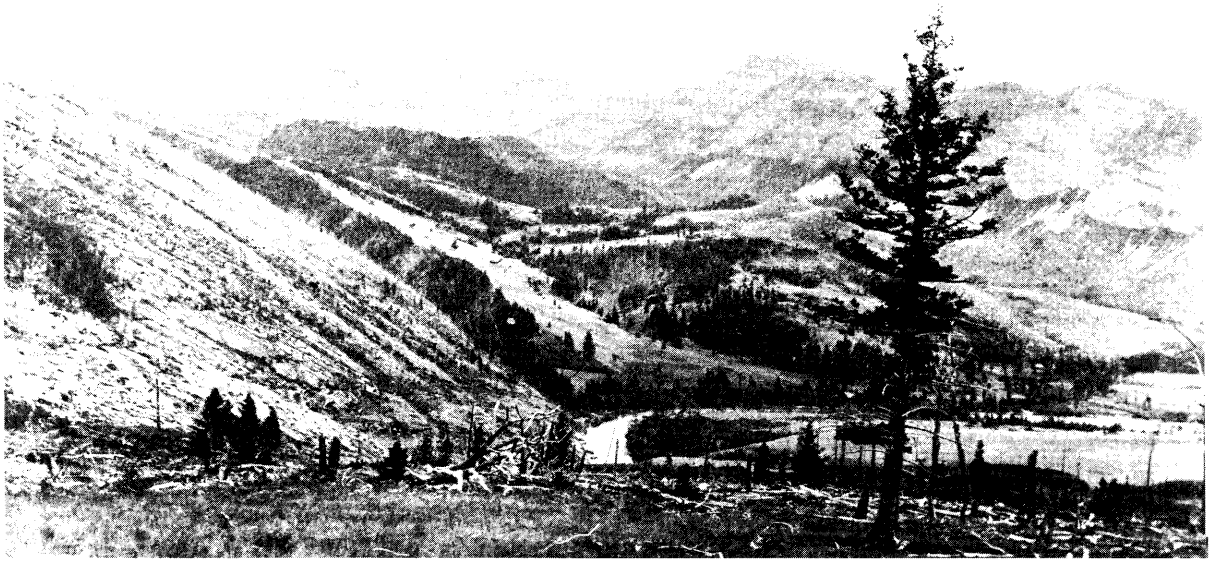


Plate 22a (July 1899) **Fire Group 6: Moist Douglas-fir.** **Elevation 4,800 ft (1 463 m)**

Looking south-southwest across the Sun River toward Home Gulch from upper ridge in Wagner Basin. Effects of past fires are shown as snags in foreground and on lower slope at left.

Photograph by H. B. Ayres, courtesy of the National Archives.

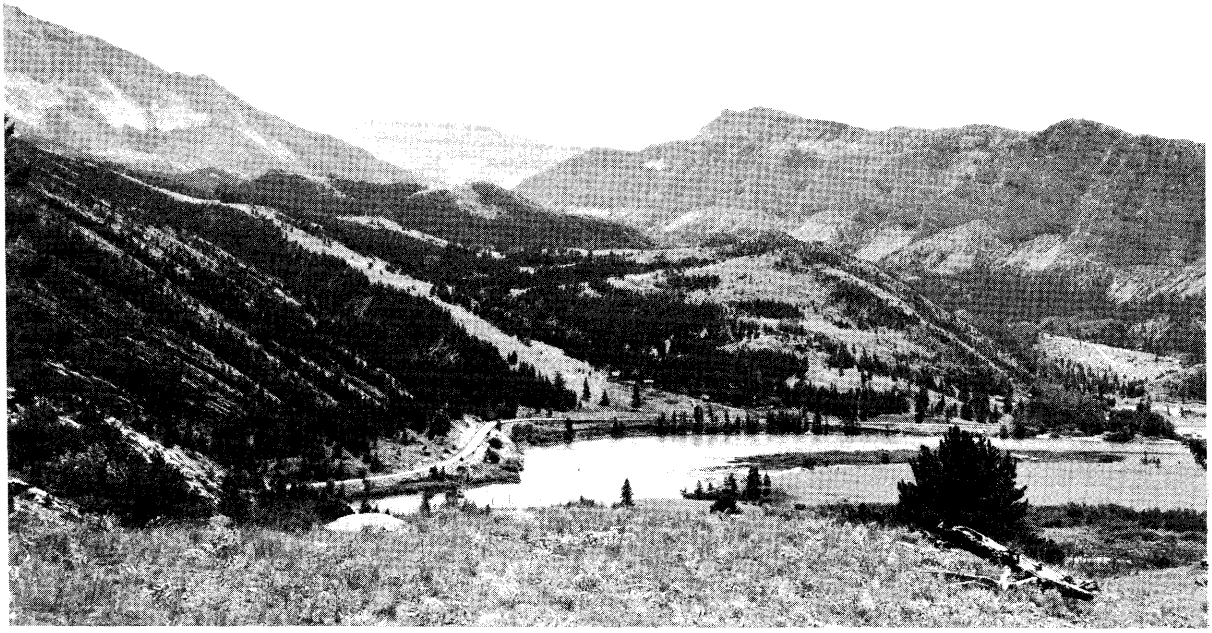


Plate 22b (September 8, 1981) **82 years later**

Dense conifer stands now occupy much of the area that was formerly open. Note particularly the band of conifers along the distant ridge at right.

Photograph by R. F. Wall.

Plate 23a (1900) **Fire Group 6: Moist Douglas-fir.** **Elevation 5,300 ft (1 616 m)**

From the ridge about 5 miles west of Haystack Butte, the view is southwest across Smith Creek toward Crown Mountain on east front of Rocky Mountains, Lewis and Clark National Forest. Near slopes are in early succession following wildfire in latter 1800's that removed conifers and stimulated production of aspen, willow, chokecherry, mountain maple, and other deciduous vegetation. Stumps resulting from timber cutting and snags indicate that the pre-1900 conifer stands were less dense than current stands.

USGS photograph 665 by C. D. Walcott.

Plate 23b (September 16, 1981) **81 years later**

Slopes below camera point and adjacent terrain as well as near slope are now densely covered by Douglas-fir. View was obtained by cutting screening fir and climbing one of the larger Douglas-fir about 50 yards from original camera position at top of ridge. Canopy closure has resulted in a decline in condition of deciduous species.

Photograph by G. E. Gruell.

Plate 24a (1900) **Fire Group 6: Moist Douglas-fir.** **Elevation 5,300 ft (1 616 m)**

Looking west-northwest toward Cyanide Mountain on the Wood Canyon drainage, Rocky Mountain Front, from a point approximately 50 yards below previous plate. Influence of wildfire in latter 1800's is indicated on left side of photo and on Cyanide Mountain in distance by presence of snags and early successional vegetation including aspen. Grassy slopes on right are apparently too dry to support conifers.

USGS photograph 666 by C. D. Walcott.

Plate 24b (September 16, 1981) **81 years later**

Camera was moved about 100 yards down slope from original position to avoid trees that screened view. Closure of Douglas-fir canopy (lower left) has resulted in deterioration of aspen and associated early successional plants. Proliferation of conifers is apparent in distance.

Photograph by G. E. Gruell.

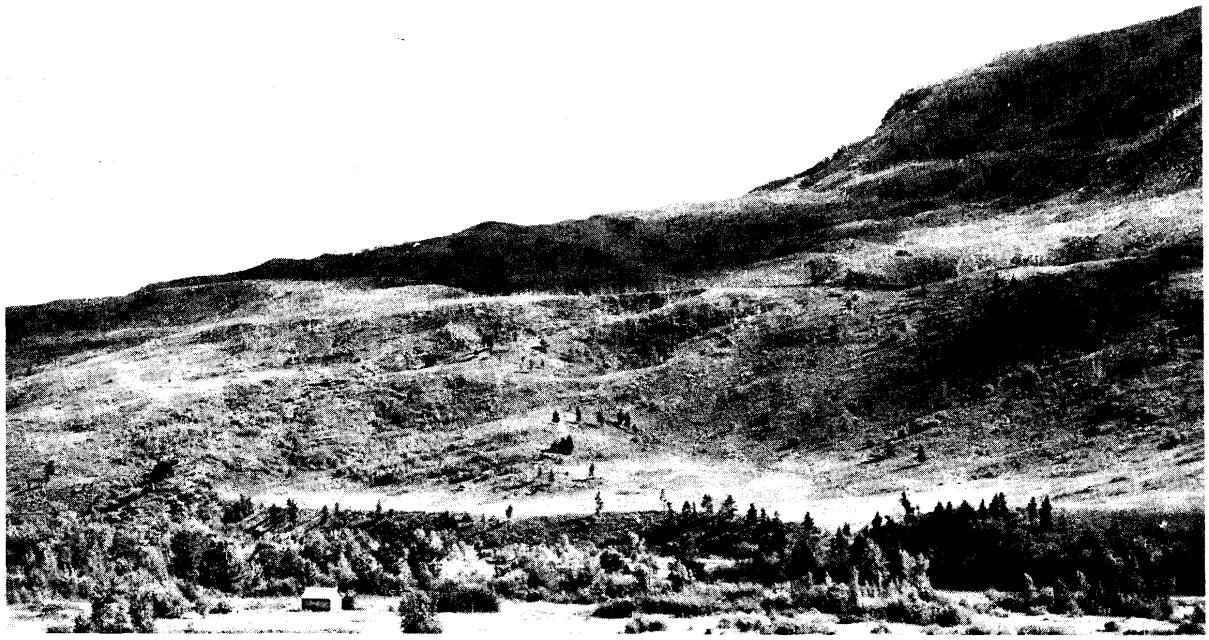


Plate 25a (1900) **Fire Group 6: Moist Douglas-fir.** **Elevation 4,500 ft (1 372 m)**

A southeast view from low bluff on Wallace Bean Ranch. Location is on Dearborn River south of Augusta, Mont. Snags and early successional aspen, willow, and other deciduous vegetation attest to wildfire in latter 1800's.

USGS photograph 667 by C. D. Walcott.

Plate 25b (September 7, 1981) **81 years later**

Cabin in 1900 photo is no longer standing. Drainage bottom in midground now supports mature cottonwoods, aspen, and willow. Slopes in distance that were formerly open are now largely covered by Douglas-fir. Mature aspen stands are also evident.

Photograph by R. E. Wall.

Plate 26a (July 10, 1921) **Fire Group 5: Cool-dry Douglas-fir.** **Elevation 5,000 ft (1 524 m)**

Looking northwest across the Dearborn River toward Steamboat Mountain from a point approximately 2.5 miles west of what is now the Diamond X Ranch. The vegetation on near slope and in distance is in early succession following wildfire several decades earlier. Conifers surviving this fire were confined to moist sites and rocky areas where fuels were sparse.

USGS photograph 1108 by W. C. Alden.

Plate 26b (September 7, 1981) **60 years later**

Camera was moved backward to avoid Douglas-fir and limber pine that screened original view. Scene shows a marked change in tree cover on the deeper soils. Conifer establishment has been slow on the harsher (rocky and dry) sites.

Photograph by R. F. Wall.

Plate 27a (ca. 1920) **Fire Group 2: Warm-dry ponderosa pine.** **Elevation 4,600 ft (1 402 m)**
View is north-northeast on west side of Sullivan Hill just off county road about 25 miles west of Cascade, Mont. Landscape has been dusted by a recent snowfall. The slopes are essentially a grassland type with patches of shrubs. The predominant conifers are limber pine on ridges at right and ponderosa pine on the left.
Photograph by E. Kopac, courtesy of Library of Congress.

Plate 27b (July 26, 1981) **About 61 years later Vegetative changes are difficult to interpret. Shrubs, including willow and chokecherry, have deteriorated. Ponderosa pine stands have matured and thickened, but show little expansion into grasslands.**
Photograph by R. F. Wall.

Plate 28a (1901) **Fire Group 6: Moist Douglas-fir.** **Elevation 5,300 ft (1 616 m)**

A southeast view of slope just outside the old mining town of Marysville, Mont. Railroad tracks, tailings, trails, and stumps attest to intensity of mining activity. Widespread occurrence of snags and the stage of understory development indicate that slopes were swept by a wildfire several decades earlier.

USGS photograph 95 by R. H. Chapman.

Plate 28b (July 24, 1981) **80 years later**

Camera position is somewhat lower and to the left of original position. Nonetheless, this scene shows a dramatic change following earlier disturbances. Various deciduous shrubs and trees including aspen, chokecherry, willow, and rose now grow on sites not occupied by conifers. The predominant conifer is Douglas-fir.

Photograph by R. F. Wall.

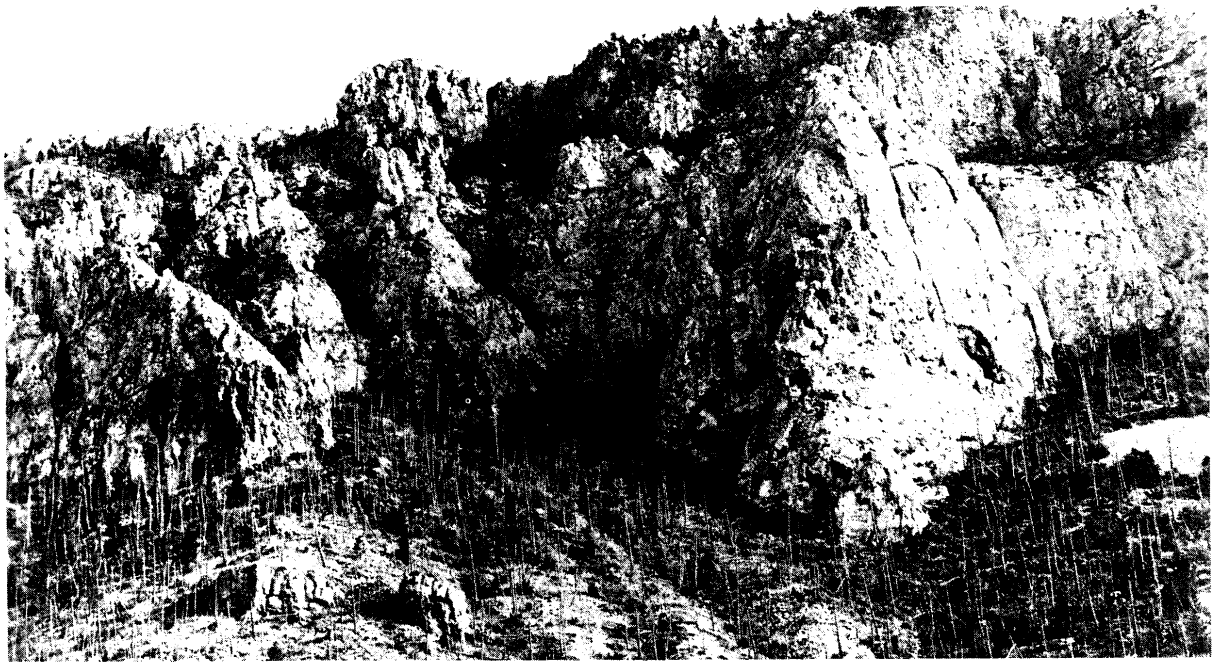


Plate 29a (1900) **Fire Group 4: Warm-dry Douglas-fir.** **Elevation 4,000 ft (1 220 m)**

The camera faces due south across Beaver Creek at a point 3.2 miles downstream from Nelson, Mont., on Helena Ranger District. Snags and size of young conifers indicate that the slopes were swept by a crown fire in the late 1800's. A variety of herbs and shrubs comprise understory vegetation.

USGS photograph 642 by C. D. Walcott.

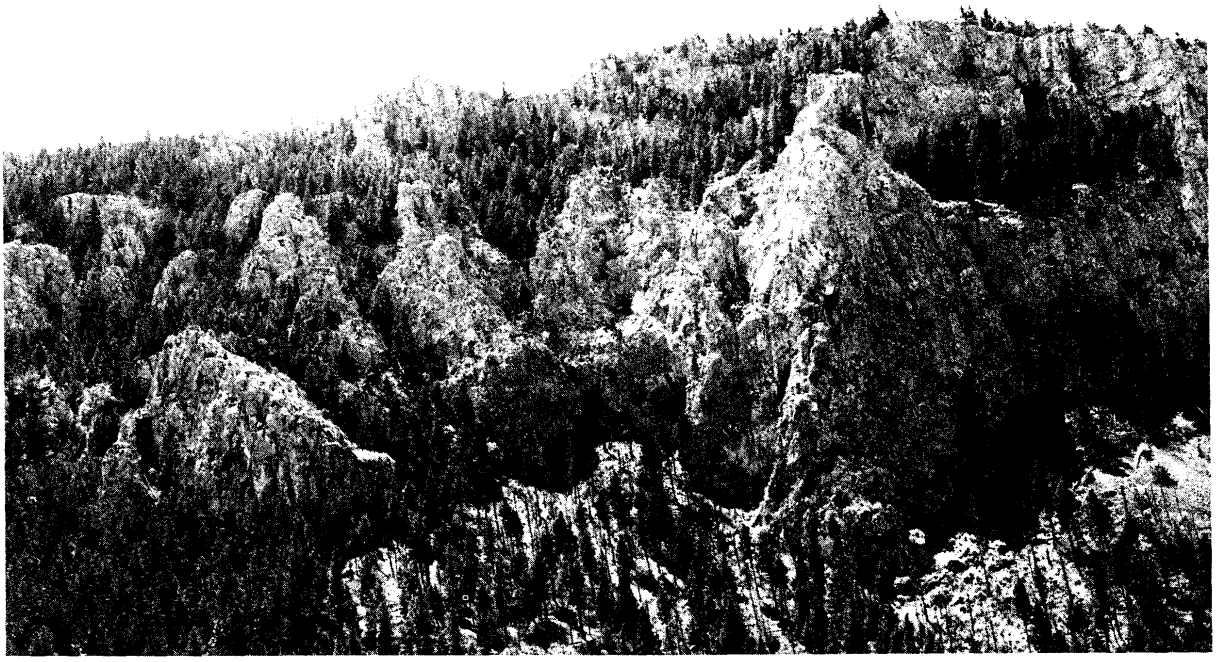


Plate 29b (July 24, 1980) **80 years later**

Douglas-fir regenerated following the late 1800's fire. Understory vegetation, including mountain maple, snowberry, buffaloberry, serviceberry, and currant, has since deteriorated as a result of crown closure. Snags at center and right of photograph resulted from a small wildfire in 1968. This fire caused extensive regeneration of a variety of shrubs and herbs.

Photograph by W. J. Reich.

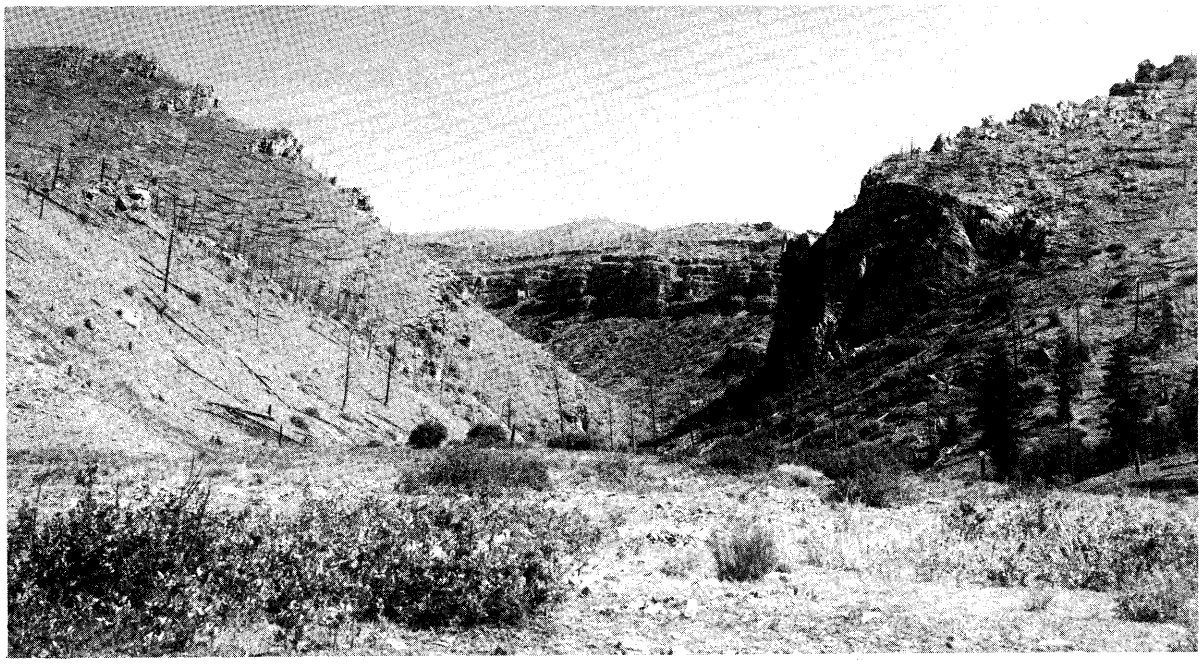


Plate 30a (1900) **Fire Group 4: Warm-dry Douglas-fir.** **Elevation 4,900 ft (1 494 m)**

The camera faces north from the mouth of Soup Creek approximately 4 miles above the Soup Creek crossing at the "old Smith Place," Big Belt Mountains, Helena Ranger District. This area was severely burned, apparently by the large wildfire of 1875. Shrubs and herbs comprised the primary vegetation during this early stage of succession. The dark shrubs in foreground are chokecherry. Heavy utilization by livestock is evident.

USGS photograph 664 by C. D. Walcott.

Plate 30b (July 25, 1980) **80 years later**

Canyon bottom is now well covered by vegetation including ponderosa pine, Douglas-fir, Rocky Mountain juniper, chokecherry, dogwood, willow, skunkbush, mountain maple, ninebark, and mockorange. Herbaceous vegetation in foreground had not been grazed by livestock as of July 25.

Photograph by W. J. Reich.

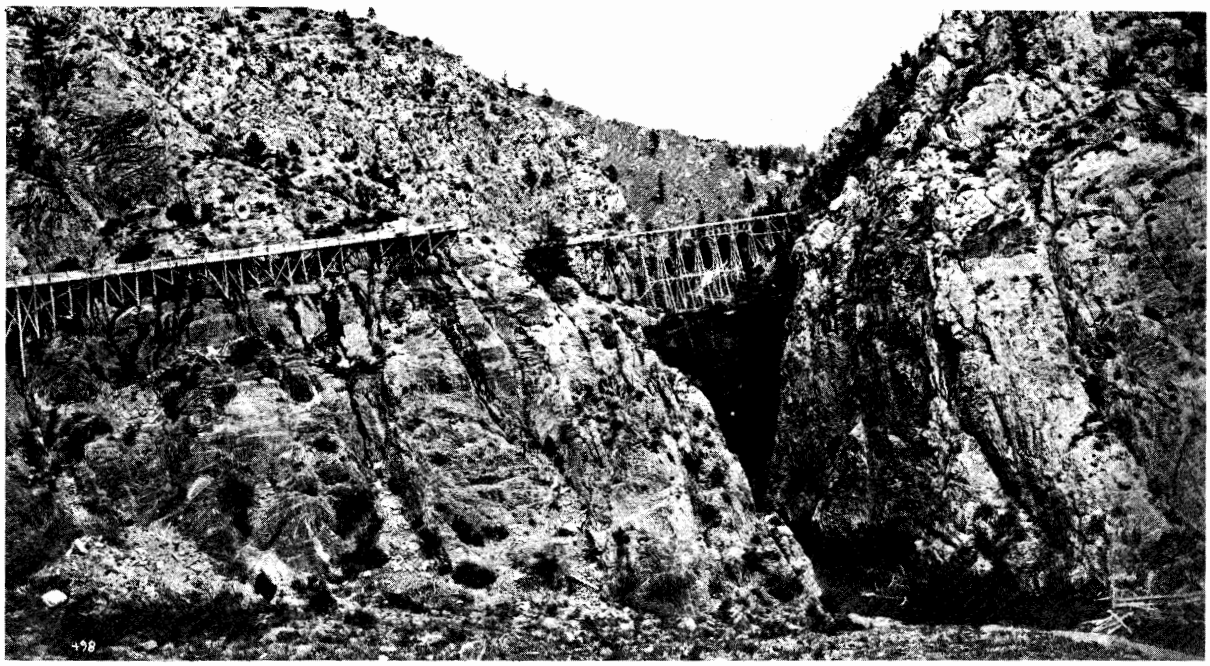


Plate 31a (1872) **Mahogany Fire Group.** **Elevation 3,900 ft (1 889 m)**

Looking northeast at the Trout Creek narrows below York, Mont., on the Helena Ranger District, Helena National Forest. Flume was constructed to provide water for hydraulic mining on gravel bars along the Missouri River. Shrubs and trees on the steep, rocky faces include curlleaf mountain-mahogany, Rocky Mountain juniper, ponderosa pine, and Douglas-fir.

USGS photograph HS-17 by W. H. Jackson courtesy of Montana Historical Society.

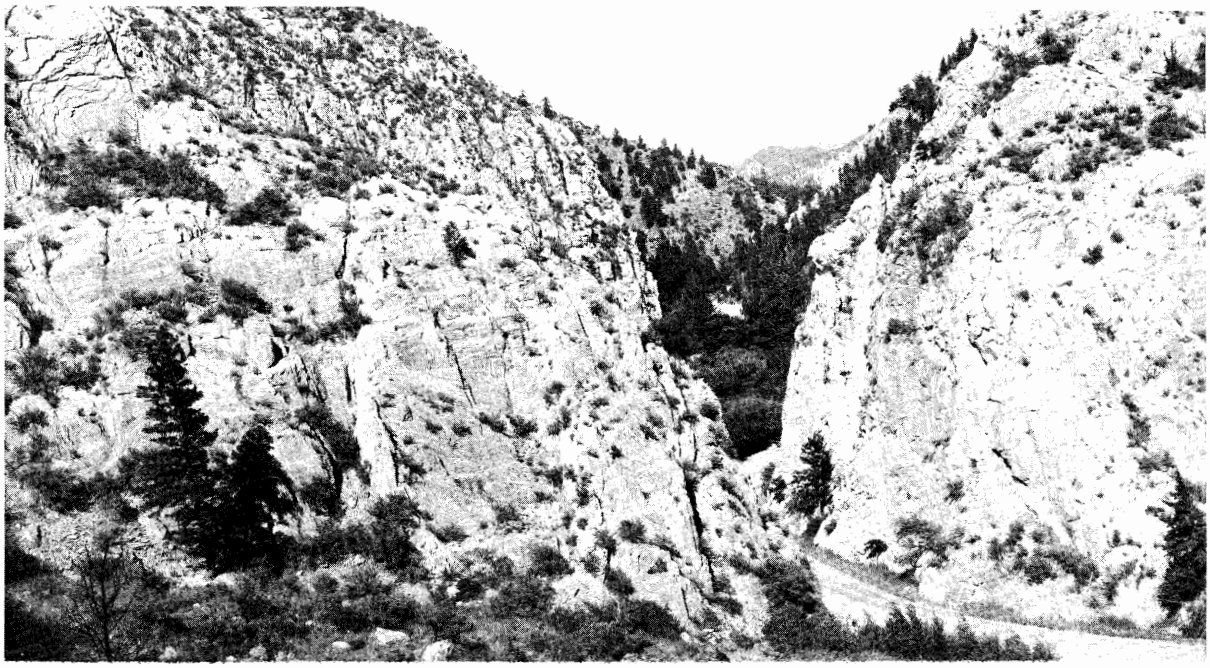


Plate 31b (July 24, 1980) **108 years later**

Flume is gone and a road now occupies most of canyon bottom. Young conifers in rocks at upper left in the 1872 scene were removed by fire or cutting. Curlleaf mountain-mahogany has regenerated on deeper soils and grown considerably. Conifers are beginning to predominate on distant slopes.

Photograph by W. J. Reich.

Plate 32a (ca. 1880) **Fire Group 4: Warm-dry Douglas-fir.** **Elevation 4,000 ft (1 220 m)**

Looking southwest down Magpie Creek 0.2 miles above junction with State Highway 284 east of the Canyon Ferry Reservoir. Conifers in midground are in an early successional stage. Deciduous vegetation includes skunkbush in foreground and cottonwood. Sagebrush occupies openings and the flats below. Tailings at right are evidence of earlier placer mining.

Photograph by C. E. Dalton, courtesy University of Montana Archives and Special Collections.

Plate 32b (July 25, 1980) **100 years later**

Camera was moved to the right approximately 100 feet to higher ground to avoid conifers that completely screen the original view. Today, ponderosa pine predominates. Rocky Mountain juniper and scattered Douglas-fir are also present. Sagebrush, skunkbush, and perennial grasses dominate the foreground.

Photograph by W. J. Reich.

Plate 33a (1872) **Mahogany Fire Group.** **Elevation 4,400 ft (1 341 m)**

A northeast view at the mouth of Hellgate Canyon, Big Belt Mountains, Helena National Forest. Perennial grasses comprise primary ground cover on southerly exposure on left. Scattered young conifers are also evident. Southwesterly exposure appears to be largely occupied by shrubs.

USGS photograph 993 by W. H. Jackson.

Plate 33b (July 30, 1981) **109 years later**

Cover on southerly exposure has increased markedly as a result of Douglas-fir and Rocky Mountain juniper regeneration. Shrub cover including curlleaf mountain-mahogany has increased on southwesterly exposure.

Photograph by R. F. Wall.

Plate 34a (1898) **Fire Group 4: Warm-dry Douglas-fir.** **Elevation 4,500 ft (1 372 m)**

A view due east up Whites Gulch in the Big Belt Mountains from a point on the Helena National Forest boundary. South slope on left has been intensively grazed. Deciduous vegetation including alder, cottonwood, aspen, and willow dominate along stream course. Snags on northwest slope at right attest to an earlier stand-destroying fire. The growth stage of Douglas-fir on this slope suggests this fire occurred several decades earlier.

USGS photograph 531 by C. D. Walcott.

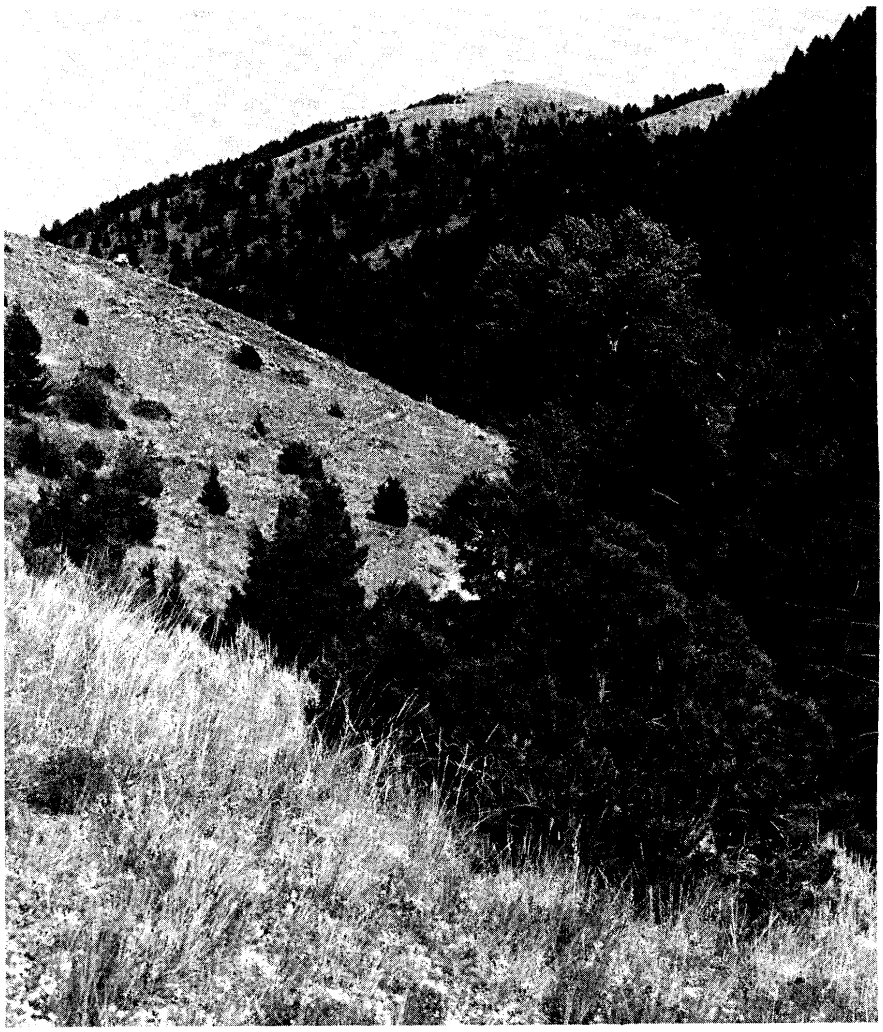


Plate 34b (July 26, 1980) 82 years later

This view is offset approximately 50 feet upslope to avoid vegetation that screens original view. Grass cover in foreground had not been grazed by livestock as of July 26. Canyon bottom now supports dense vegetation, including Douglas-fir. Establishment of Douglas-fir, Rocky Mountain juniper, mountain big sagebrush, and skunkbush has changed the appearance of the south slope. The northwest slope is densely covered by Douglas-fir.

Photograph by W. J. Reich.

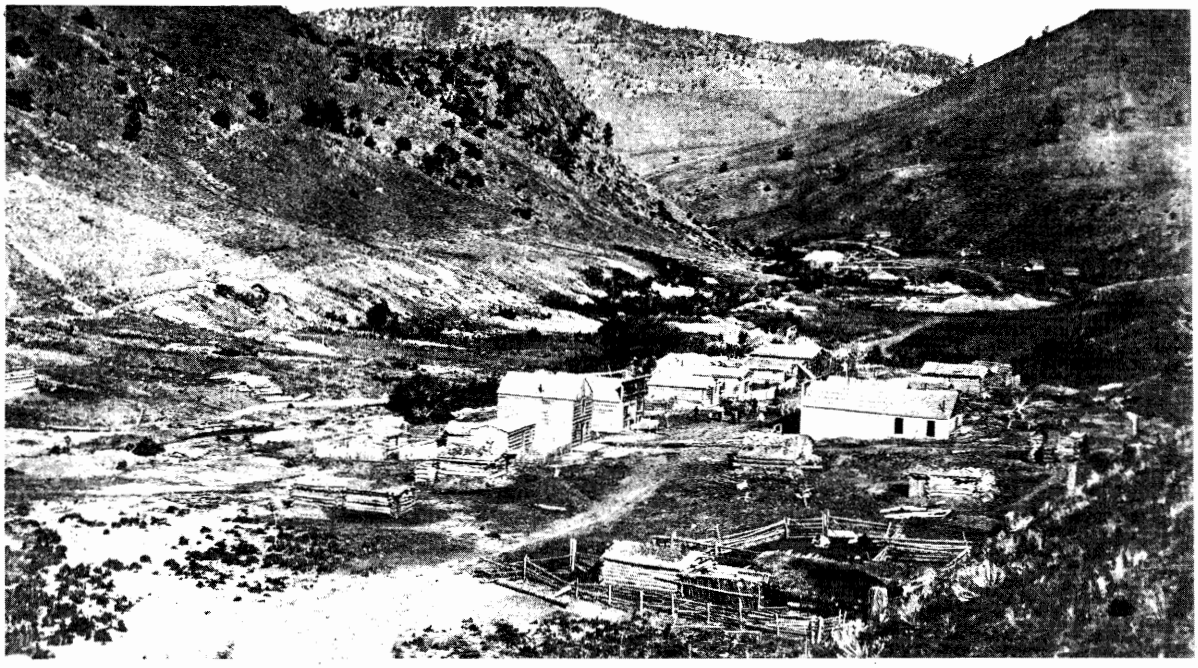


Plate 35a (ca. 1880) **Fire Group 4: Warm-dry Douglas-fir.** **Elevation 5,200 ft (1 585 m)**

Looking east-southeast over Hassel, Mont. This site is on Indian Creek west of Townsend and adjacent to the Helena National Forest. Ground cover appears to be predominantly herbaceous vegetation. Scattered Rocky Mountain juniper along with a few ponderosa pines and limber pines occupy the more rocky terrain on southerly slope at left. A few widely scattered conifers can be seen on the northerly slope at right. Conifers are more abundant on distant slope.

Photograph courtesy Montana Historical Society; photographer unknown.

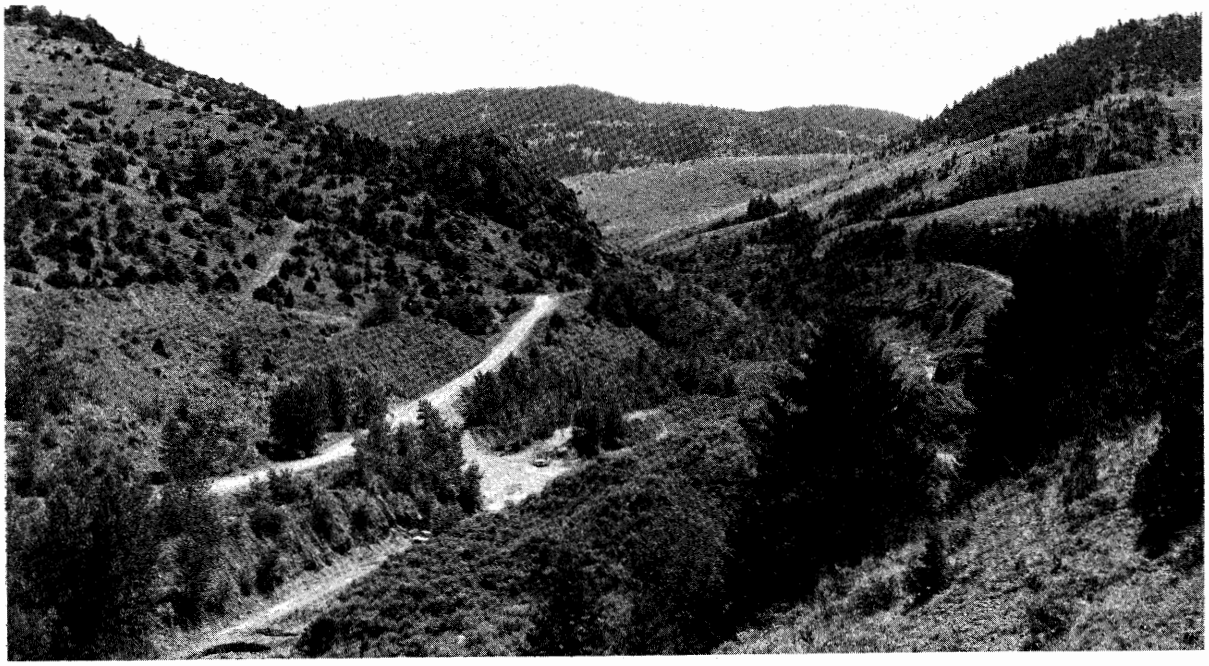


Plate 35b (July 28, 1980) **About 100 years later**

Past mining operations have drastically altered the canyon bottom. Disturbed dry areas are now thickly covered by mountain big sagebrush, while moist sites along stream course support willow, aspen, and cottonwood. Rocky Mountain juniper and Douglas-fir have increased greatly on the formerly open slopes. Photograph by W. J. Reich.

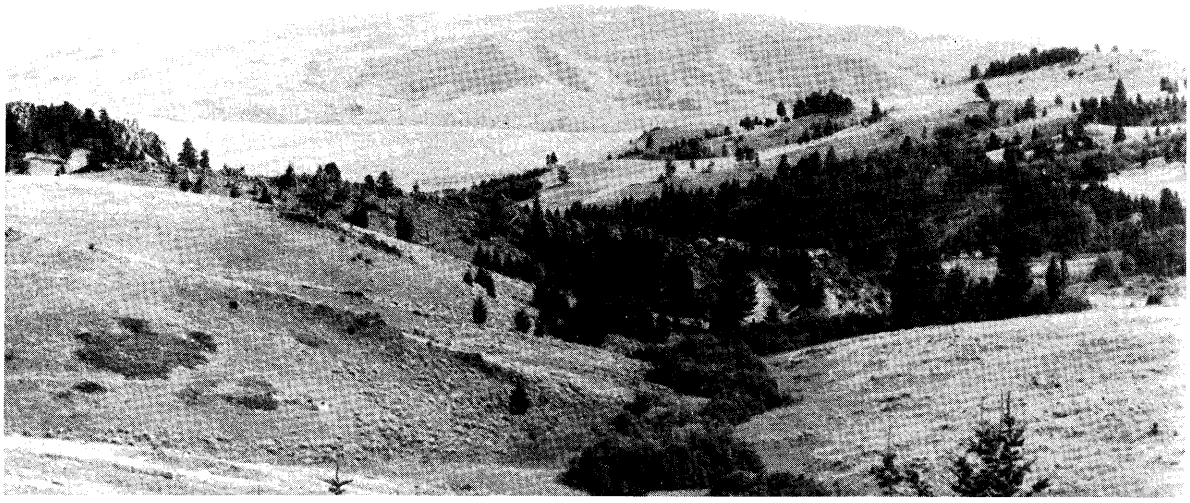


Plate 36a (1927) Fire Group 6: Moist Douglas-fir. Elevation 6,000 ft (1 829 m)

The view is south-southeast from a point 0.5 miles south of Castle, Mont. Conifer cover is primarily Douglas-fir. Scattered sagebrush occupies the deep soils on the lower slopes at left and in foreground at right. Willows predominate along stream bank below.

USFS photograph 220102 by K. D. Swan.

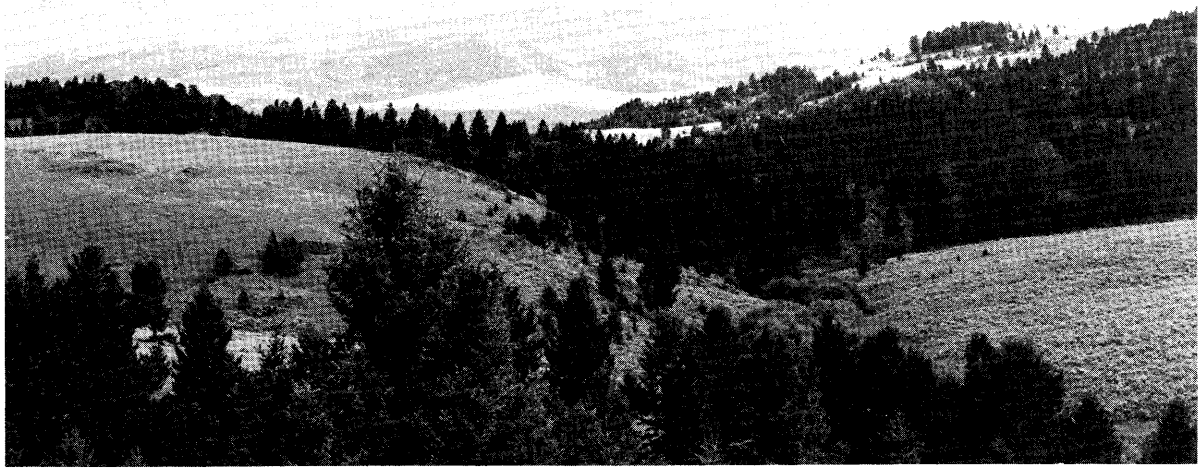


Plate 36b (September 11, 1979) 52 years later

Douglas-fir saplings in foreground required moving camera point approximately 150 feet below original position. Many sites that were formerly open are now occupied by Douglas-fir. The increased tree size and density of stands have resulted in a decline in early successional species including willow and aspen. Note the increase in sagebrush at right foreground.

Photograph by W. J. Reich.

Plate 37a (1924) **Fire Group 5: Cool-dry Douglas-fir.** **Elevation 5,300 ft (1 616 m)**

Looking southwest at slopes above Haystack Springs in Dry Range, Lewis and Clark National Forest. Snags indicate a wildfire that occurred in 1910. The cabin pictured was constructed in 1919 by A. Watson and used during summer months as a base for sheep grazing operations. Aspen in an early growth stage is evident in midground.

USFS photograph, photographer unknown.

Plate 37b (September 24, 1981) **57 years later**

Camera was placed approximately 50 yards upslope and behind the original position to avoid aspen that screen original view (inset). Aspen have regenerated on perimeter of original stand including the inside of the cabin, which has lost its roof. Slopes above cabin are mostly covered by a dense Douglas-fir stand. Where canopies have closed, aspen and willow have died out.

Photograph by G. E. Gruell.

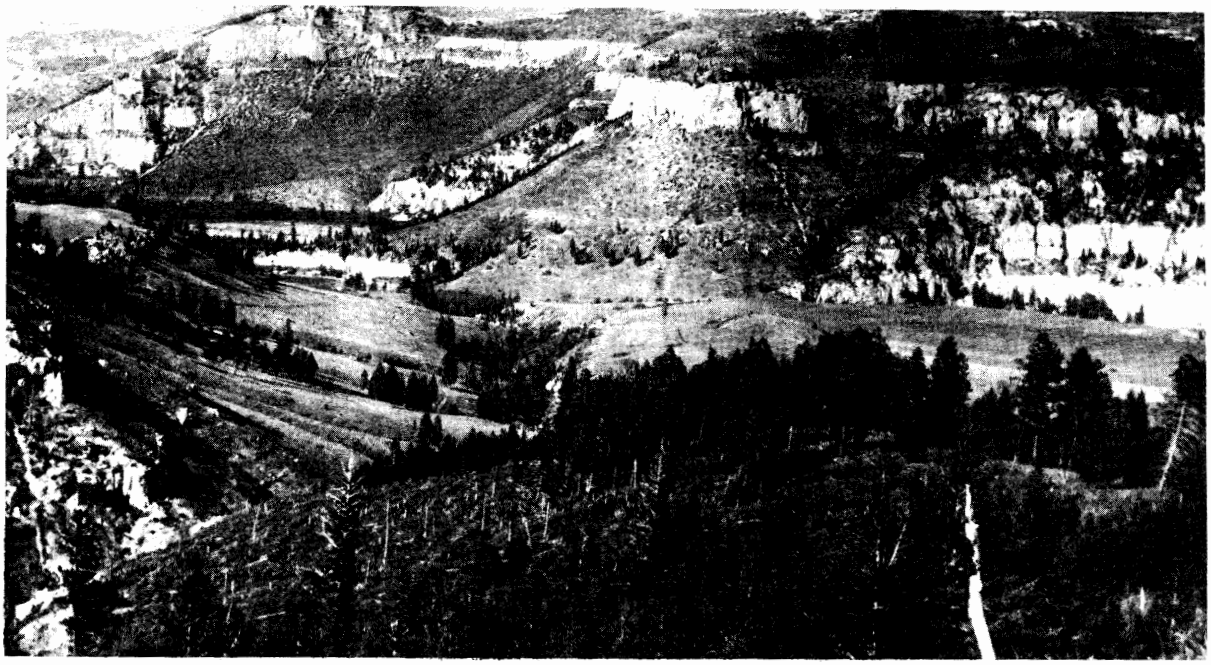


Plate 38a (1909) Fire Group 6: Moist Douglas-fir. Elevation 4,000 ft (1 220 m)

Looking due north across the Smith River from a point approximately 3 miles east from the head of Spring Coulee. Snags on slope below and early growth stage of understory plants indicate that this locality was swept by wildfire several decades earlier. This fire promoted development of a dense shrub cover. Fire's influence on distant southwest slopes is indicated by confinement of conifers to rock outcrops and moist draws.

USGS photograph 137 by V. H. Barnett.

Plate 38b 72 years later

Regeneration and growth of Douglas-fir (inset) made it necessary to move camera approximately 75 yards northeast to the only natural opening. Open slope in 1909 scene that resulted from fire is now densely covered by Douglas-fir. In distance, conifers show a marked increase in density.

Photograph by G. E. Gruell.

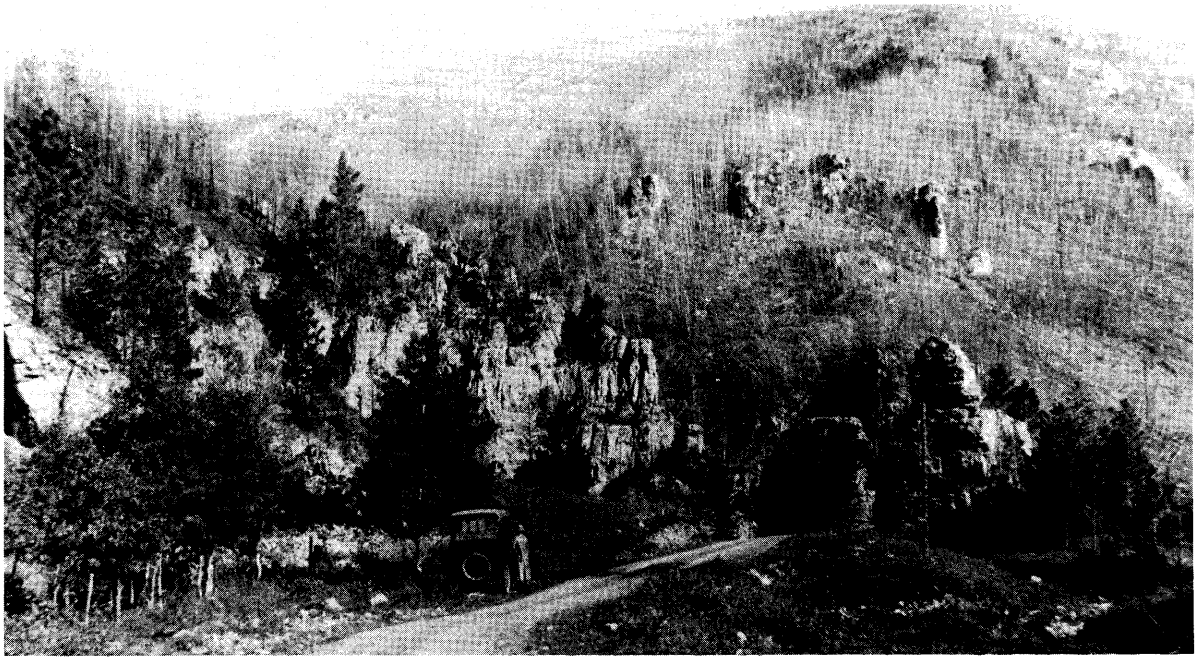


Plate 39a (August 1922) **Fire Group 6: Moist Douglas-fir.** **Elevation 4,800 ft (1 463 m)**

A southeast view into Monarch Canyon from a point approximately 2 miles north of Monarch, Mont., on the Belt Ranger District, Little Belt Mountains. Far slopes and ridge above cliffs at left were swept by wildfire in 1919.

USFS photograph by R. F. Rush.

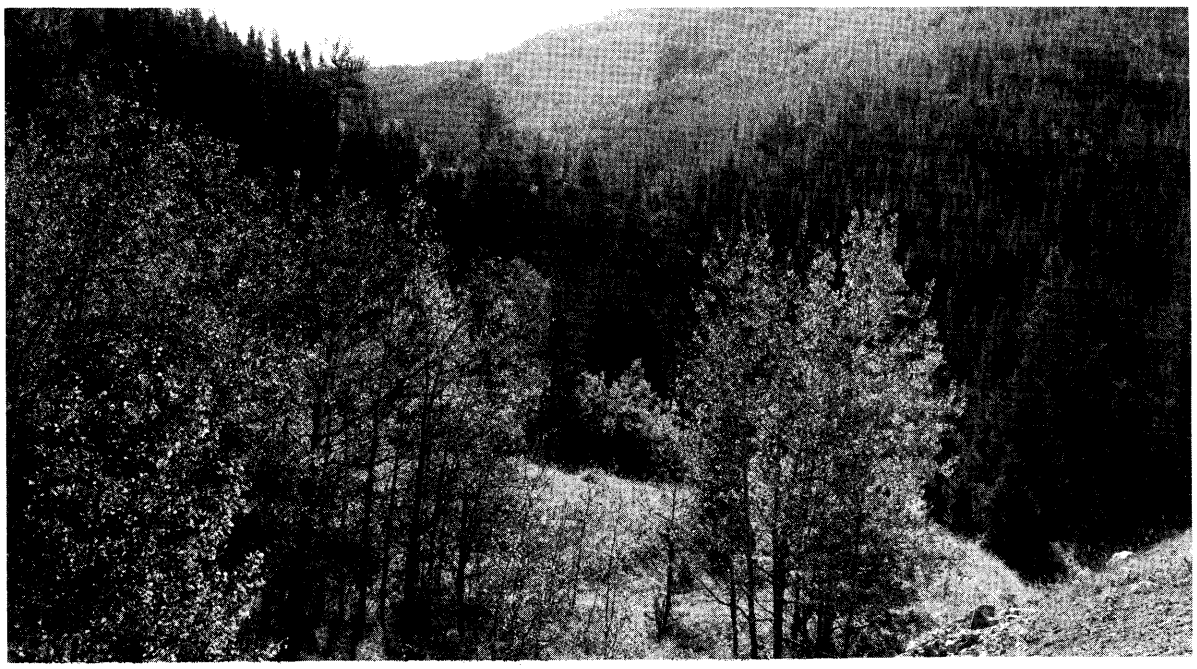


Plate 39b (September 13, 1979) **57 years later**

Construction of county road has altered foreground. Aspen at lower-left in early view has matured. Far slopes and ridge at left are now covered by a dense stand of lodgepole pine. Douglas-fir are also regenerating in this locality.

Photograph by W. J. Reich.

Plate 40a (ca. 1930) **Fire Group 6: Moist Douglas-fir.** **Elevation 5,100 ft (1 555 m)**

Looking west-southwest toward the Belt Creek Ranger Station, Lewis and Clark National Forest. Open slopes behind station support shrubs, herbs, and young conifers that regenerated following a wildfire in 1919. Note snags that resulted from this fire.

USFS photograph; photographer unknown.

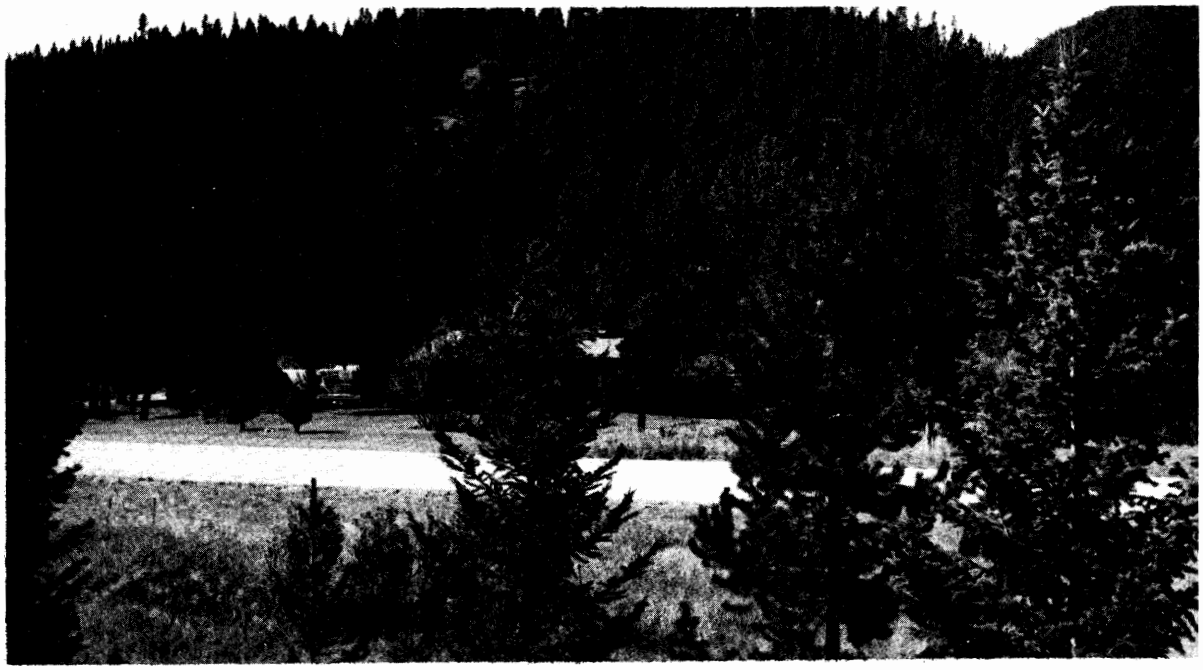


Plate 40b (September 13, 1979) **About 49 years later**

Camera is positioned lower on slope to allow a less-obstructed view. Conifers on slope behind Ranger Station are predominantly Douglas-fir. Lodgepole pine are also present. Conifer growth has shaded out much of the shrub and herb understory that regenerated following the 1919 fire.

Photograph by W. J. Reich.

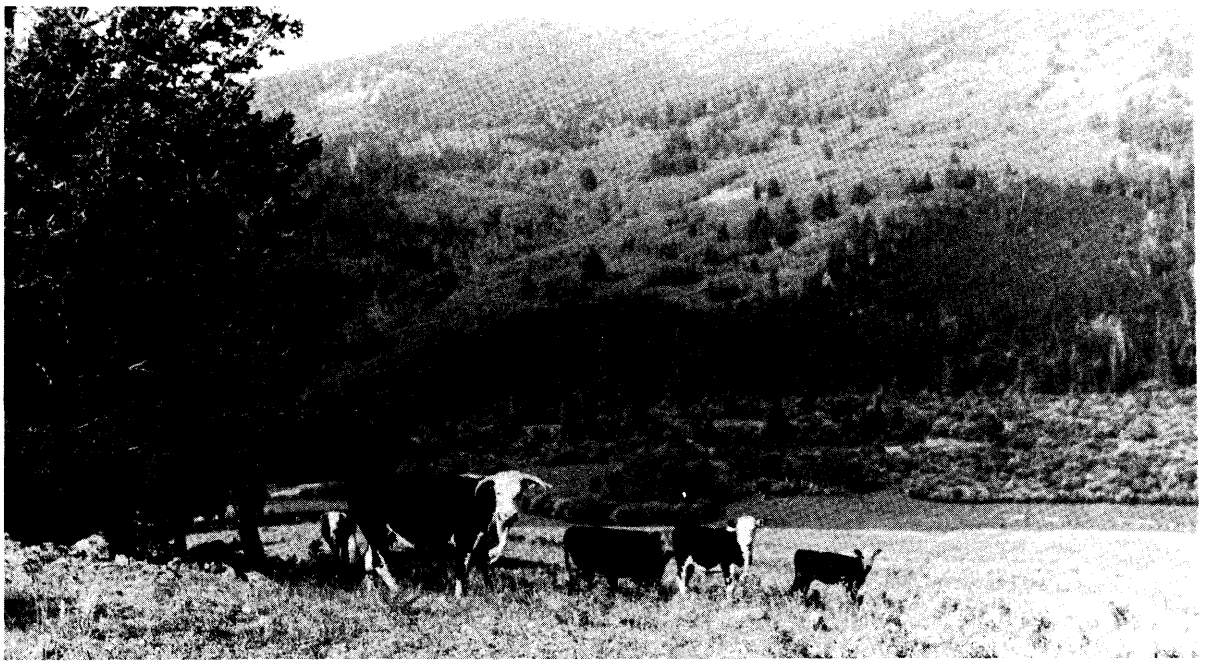


Plate 41a (September 1927) **Fire Group 6: Moist Douglas-fir.** **Elevation 5,400 ft (1 646 m)**

Looking south across Sheep Creek in the vicinity of the Calf Creek Guard Station, White Sulphur Springs Ranger District. Far slopes are in an early stage of succession with young aspen and Douglas-fir predominating. The young age class of conifers suggests recovery following wildfire in the latter 1800's.

USFS photograph 220660 by K. D. Swan.

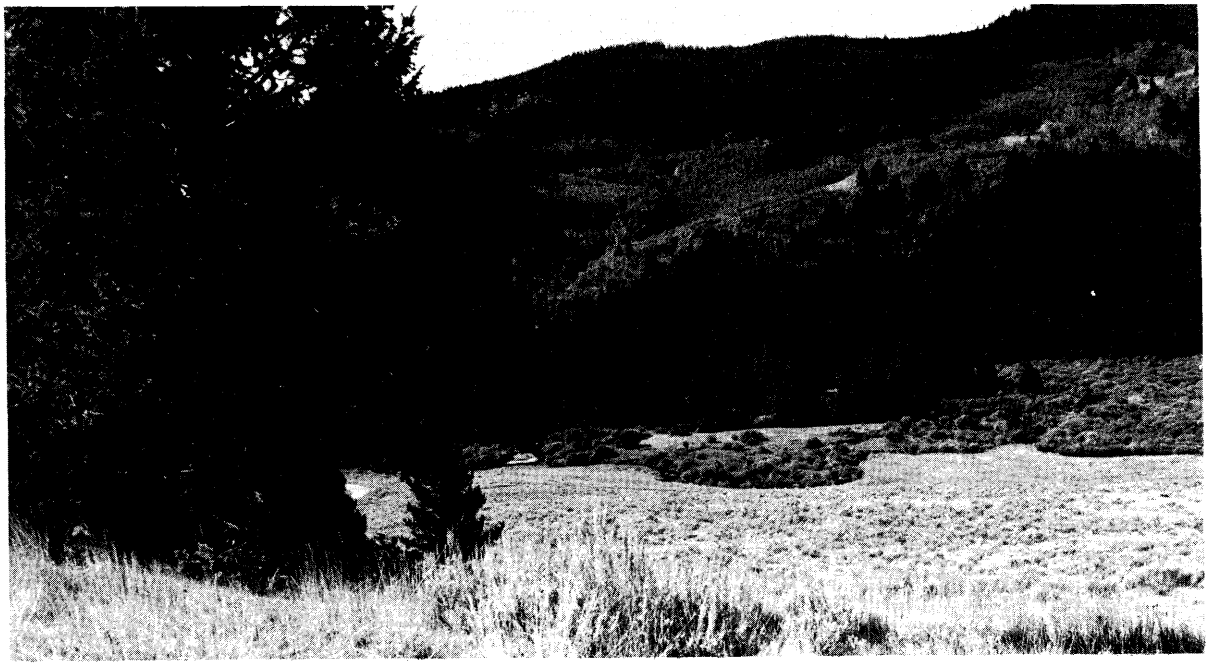


Plate 41b (September 12, 1979) **70 years later**

Mountain big sagebrush has become established in foreground, while cottonwood trees that formerly occupied streambank at lower center are gone. Increased density and growth of Douglas-fir along stream bottom and on far slopes have resulted in decline of willow and aspen on sites where these species competed for space.

Photograph by W. J. Reich.

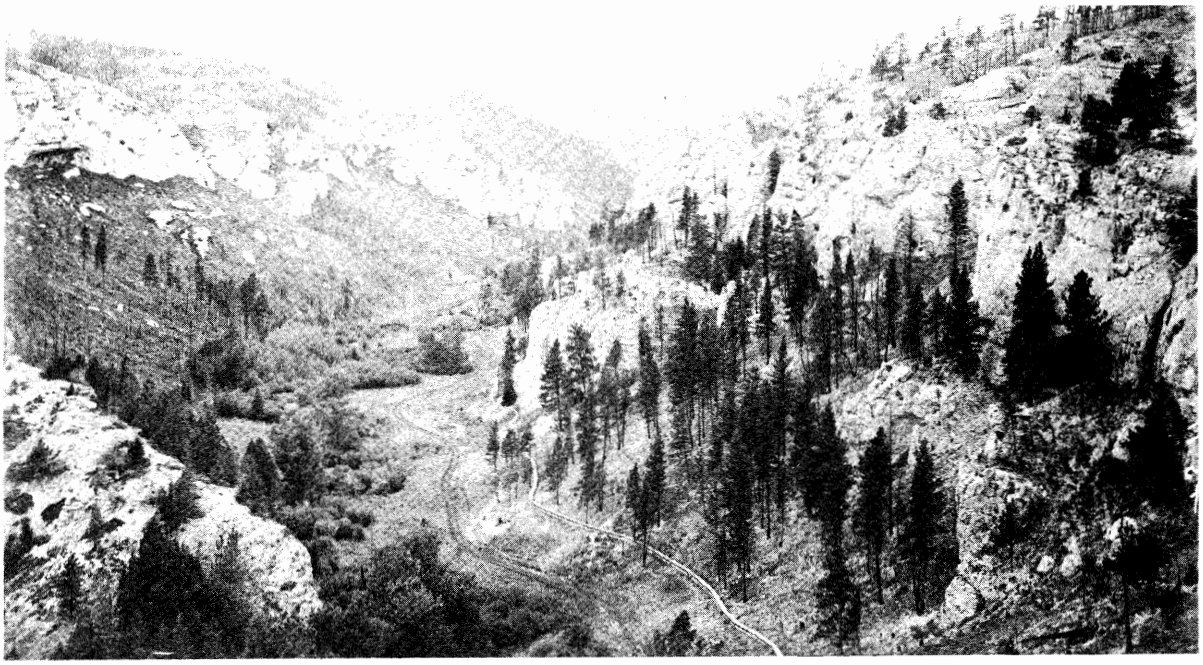


Plate 42a (1910) **Fire Group 6: Moist Douglas-fir.** **Elevation 5,600 ft (1 707 m)**

The camera faces northwest up Yogo Creek at a point on rock outcrop directly above the American Sapphire Mine, Little Belt Mountains, Lewis and Clark National Forest. Stumps along bottom and snags on both sides of canyon are evidence of localized cutting and an extensive wildfire. Willow, cottonwood, and aspen occupy sites along stream course. Conifers on right are primarily ponderosa pine. Note flume at right of road.

USGS photograph 11 by D. B. Sterret.

Plate 42b (August 20, 1980) **70 years later**

Douglas-fir predominates on old burn at left. Ponderosa pine stand on the drier southwest slope on right shows less change. Alteration of canyon bottom by road construction and increased competition from conifers has resulted in decline of willow and aspen.

Photograph by W. J. Reich.

Plate 43a (1888) **Fire Group 4: Warm-dry Douglas-fir.** **Elevation 4,300 ft (1 311 m)**

A north-northwest view of troopers in vicinity of Fort Maginnis. This fort was located on the east side of the Judith Mountains (distance) about 20 miles northeast of Lewistown, Mont. Ground cover on ridge and lower slopes in distance is apparently dominated by perennial grasses. Conifer distribution on far slopes is largely confined to localized sites. Pattern of regenerating conifers suggests that wildfire had burned the stand several decades earlier.

Photograph by W. H. Culver; courtesy of Montana Historical Society.

Plate 43b (July 18, 1980) **92 years later**

Taken later in the season, the foreground vegetation shows effects of current livestock grazing. Shrubs including chokecherry, currant, rose, shrubby cinquefoil, and common juniper are more conspicuous in rocks, as are conifers and shrubs at left midground (arrow). Stream course in distance at center left of photo, which formerly was treeless, now supports large cottonwoods, Douglas-fir, and ponderosa pine. Absence of fire has allowed profuse regeneration of Douglas-fir and ponderosa pine on far slopes.

Photograph by W. J. Reich.

Plate 44a (1909) **Fire Group 6: Moist Douglas-fir.** **Elevation 6,100 ft (1 860 m)**

Looking north-northwest up Blake Creek at a point 1 mile above forest boundary on south side of Big Snowy Mountains, Lewis and Clark National Forest. Scene shows effects of wildfire in the late 1800's that burned both sides of drainage. Scattered ponderosa pine and Douglas-fir occupy near slope and canyon bottom. Herbs and shrubs comprise early successional vegetation in burned areas. On right, fire created a mosaic of burned and unburned timber. Note rock outcrop in burned stand.

USGS photograph 114 by W. R. Calvert.

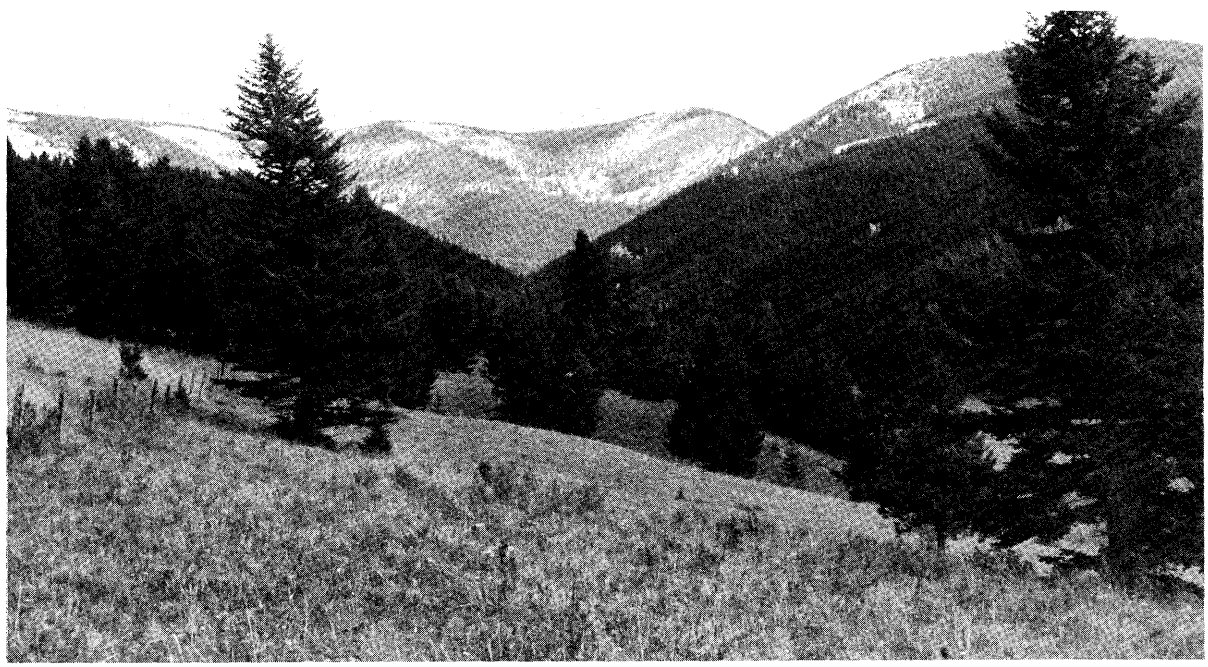


Plate 44b (August 20, 1980) **71 years later**

Camera was moved left of original point to avoid trees that screened early view. Regeneration of Douglas-fir has resulted in a landscape dominated by conifers. The rock outcrop visible in 1909 is now almost totally obscured by tree growth. Conifer competition has largely eliminated early successional understory species.

Photograph by W. J. Reich.

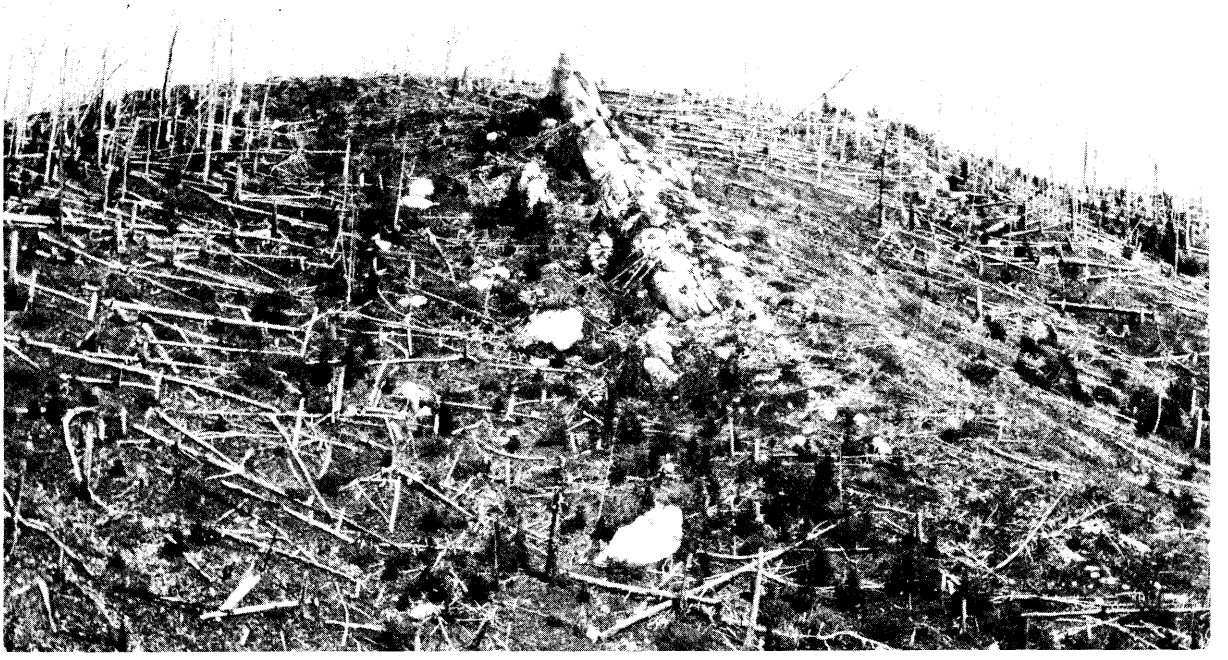


Plate 45a (1909) **Fire Group 6: Moist Douglas-fir.** **Elevation 6,100 ft (1 860 m)**

Close-up view of rock outcrop shown in previous plate. The presence of Douglas-fir regeneration and the condition of snags suggest this burn occurred in the 1880's.

USGS photograph 113 by W. R. Calvert.

Plate 45b (August 20, 1980) **71 years later**

This view was offset approximately 100 yards south of original point to avoid Douglas-fir which screened original view. The dense Douglas-fir stand now almost totally obstructs view of rock outcrop.

Photograph by W. J. Reich.

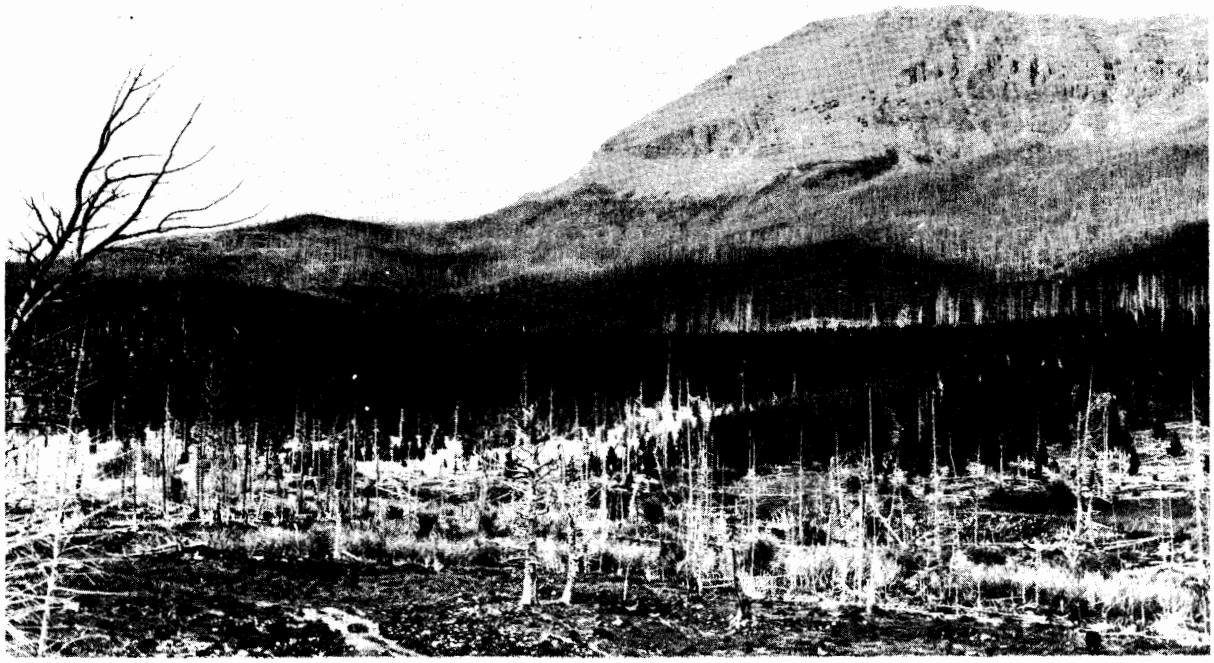


Plate 46a (ca. 1909) **Fire Group 6: Moist Douglas-fir.** **Elevation 4,700 ft (1 433 m)**

Looking northeast across Swimming Woman Creek toward Half Moon Pass (center left) in Big Snowy Mountains, Lewis and Clark National Forest. Standing snags along stream course and in distance indicate a large wildfire in the latter 1800's. Vegetation along creek bottom has been heavily grazed by livestock.

USGS photograph 117B by W. R. Calvert.

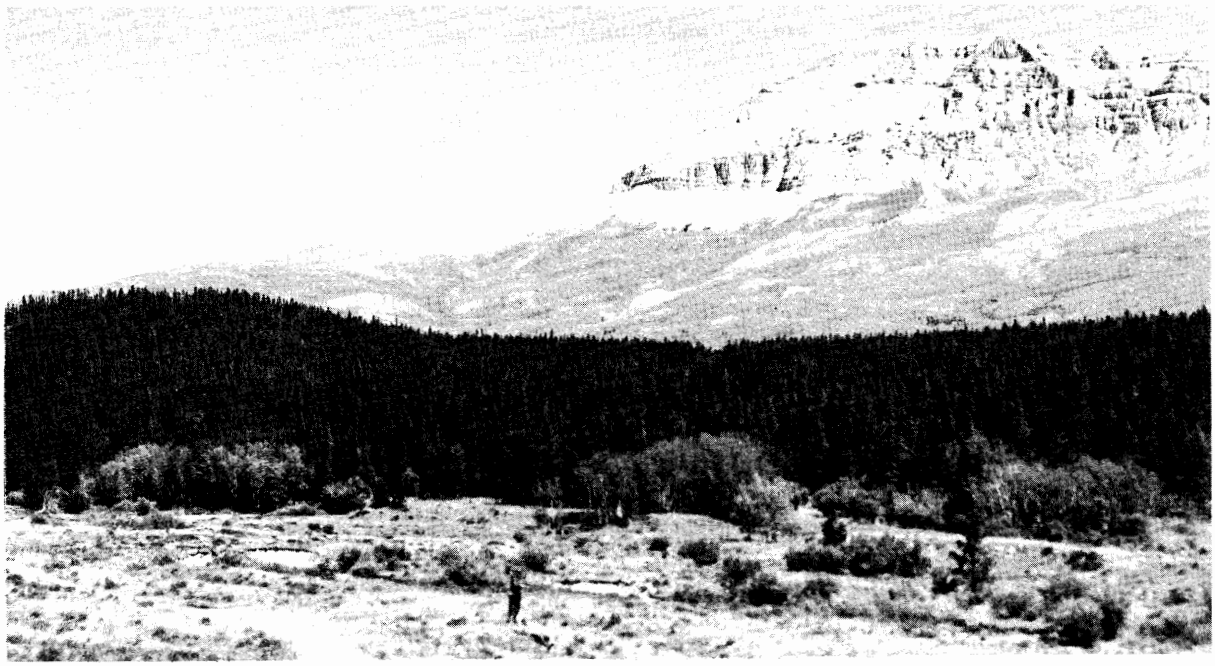


Plate 46b (September 12, 1981) **About 72 years later**

Few conifers have regenerated along drainage bottom which has received heavy livestock grazing. Willow is less dense than formerly, while aspen in midground have matured. Subsequent wildfires in 1921 and 1955 have kept distant slopes mostly free of conifers.

Photograph by R. F. Wall.

South-Central Region

The South-Central Region is represented by plates 47–81 (fig. 4). This region includes the Deerlodge National Forest at the headwaters of the Clark Fork River as well as the Beaverhead and Gallatin Forests and the west side of the Custer National Forest. Adjacent lands in Idaho immediately south and east of the Centennial Mountains are also included. The continental climate in this region is cold and dry, and valleys have high base elevations (Arno 1979). Summer temperatures can be quite warm, while winter temperatures of -40° F are not unusual in some of the higher valleys.

Only about 25 percent of the area in the western portion of the region is forested. Some mountain ranges south of Dillon are so dry that little forest is supported even at 8,000 ft (2 439 m). Nearly half of the land in the moister eastern portion of the region is forested.

Because of cooler drier conditions, forests in the western portion have lower growth potential. Understories are more grassy and contain fewer deciduous shrubs than their counterparts to the east. Growing seasons are apparently too short and cold for ponderosa pine except for very localized occurrences. Most forested areas are dominated by Douglas-fir or lodgepole pine. Subalpine fir is abundant at high elevations, and Engelmann spruce is locally abundant on moist sites. Limber pine and Rocky Mountain juniper are confined to localized dry sites.

Nonforest land in the western part of the region is semiarid steppe (*Artemisia*) and grassland (*Agropyron, Festuca,* and *Stipa*). To the east, *Artemisia* is not as widely distributed. Aspen is found in localized stands throughout the region. Best development is in the Gravelly, Madison, and Gallatin Ranges.

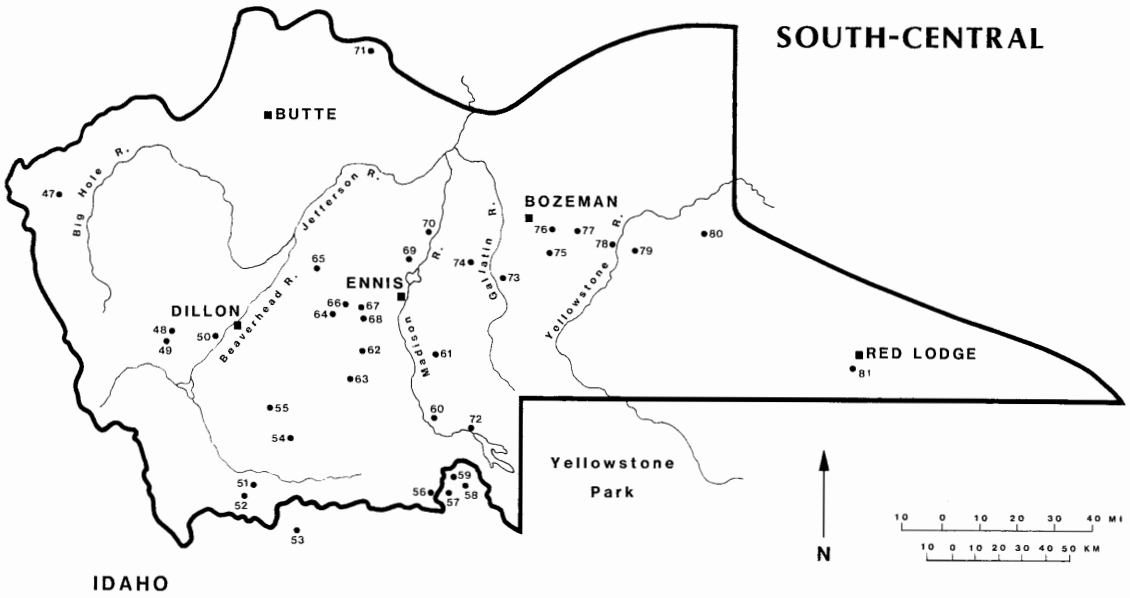
Prior to European settlement, conditions for wildfires were favorable because of dry summer periods and the interspersion of forests within grasslands. Lightning was a major ignition source, and Indians apparently set fires routinely for various purposes (Gruell 1983).

Observations in 1805 and 1806 by Lewis and Clark (Thwaites 1959) suggest that large wildfires set by Indians for purposes of communicating were a common phenomenon on the upper Missouri drainages. In August 1805, Lewis and Clark observed two fires between the Three Forks of the Missouri and Horse Prairie. Concern about Indian-set wildfires was expressed when the party was selecting a safe location to cache their dugout canoes. The canoes were submerged at the headwaters of the Beaverhead River to protect them from fire and Indians. Mullan (1855b) reported Indian burning along the Wisdom (Big Hole) River in the vicinity of present day Melrose, Mont., and near Divide, Mont.

Indians set fires to flush enemies, as experienced by Osborne Russell during an 1835 battle in the upper Madison drainage (Haines 1965). In 1863, DeLacy (1902) observed recent burns in the Lower Gallatin Canyon and Gallatin Valley that he attributed to Indians. Hayden (1872) described the early landscape in the upper Gallatin as having been subjected to frequent fires.

Fire scar analysis at 12 widely separated sites (5,300 to 7,600 ft) (1 616 to 2 317 m) in limber pine, cool-dry Douglas-fir, and moist Douglas-fir h.t.'s suggest a mean fire interval of 35 to 40 years (Arno and Gruell 1983). Considering that these data were from forested sites, it is probable that fire frequencies in grasslands were even shorter.

Photographic evidence, historical narratives, and fire history studies (Arno and Gruell 1983) suggest that presettlement fires favored the growth of perennial bunchgrasses and suppressed sagebrush on sites having good potential for growth of grasses (plates 47, 50, 58, and 67). Short fire intervals no doubt tended to keep some localities in grassland. Longer intervals apparently allowed sagebrush to reinvade sites (plate 72). Most sites are now occupied by sagebrush in varying densities. The increase in sagebrush density was apparently promoted by decades of livestock grazing and absence of fire (plate 63).



Drier rocky sites dominated by junipers (Juniper Fire Group) supported fewer trees in earlier years (plates 55, 66, and 80). Tree age and fire evidence suggest that early fires burned irregularly because of discontinuous fuels. Old junipers are usually confined to rock outcrops, ridges, and dry, rocky south slopes where fuels were sparse. Young junipers have become established on more productive sites that formerly were swept by recurrent wildfire. There is little evidence of junipers having formerly occupied these sites.

Dry limber pine h.t.'s (Fire Group 1) were sparsely covered by trees in the early 1900's. As in the North-Central Region, the absence of fire for many years has allowed limber pine to increase (plates 69 and 81).

Fire-sensitive curlleaf mountain-mahogany (Mahogany Fire Group) have been favored by the absence of fire. Photographic evidence and age structure of stands suggests that the absence of fire allowed plants to radiate from protected sites and become established on deeper soils that had been frequently swept by fire (plate 49). Although mahogany spread to additional sites, some stands have deteriorated during the past several decades because of insect damage and intensive use by ungulates. Mahogany has also deteriorated as a result of suppression from conifers.

Fire's influence on Douglas-fir appears to have varied by fire group. Stands were very open and patchy in the cool-dry h.t. (Fire Group 5) (plates 59, 63, 65, 68, and 78). These stands were predisposed to frequent ground fires because of grassy fuels. Fire stimulated production of grasses and suppressed full development of shrubs. Surviving trees were restricted to localized moist sites, rock outcrops, talus slopes, and stony ridges where fuels were sparse. Where site conditions were better, frequent fire favored development of seral aspen and often the virtual exclusion of Douglas-fir. In the absence of fire during the past 50 to 100 years, Douglas-fir regenerated successfully and stands thickened (plates 75 and 79). The long absence of fire initially resulted in optimum development of various big game browse plants, but these plants have since deteriorated or died out as a result of forest canopy closure.

The presence of few stumps or old-growth trees indicates that grassy sites lacked trees entirely or formerly supported a scattered tree cover. Encroachment of Douglas-fir into grasslands appears to have occurred at irregular intervals when there was a coincidence of a heavy seed crop and high moisture (Sindelar 1971). These sites are underlain by dark grassland soils with mollic horizons that could have developed either (1) under grassland or (2) perhaps under Douglas-fir having an understory of pinegrass and other base-rich grasses and shrubs (Tomar and Nimlos 1982). The photographic evidence and field inspection suggest that the first alternative is most likely.

On sites where sagebrush was a minor component in the presettlement grassland, conifer encroachment was no doubt preceded by invasion of sagebrush. Sagebrush proliferated in the absence of fire and provided sheltered microsites for Douglas-fir seedlings (Sindelar 1971). During the course of many decades, Douglas-fir growth and subsequent canopy closure has resulted in mortality of sagebrush. This die-off can be seen in varying states of decomposition beneath the tree layer (plate 63).

Moist Douglas-fir h.t.'s (Fire Group 6) show marked changes in appearance over the past 50 to 100 years. These types were historically subjected to fires of various intensities. Fire produced a mosaic of treatments on the landscape that is readily apparent in early photographs (plates 72-74 and 77). This disturbance was particularly responsible for rejuvenating aspen and other deciduous vegetation. As a consequence, stands in earlier years supported more aspen (plates 60-63 and 72-74). In the absence of fire, aspen has deteriorated.

Plate 47a (1916) **Fire Group 5: Cool-dry Douglas-fir.** **Elevation 6,600 ft (2 012 m)**

A view north-northwest across the north fork of the Big Hole River toward Battle Mountain. Scene is on the Big Hole Battlefield National Monument. The shrubs behind T. C. Sherril are willow, while the vegetation on the open slope is an association of mountain big sagebrush, perennial grasses, and forbs. Douglas-fir borders the opening at upper right. The two large Douglas-fir trees in the opening were used as cover by a Nez Perce sharpshooter who fired on troopers.

Photograph by Will Cave. Courtesy of University of Montana Archives and Special Collections.

Plate 47b (June 25, 1980) **64 years later**

Willows appear to be more dense and Douglas-fir are invading what was formerly an open slope. The sparse appearance in upper branches of the sniper trees is the result of dieback. Mountain big sagebrush has increased in density. Fire scar evidence in this locality (Pierce 1982; Arno and Gruell 1983) suggests that prior to 1900, wildfire swept these slopes on the average of about every 35 years.

Photograph by G. E. Gruell.

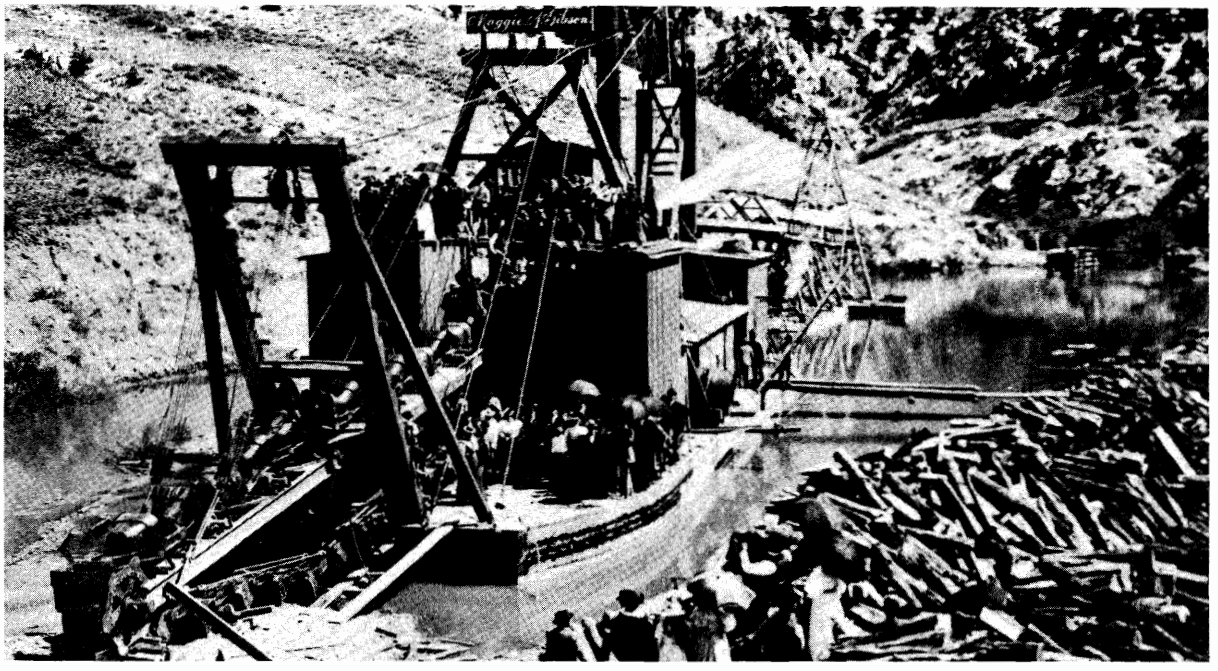


Plate 48a (ca. 1890-1900) **Fire Group 5: Cool-dry Douglas-fir.** **Elevation 5,800 ft (1 768 m)**

Looking south-southeast across Grasshopper Creek from west bank about 1 mile below Bannack, Mont. Occasion is dedication of Maggie A. Gibson dredge. Wood supply for powering dredge suggests that logging was intense in this locality. Limber pine occupy upper slope at left. Distant slopes at right center support an association of Douglas-fir, limber pine, Rocky Mountain juniper, and curlleaf mountain-mahogany. These slopes show evidence of a wildfire in the late 1800's.

Photograph courtesy Montana Historical Society, photographer unknown.

Plate 48b (July 9, 1981) **About 80 to 90 years later**

Stream course is now covered by willow and other shrubs. Sagebrush has revegetated dredge tailings. Conifer cover on distant slopes has increased.

Photograph by G. E. Gruell.

Plate 49a (1880) **Mahogany Fire Group.** **Elevation 5,800 ft (1 768 m)**

Northeast view of Bannack City, Mont. The open slopes above town support sagebrush/grass. Dark shrubs on near ridge are curlleaf mountain-mahogany. Patchy distribution of conifer shows effects of logging and fire.

Montana Department of Fish, Wildlife, and Parks photograph, courtesy of Roy Herseth.

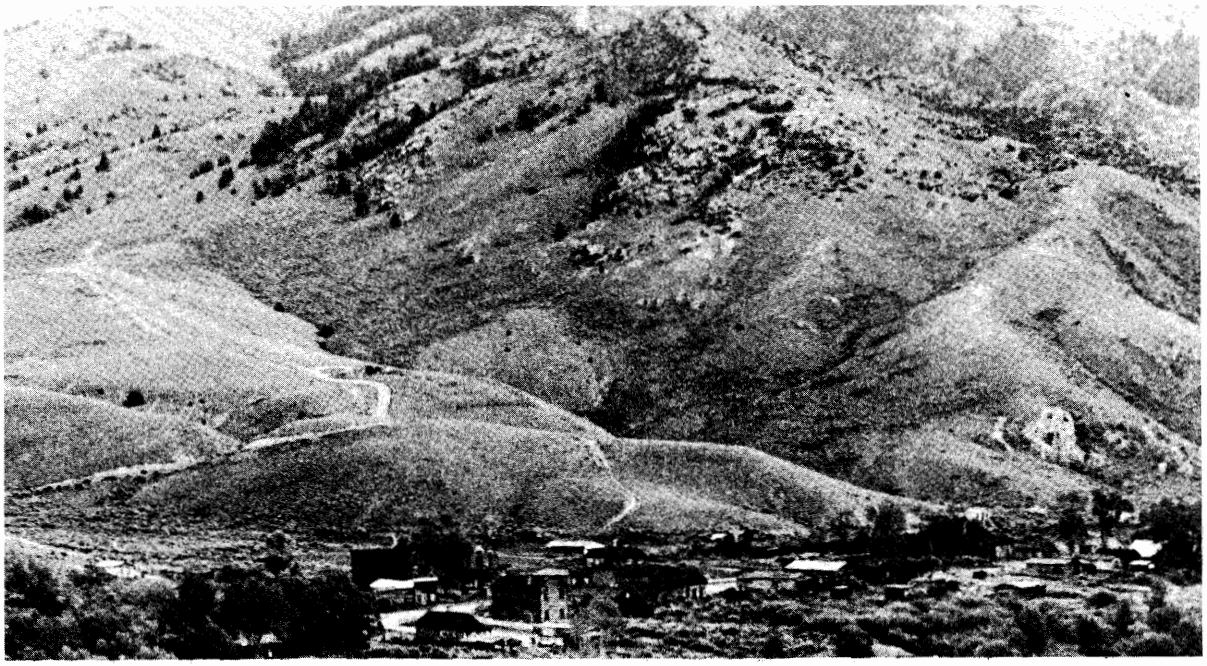


Plate 49b (May 1981) **101 years later**

Mature cottonwood, willow, and other riparian vegetation now dominate Grasshopper Creek bottomland, while Bannack is a remnant of its former self. Mahogany stands have increased in density on deep soils, as have conifers.

Montana Department of Fish, Wildlife, and Parks photograph by Roy Herseth

Plate 50a (1871) Sagebrush/Grass Fire Group. Elevation 5,300 ft (1 616 m)

The camera faces northeast toward Rattlesnake Cliffs and site now occupied by Interstate 15 rest stop about 10 miles southwest from Dillon, Mont. Scene shows a grassland dominated landscape that appears to be closely grazed. Sagebrush can be seen on lower rocky slopes in distance on left, and inside fenced pasture. Cottonwood predominate in bottomlands along the Beaverhead River.

W. H. Jackson photograph, courtesy of Yellowstone National Park.

Plate 50b (August 8, 1981) 110 years later

Livestock grazing and absence of wildfire in this locality has allowed sagebrush to invade foreground and flats outside of fenced fields. Sagebrush cover on lower slopes at left appears to have increased markedly. Valley bottom (background, right) has been altered by construction of highway and rest stop. Foreground and midground were not effected by this work. Cottonwood in distance have grown and expanded their coverage.

Photograph by G. E. Gruell.

Plate 51a (1871) **Fire Group 6: Moist Douglas-fir.** **Elevation 6,600 ft (2 012 m)**

The camera faces south-southwest from a position near the Snowline Ranch 7.3 miles east of Lima, Mont., on Interstate 15. Lima Peaks are at right. Herbaceous vegetation dominates the foreground, while a stringer of willows lines stream course in midground. Scattered sagebrush plants are evident on flats beyond willows. Tree cover on distant slopes is an association of Douglas-fir and aspen in early succession. Fire scar samples from Douglas-fir stand (arrow) indicate four wildfires from 1726 to 1890 (Arno and Gruell 1983).

USGS photograph 57 by W. H. Jackson.

Plate 51b (June 2, 1981) **Railroad right-of-way and Snowline Ranch now occupy valley bottom. Fire's absence since 1890 has allowed Douglas-fir to develop and displace seral aspen. Aspen communities on lower slopes at right and at right center of photo (open arrow) have matured.**

Photograph by G. E. Gruell.

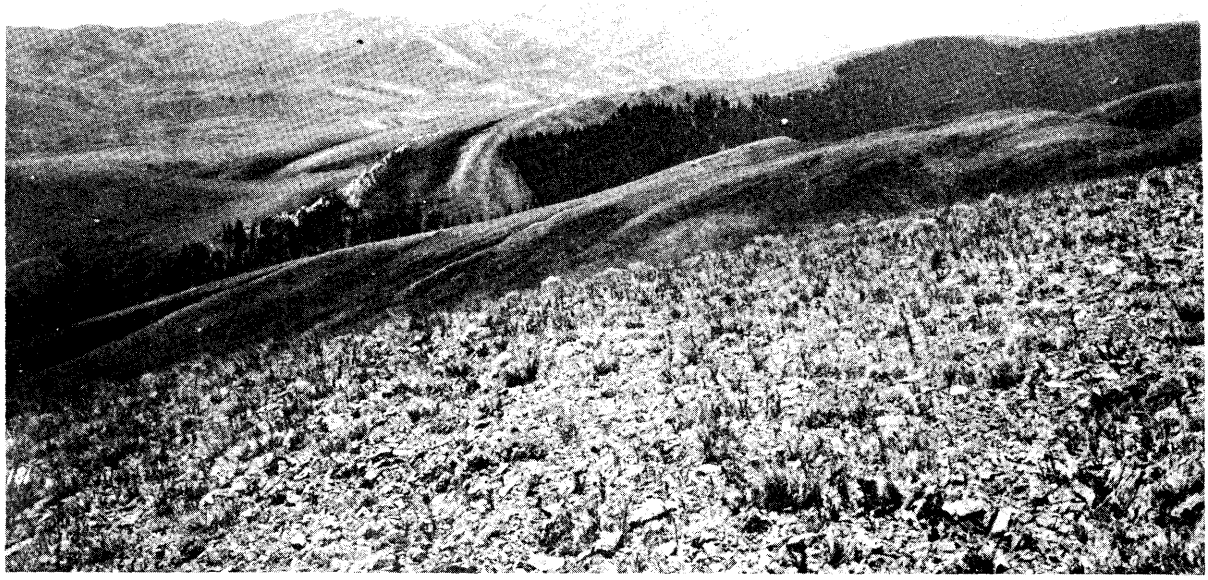


Plate 52a (1871) **Fire Group 6: Moist Douglas-fir.** **Elevation 7,900 ft (2 409 m)**

Looking south across Deep Creek at Beaverhead Mountains in distance. Camera point is on ridge above conifer stand indicated by arrow in plate 51a. North slopes of Deep Creek support Douglas-fir. Though not readily apparent, conifers on far slopes show the effect of past fires. Some stands contain few trees, while other stands are small, being separated by large openings.

USGS photograph 56 by W. H. Jackson.

Plate 52b (1981) **110 years later**

Douglas-fir shows a marked increase in density along Deep Creek and on the distant slopes of the Beaverhead Mountains. Sites that formerly supported few or no conifers are now covered by dense stands.

Photograph by G. E. Gruell.

Plate 53a (1871) Sagebrush/Grass Fire Group. Elevation 6,400 ft (1 951 m)

Camera faces southwest up Pleasant Valley Creek from ridge located on west side of Interstate 15, 8.4 miles south of Monida Pass. Patch of sagebrush in foreground shows evidence of recent fire. Homestead at left, road, and telegraph poles attest to early settlement. Note open character of slopes in distance at right. Fire scars from group of conifers at right (arrow) showed four fires between 1777 and 1853, with a mean fire interval of 21 years (Arno and Gruell 1983).

USGS photograph 55 by W. H. Jackson.

Plate 53b (August 15, 1981) 110 years later

Camera point has been altered by highway construction. Homestead has been removed and road in valley is no longer used by interstate travelers between Idaho and Montana. A long period with little or no fire has allowed growth of scattered Douglas-fir and aspen communities.

Photograph by G. E. Gruell.

Plate 54a (September 19, 1928) **Fire Group 5: Cool-dry Douglas-fir.** **Elevation 7,000 ft (2 134 m)**

The camera faces east-southeast at a point on upper Blacktail Deer Creek approximately 1.5 miles above Whiskey Springs. Flat area in foreground and midground supports herbaceous plants in association with scattered sagebrush and rubber rabbitbrush. Slopes in distance show effects of past fires, particularly the drier southwest exposure at right where fire-scarred snags bore evidence of two early fires.

USGS photograph 2016 by W. C. Alden.

Plate 54b (June 23, 1981) **53 years later**

Flat shows effects of heavy livestock grazing. Sagebrush stand on toe slope at left has expanded down slope. In distance, aspen have matured in canyon bottom. Closure of Douglas-fir and limber pine canopy has resulted in loss of Scouler willow, aspen, snowberry, and buffaloberry.

Photograph by G. E. Gruell.

Plate 55a (1872) **Fire Group 1: Dry limber pine.** **Elevation 6,800 ft (2 073 m)**

Camera is facing north-northeast from a position on low ridge separating the Teddy Creek and Price's Creek tributaries of Blacktail Deer Creek. This locality is in Price's Canyon in the Blacktail Mountains south of Dillon, Mont. Ridge in foreground supports perennial grasses and scattered sagebrush. Based on present species composition, streambottom vegetation (open arrow) in midground at right was primarily comprised of Great Basin wildrye and rose. Dark shrubs (closed arrow) at right are willows. Note distribution of conifers in distance. Fire-scarred trees in this locality indicated at least five fires from 1588 to 1877 (Arno and Gruell 1983).

USGS photograph 902 by W. H. Jackson.

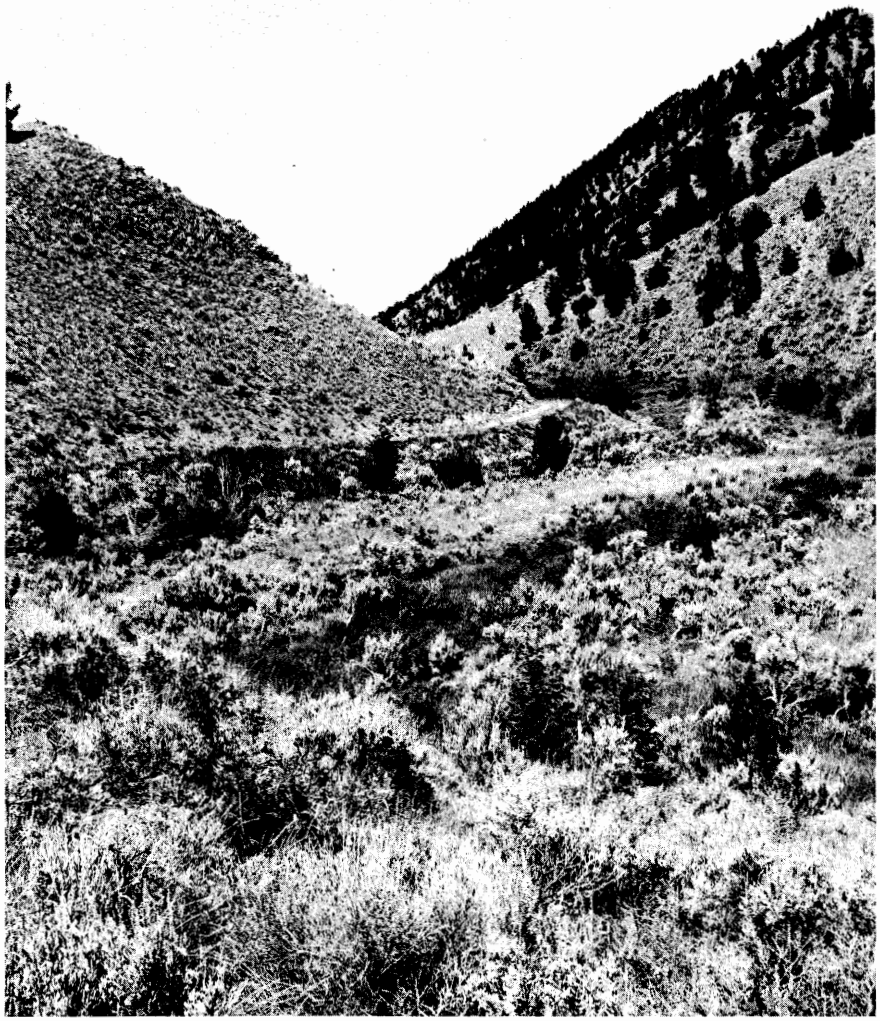


Plate 55b (July 8, 1981) 109 years later

Camera point was moved about 30 feet north to avoid screen of Rocky Mountain juniper and limber pine. Sagebrush density has increased on ridge in foreground, bottomland, and on slopes. Conifers now occupy sites in foreground and midground that were formerly treeless. Limber pine and Douglas-fir density in distance have increased markedly.

Photograph by G. E. Gruell.

Plate 56a (September 20, 1928) **Fire Group 6: Moist Douglas-fir.** **Elevation 7,200 ft (2 195 m)**

An east-southeast view toward the Continental Divide from a point on the Targhee National Forest 0.25 miles north of Red Rock Pass. The widespread distribution of snags and early successional vegetation indicates a wildfire several decades earlier.

USGS photograph 2017 by W. C. Alden.

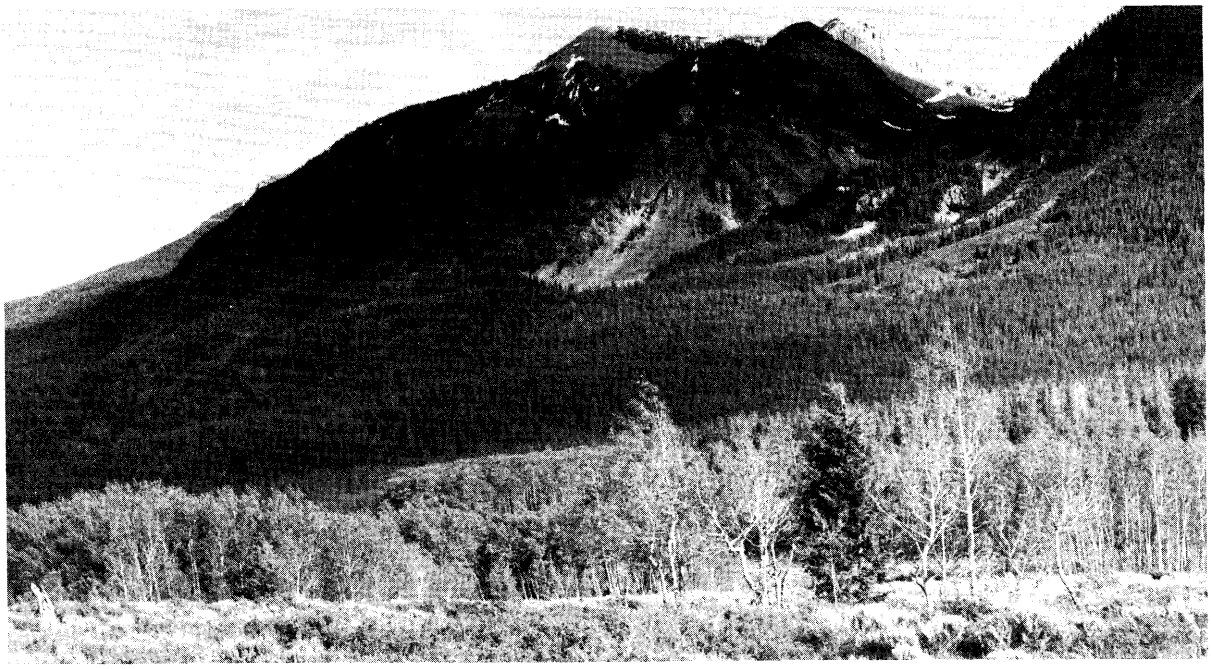


Plate 56b (June 25, 1981) **53 years later**

Snag at lower left is same one pictured in original view. Shrubs in foreground and midground are primarily sagebrush and snowberry. Aspen stands have matured and Douglas-fir and lodgepole pine have largely developed into dense stands.

Photograph by G. E. Gruell.

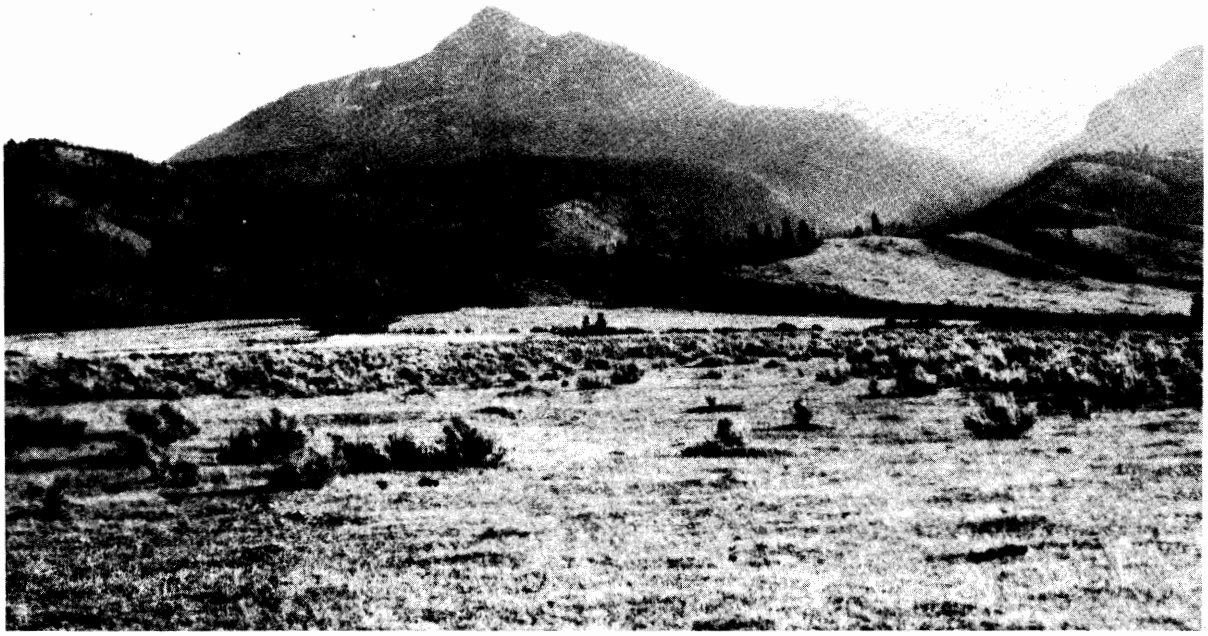


Plate 57a (September 20, 1928) **Fire Group 6: Moist Douglas-fir.** **Elevation 6,500 ft (1 982 m)**

A south-southwest view of Sawtell Peak from valley floor approximately 2.5 miles southwest of Henrys Lake. Perennial grasses and sagebrush occupy bottomlands. Snags and differences in conifer growth patterns indicate past wildfires.

USGS photograph 2018 by W. C. Alden.

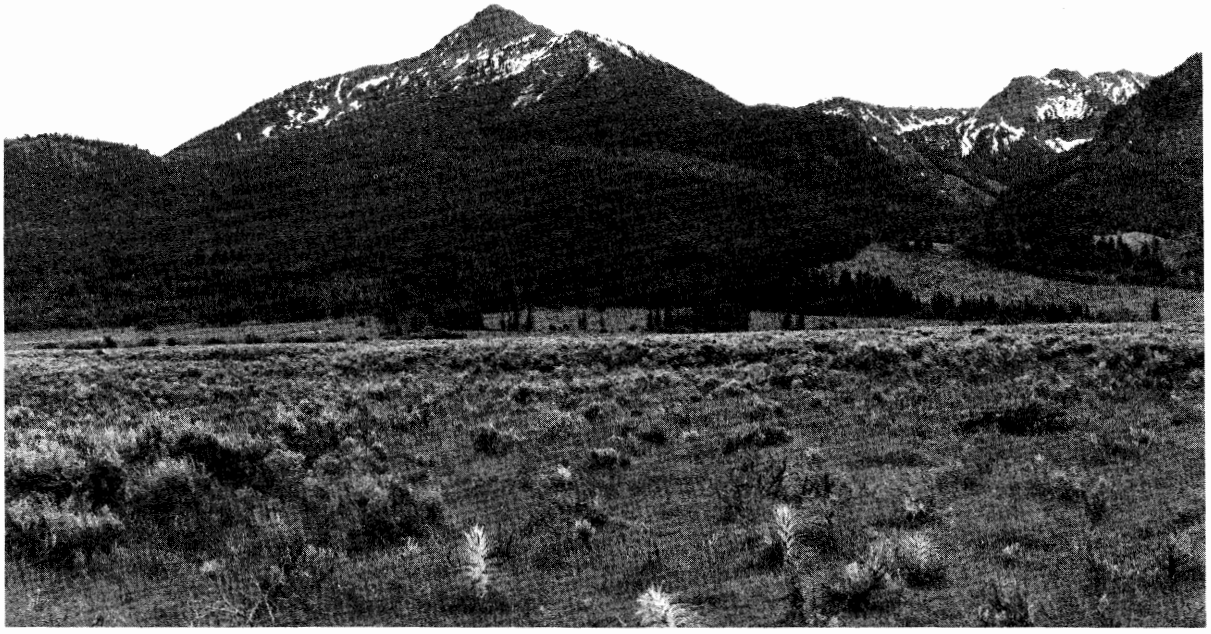


Plate 57b (June 25, 1981) **53 years later**

Lack of reference points in foreground and midground precluded close duplication of original camera point. Openings and sparsely vegetated sites evident on far slopes in 1928 are now covered by lodgepole pine, Douglas-fir, and aspen.

Photograph by G. E. Gruell.

Plate 58a (1872) Sagebrush/Grass Fire Group. Elevation 6,700 ft (2 043 m)

Looking west-southwest across the north end of Henrys Lake from the lower slopes near site now occupied by Wildrose Guest Ranch. Ground cover in the foreground appears to be an association of herbs and scattered snowberry plants. The dark, clustered plant seems to be a woody-based forb. Aspen in various successional stages are evident adjacent to the lake. Far slopes show thinning effect of past fires on conifers.

USGS photograph 178 by W. H. Jackson.

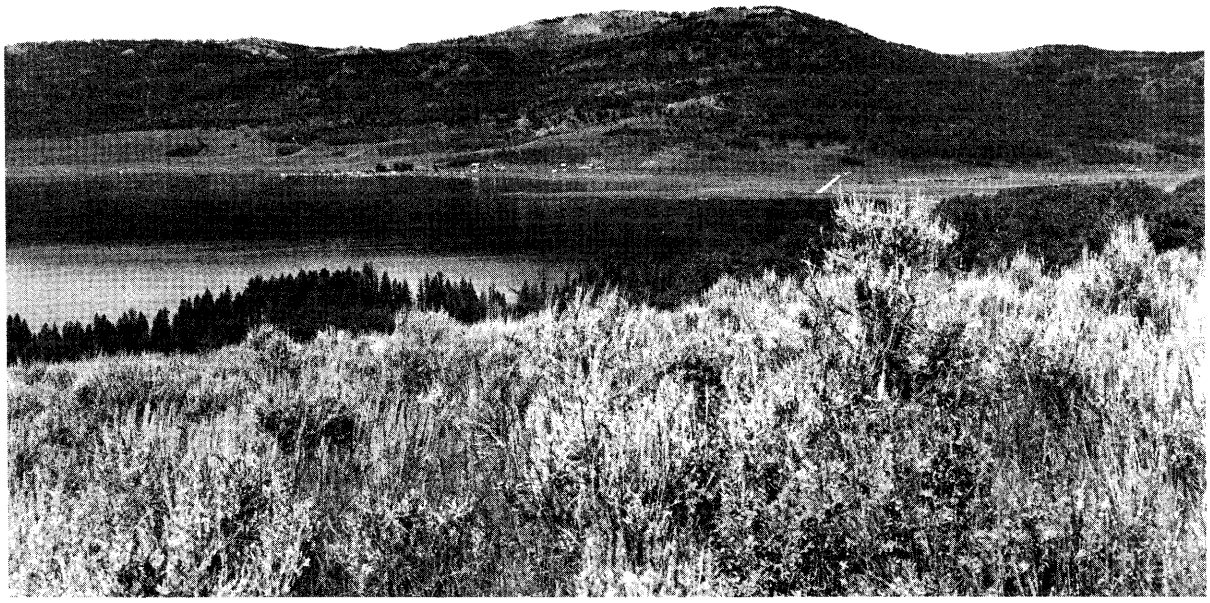


Plate 58b (June 25, 1981) 109 years later

Foreground now supports a dense mountain big sagebrush stand. Associated vegetation includes scattered snowberry that is being outcompeted by sagebrush, Idaho fescue, bluebunch wheatgrass, and other perennial grasses and forbs. At right, aspen growth screens former view. Lake level was raised about 15 feet for irrigation purposes. In distance, aspen stands have matured, while Douglas-fir density has increased markedly. Photograph by G. E. Gruell.

Plate 59a (1872) **Fire Group 5: Cool-dry Douglas-fir.** **Elevation 6,500 ft (1 982 m)**

Looking north toward Black Mountain from Sawtell's ranch on west side of Henrys Lake. Site is now occupied by Staley Springs Resort. Extreme right midground shows bottomlands before the level of Henrys Lake was raised. Foothills in distance support open Douglas-fir stands. Fire-scarred trees in this locality show a mean fire interval of 56 years or less (Arno and Gruell 1983). Four fires occurred from 1694 to 1862.

USGS photograph 180 by W. H. Jackson.

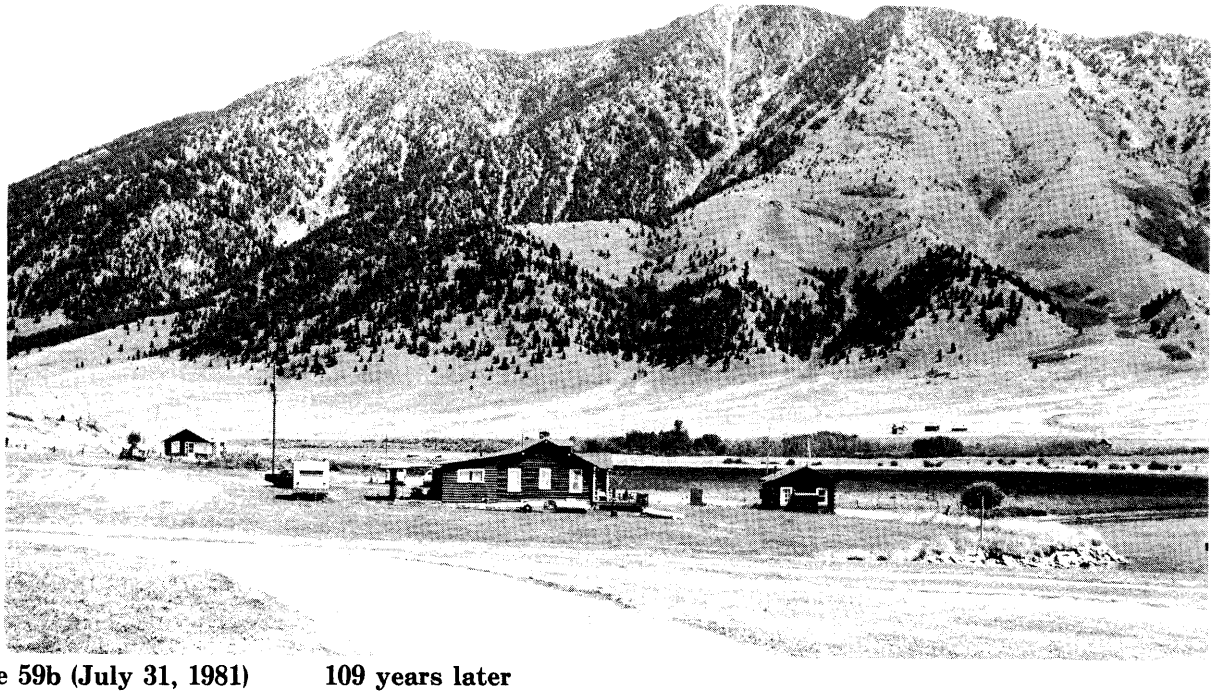


Plate 59b (July 31, 1981) **109 years later**

Original view was screened by cabins, making it necessary to move camera north. Lake now covers low-lying areas at right. Absence of fire for over 100 years has allowed development of dense Douglas-fir on the lower slopes. The once open slopes above, which were formerly kept free of conifers by fire, are now supporting scattered Douglas-fir. Photographs are not sharp enough to allow comparison of sagebrush cover on distant benchlands.

Photograph by G. E. Gruell.

Plate 60a (September 22, 1927) **Fire Group 6: Moist Douglas-fir.** **Elevation 7,400 ft (2 256 m)**

Looking north across Papoose Creek (midground) toward the Madison Range, southeast of Cameron on the Beaverhead National Forest. Scene shows dense stand of spruce and Douglas-fir in moist bottom. Adjacent slopes support scattered Douglas-fir and young aspen. Analysis of fire scars in this locality shows four fires prior to 1866, with a mean fire interval of 49 years (Arno and Gruell 1983).

USGS photograph 1890 by W. C. Alden.

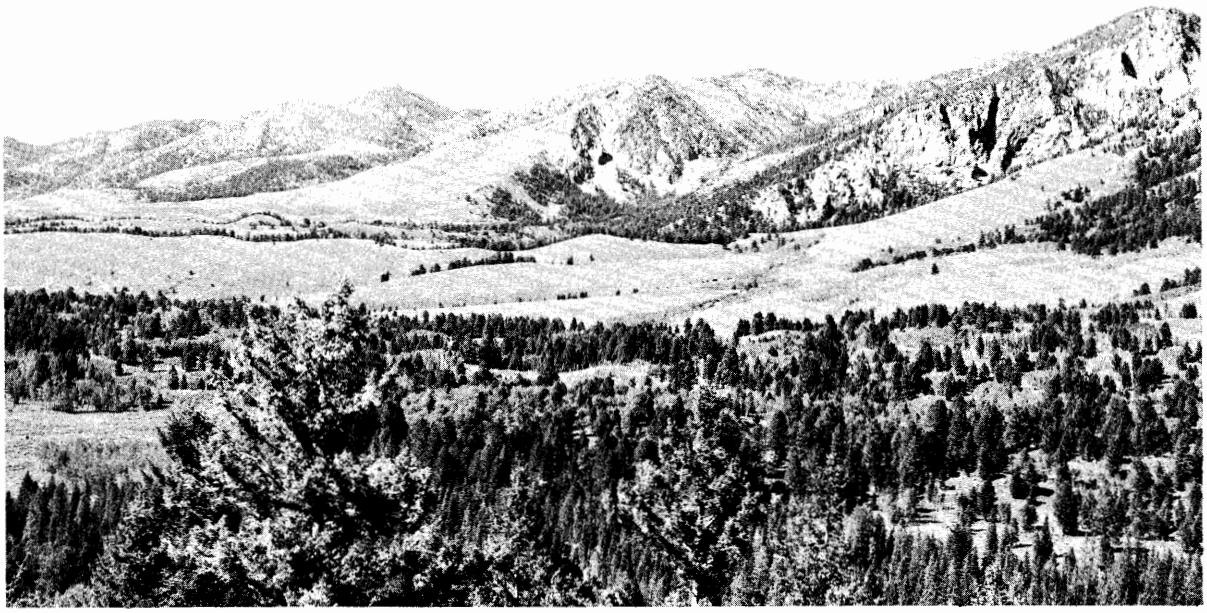


Plate 60b (June 24, 1981) **54 years later**

Camera was moved approximately 50 yards down ridge to the only view that was not fully screened by growth of trees. The absence of fire has favored proliferation of Douglas-fir. Field inspection revealed that aspen stands have deteriorated because of competition from Douglas-fir and absence of fire's rejuvenating influence.

Photograph by G. E. Gruell.

Plate 61a (1936) **Fire Group 6: Moist Douglas-fir.** **Elevation 6,400 ft (1 951 m)**

Looking south-southeast toward the Madison Range from a bench above the old Bear Creek Ranger Station, Beaverhead National Forest. Young Douglas-fir and aspen seem to be the result of wildfire during the late 1800's.

USFS photograph 331280 by K. D. Swan.

Plate 61b (August 29, 1979) **43 years later**

Openings formerly occupied by aspen are now dominated by Douglas-fir. Where aspen have not been in competition with conifers, aspen stands have matured and are in good condition. Note growth of aspen clone at lower left.

Photograph by W. J. Reich.

Plate 62a (1916) **Fire Group 6: Moist Douglas-fir.** **Elevation 6,900 ft (2 104 m)**

Looking north across Romy Lake in the Gravelly Range, Beaverhead National Forest. Lake shoreline and flats in distance are covered by large willows. Note young conifers on lower and distant slopes. Young aspen suggest previous disturbance by wildfire.

USGS photograph 201 by D. D. Condit.

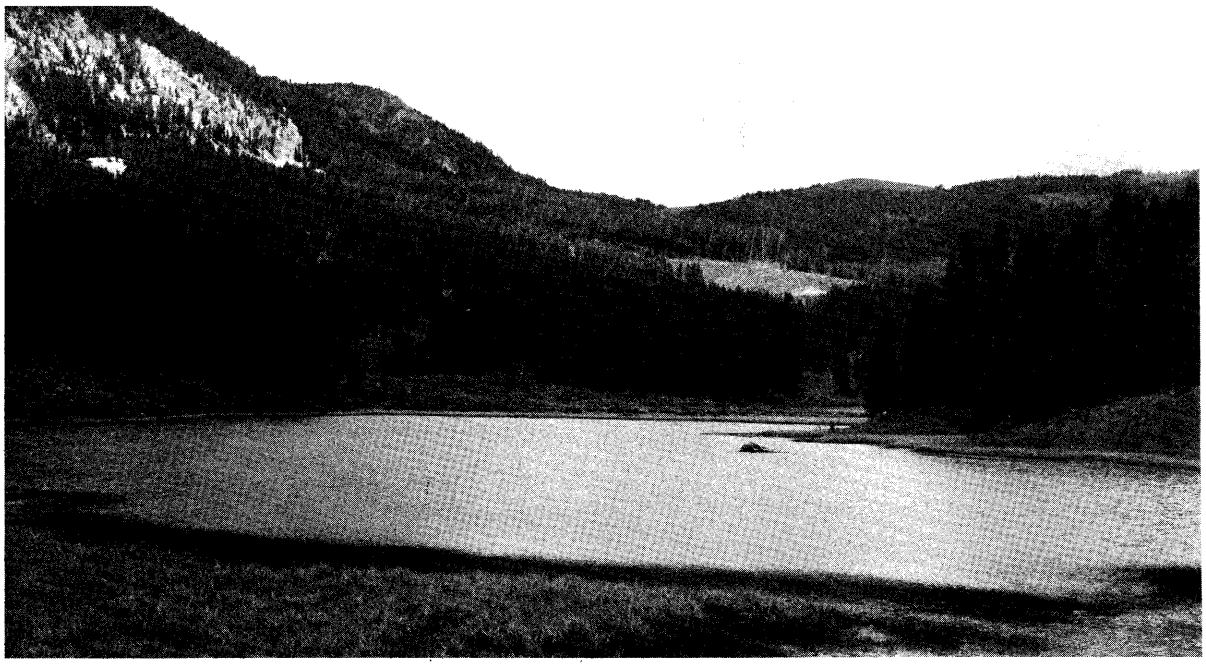


Plate 62b (July 8, 1980) **64 years later**

Raising of lake level apparently killed willows. On the flats in the distance, willows are smaller than in 1916. Douglas-fir and other conifers have regenerated in the large opening beyond lake. Competition from conifers has resulted in deterioration and die off of aspen on various sites. The opening at right center is a clearcut made during a 1962 timber sale.

Photograph by W. J. Reich.

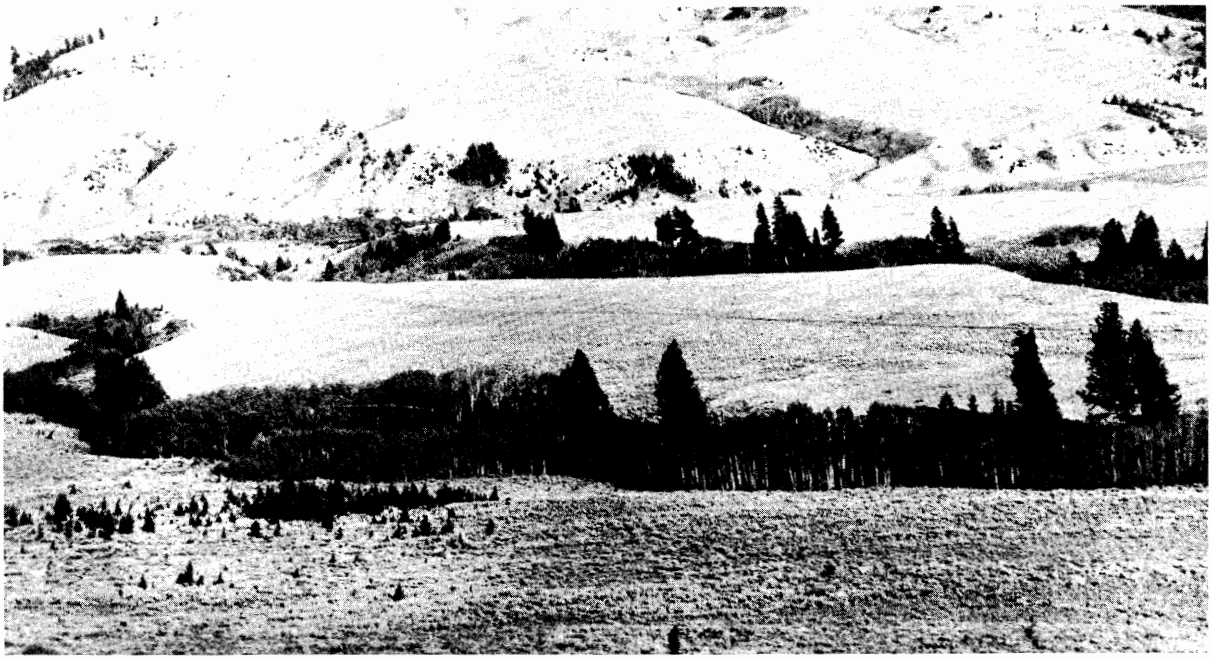


Plate 63a (August 1936) **Fire Group 5: Cool-dry Douglas-fir.** **Elevation 6,500 ft (1 982 m)**

Looking east from the Lewis Creek bench toward the Ruby River and Gravelly Range, near Vigilante Station, Beaverhead National Forest. Douglas-fir is invading sagebrush on near slopes at left. Young aspen stands predominate on Lewis Creek (lower) and Badger Creek (center). Drier aspects in distance support Rocky Mountain juniper and limber pine, while Douglas-fir occupies cooler sites. Fire-scarred trees and a stump on Badger and Lewis Creeks show a mean fire interval of 27 years based on six fires from 1734 to 1871 (Arno and Gruell 1983).

USFS photograph 330732 by Lincoln Ellison.

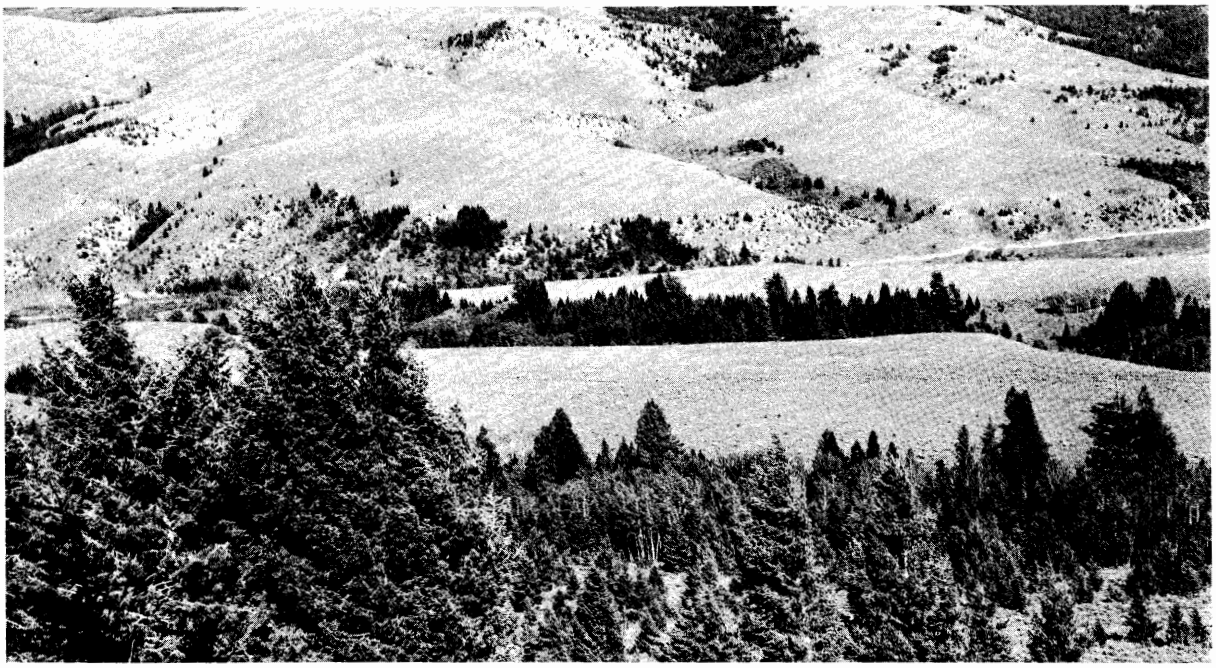


Plate 63b (June 2, 1981) **45 years later**

Douglas-fir now dominates both the sagebrush on the near slope and the aspen in the drainages. Distant slopes show increase in tree cover on both dry and moist sites.

Photograph by G. E. Gruell.

Plate 64a (July 5, 1940) **Juniper Fire Group.** **Elevation 5,500 ft (1 677 m)**

View is north-northwest across the Ruby River from a point just east of the Ruby Dam, southeast of Sheridan, Mont. Vegetation along stream bottom includes willow, water birch, currant, and young cottonwood. The southeast-facing slopes in distance support an association of Rocky Mountain juniper and limber pine. Mountain big sagebrush occupies the deeper soils, while black sagebrush is confined to the more shallow drowthy soils. The limestone outcrops support curlleaf mountain-mahogany.

USGS photograph 1584 by J. T. Pardee.

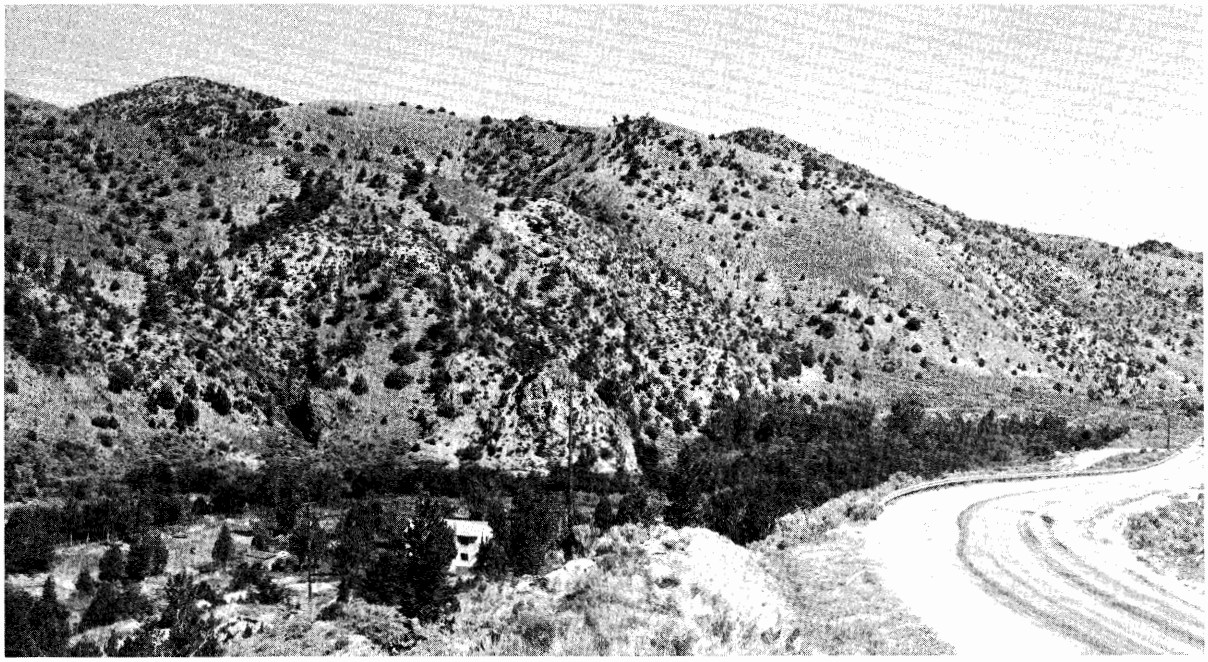


Plate 64b (July 8, 1980) **40 years later**

Road reconstruction made it necessary to elevate camera position. Trees and shrubs on flood plain at left in plate 69a were cleared. Those that were not removed have grown considerably. Sagebrush on far slope has increased in size and density as has mahogany. Rocky Mountain juniper is slowly increasing its presence on these harsh sites.

Photograph by W. J. Reich.

Plate 65a (ca. 1903-07) **Fire Group 5: Cool-dry Douglas-fir.** **Elevation 5,100 ft (1 555 m)**

Looking east-northeast toward the Tobacco Root Range from Sheridan, Mont. Drainage on left is Indian Creek. Except for conifers on Skihi Peak at left, tree cover is sparse and largely confined to the steeper slopes, ridges, and rocky outcrops that allowed some protection from wildfire.

Photograph courtesy T. J. Darby, Sheridan; photographer unknown.

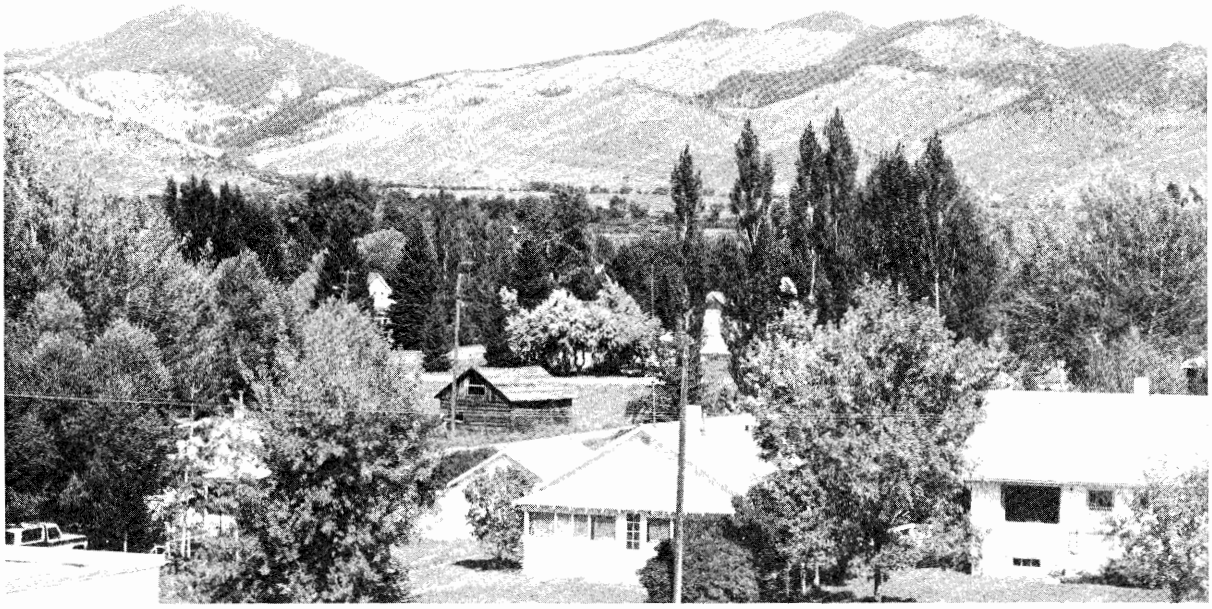


Plate 65b (September 3, 1980) **About 75 years later**

Douglas-fir and Rocky Mountain juniper have regenerated profusely. Localities that formerly supported sparse conifer stands are now densely stocked. Field inspection led to the conclusion that Douglas-fir and juniper have invaded sites that formerly were treeless because of frequent wildfires. Fire intervals of 31 years were documented by Arno and Gruell (1983) for the lower slopes immediately east of those in view.

Photograph by W. J. Reich.

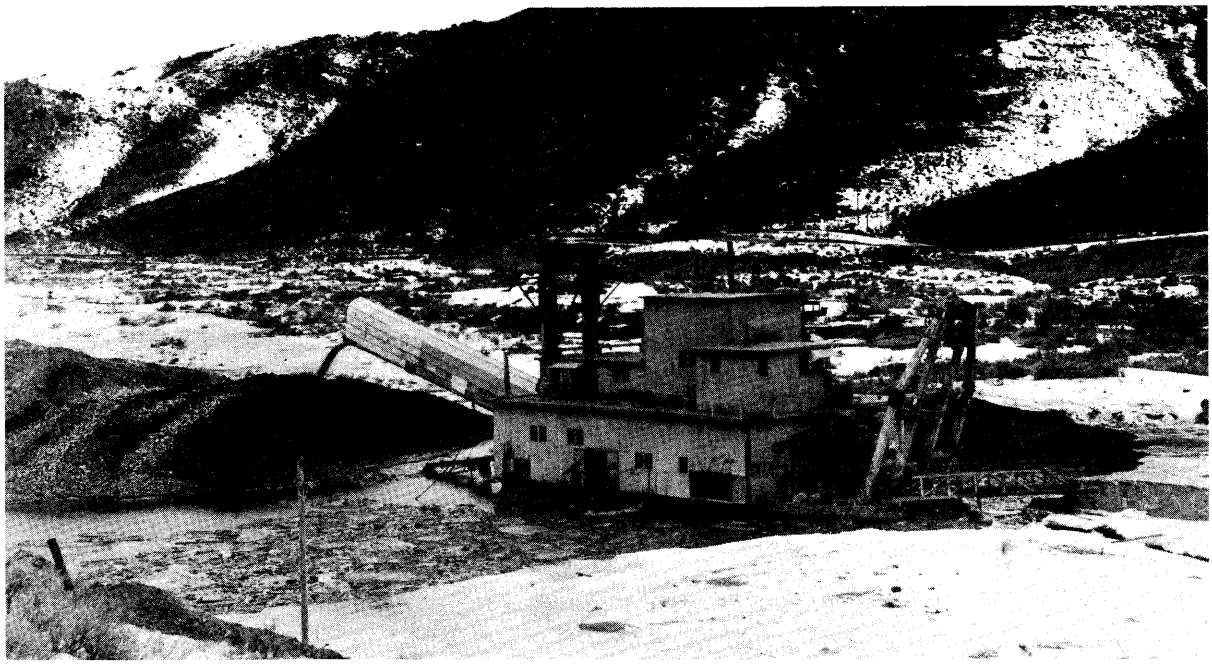


Plate 66a (ca. 1900) Juniper Fire Group. Elevation 4,600 ft (1 402 m)

Looking west across Alder Gulch and Cowrey Dredge No. 1 at a point approximately 3 miles below Nevada City, Mont. Canyon bottom has been much disturbed by dredging for gold. Southeast slopes in distance support Rocky Mountain juniper, perennial grass, and scattered sagebrush.

Photograph courtesy of Montana Historical Society, photographer unknown.

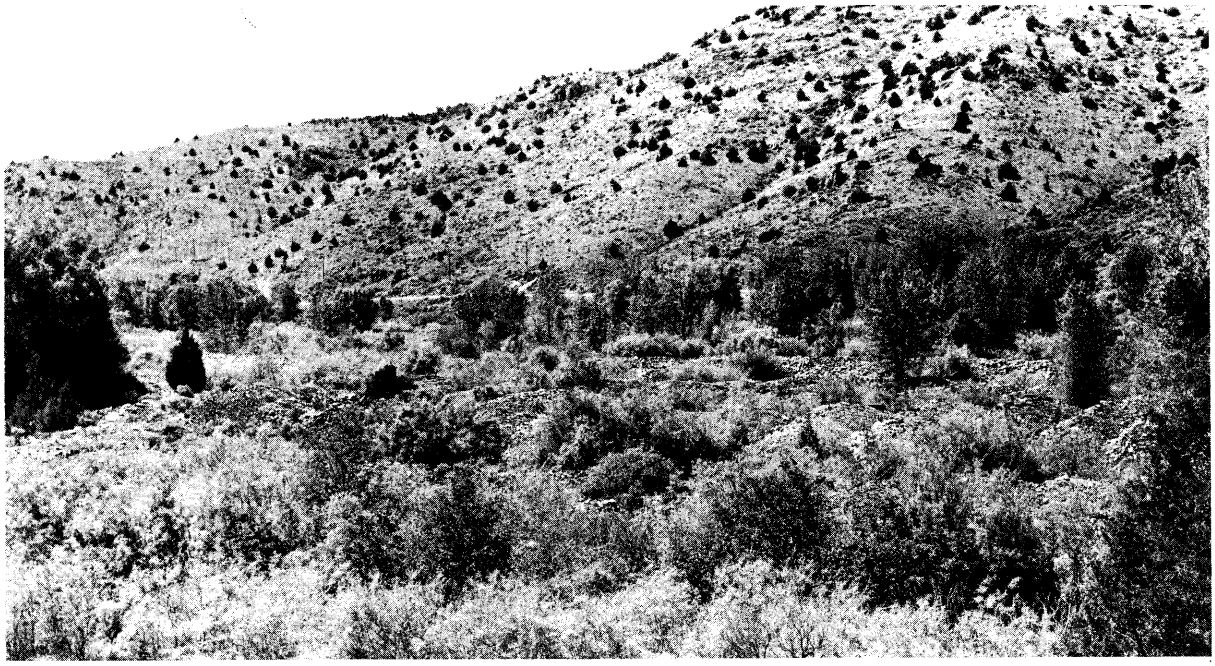


Plate 66b (June 24, 1981) About 81 years later

Heavily disturbed riparian bottoms have shown remarkable recovery and currently support an excellent mix of wildlife cover plants. Junipers on far slope have increased in number and size.

Photograph by G. E. Gruell.

Plate 67a (1924) **Sagebrush/Grass Fire Group.** **Elevation 5,800 ft (1 768 m)**

The camera faces north from Boothill above Virginia City, Mont. Graves are those of five members of Henry Plummer's infamous road agents, who were hanged by the Vigilantes in 1864. Shrubs in foreground are mountain big sagebrush. The near slope has a smooth appearance and is apparently covered by perennial grasses. A few groups of mountain big sagebrush as well as scattered plants are also present on this slope.

USFS photograph by K. D. Swan.

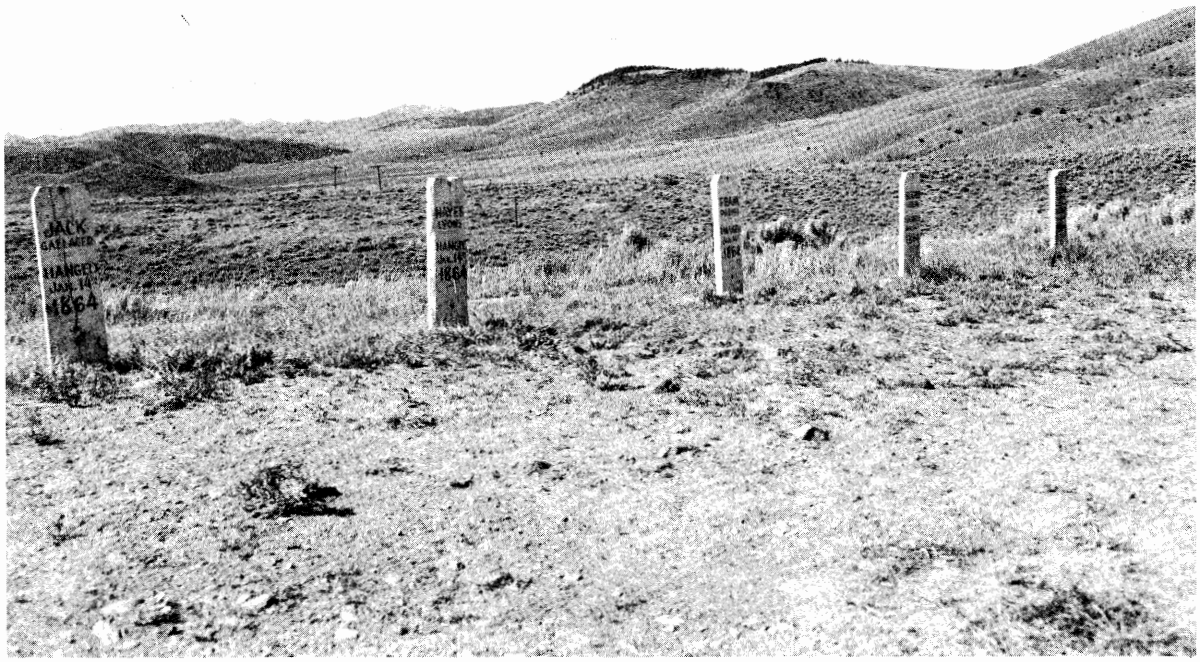


Plate 67b (July 9, 1980) **56 years later**

Grading and remonumenting graves resulted in displacement of soil in foreground. Note change in location of grave markers. Near slope shows a marked increase in the density of sagebrush. Understory plants are predominantly bluebunch wheatgrass.

Photograph by W. J Reich.

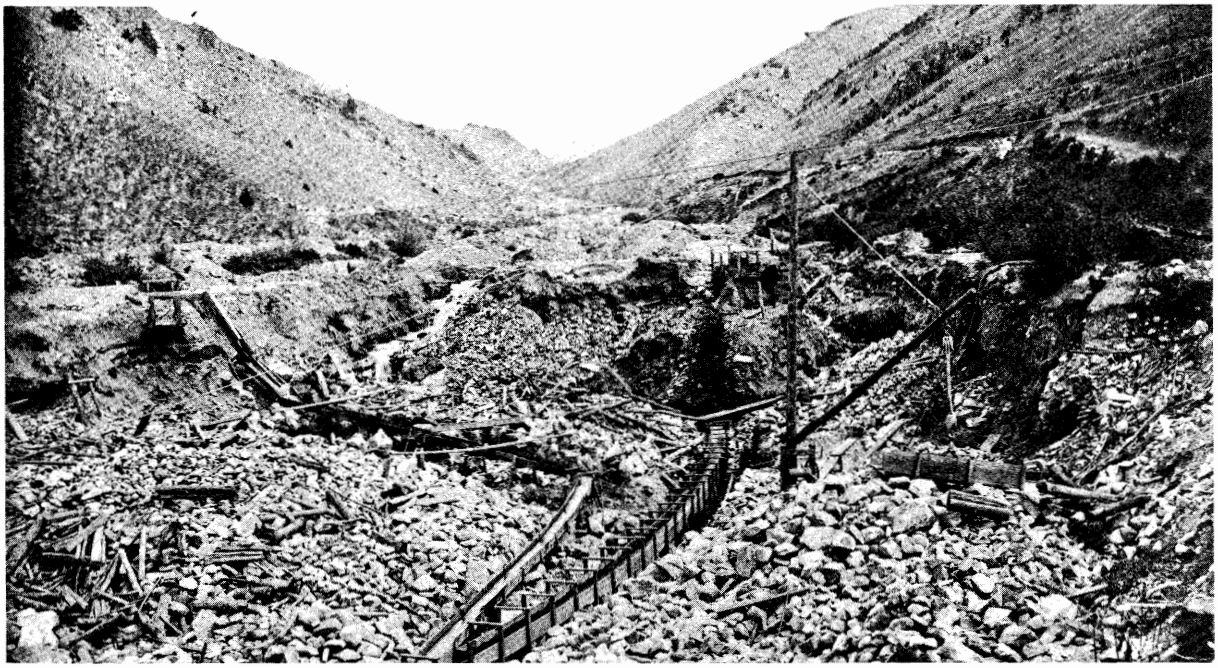


Plate 68a (1871) **Fire Group 5: Cool-dry Douglas-fir.** **Elevation 6,000 ft (1 829 m)**

An east-northeast view up Alder Gulch 2.2 miles above Virginia City, Mont. Placer mining following discovery of gold in 1863 has resulted in a marked change in canyon bottom. The open south-facing slope at left supports a few mature Rocky Mountain juniper in rock outcrops. Juniper and Douglas-fir regeneration is evident. Bluebunch wheatgrass is the predominant grass cover. Conifers on north-facing slope at right are Douglas-fir. Stumps in area indicate light cutting of trees. Wildfires had been relatively frequent in this locality. Examination of two fire-scarred stumps showed evidence of four fires before 1871.

Photograph by W. H. Jackson, courtesy of Montana Historical Society.

Plate 68b (July 28, 1981) **110 years later**

The large Douglas-fir in foreground-left (arrow) is the same one pictured in original scene. Regeneration of Douglas-fir and Rocky Mountain juniper on this slope has produced a marked change. Canyon bottom now supports various shrubs and trees, including aspen, narrowleaf cottonwood, willow, and chokecherry. North slope is densely covered by Douglas-fir.

Photograph by G. E. Gruell.

Plate 69a (August 20, 1901) **Fire Group 1: Dry limber pine.** **Elevation 5,200 ft (1 585 m)**

A north-northwest view in Bradley Creek drainage on U.S. Highway 287 approximately 4 miles south of Norris, Mont. Scene shows team that was hauling machinery. Vegetation in foreground appears to have been heavily grazed by livestock. Willows and aspen line the stream behind horses, while Rocky Mountain juniper and limber pine of varying age occupy dry southerly slopes in distance.

Photograph courtesy of Montana Historical Society, photographer unknown.

Plate 69b (July 29, 1981) **80 years later**

Foreground is in fenced pasture. Aspen clone at left has regenerated from suckers. Conifers are more dense, and skunkbush on lower slope at upper center have increased in size (arrow). The absence of livestock grazing as of July 29, 1981, had allowed a more or less continuous complex of grassy fuels.

Photograph by G. E. Gruell.

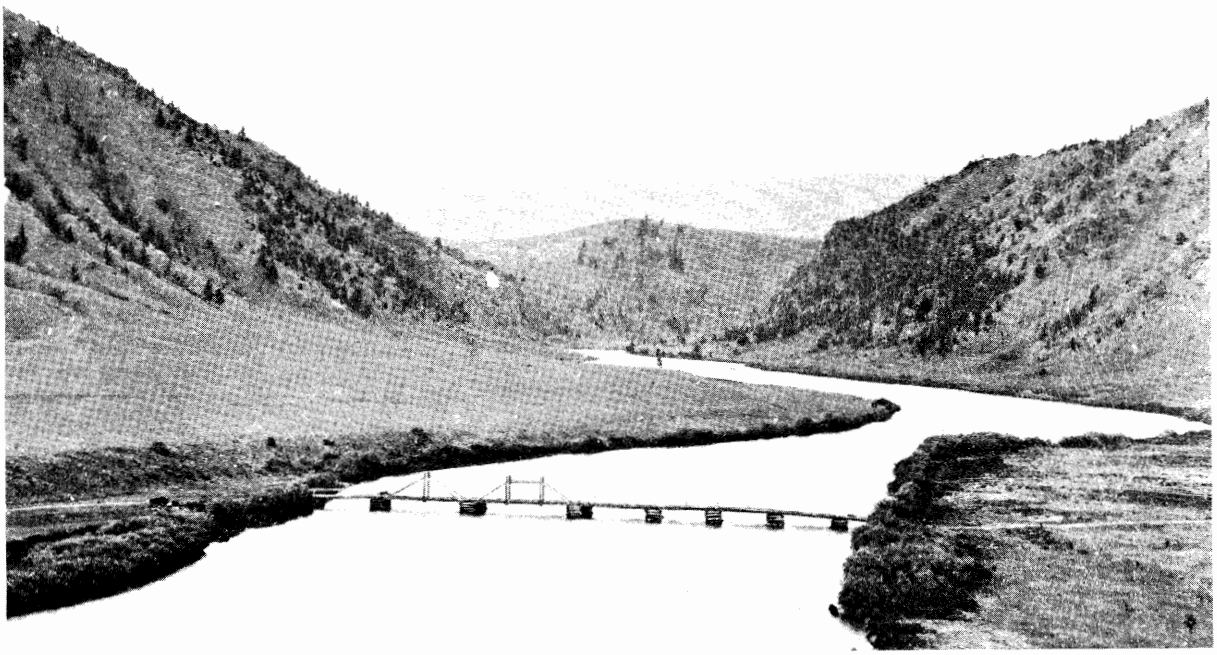


Plate 70a (1871) Mahogany Fire Group. Elevation 4,500 ft (1 372 m).
Looking south-southeast across the Madison River at a point 0.3 miles below present Highway 84 bridge crossing at Beartrap recreational area. Conifers in distance are largely Douglas-fir. Some limber pine and Rocky Mountain juniper are also present. Curlleaf mountain-mahogany are restricted to rocky outcrops.
USGS photograph 911 by W. H. Jackson.

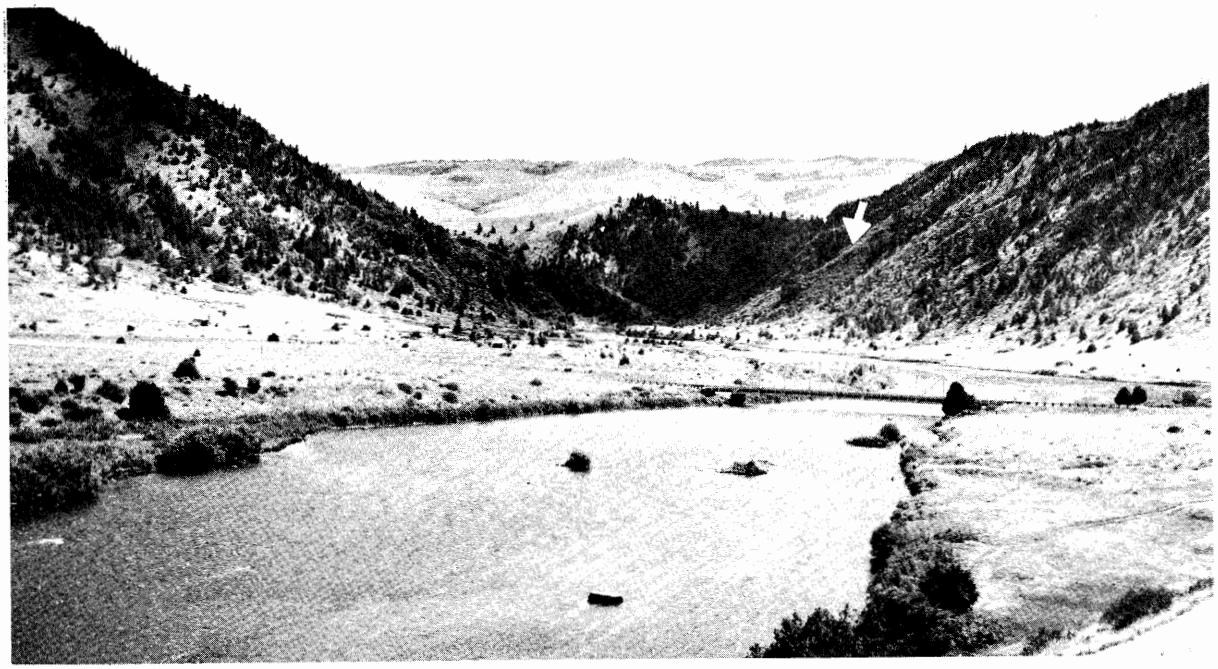


Plate 70b (August 31, 1982) 111 years later
Logging in the latter 1800's and the absence of fire allowed mahogany to proliferate. Note the large stand at right (arrow) that is growing on a site formerly dominated by conifers. Douglas-fir, juniper, and scattered limber pine also regenerated following cutting and are now outcompeting mahogany, skunkbush, and other vegetation on many sites.
Photography by G. E. Gruell.

Plate 71a (1901) **Fire Group 6: Moist Douglas-fir.** **Elevation 6,600 ft (2 012 m)**

The camera faces northeast from a point high on the slope above Elkhorn, an early mining town in the Elkhorn Mountains of west-central Montana. Adjacent slopes are in early succession following logging and wildfire in the latter 1800's.

USGS photograph 66 by R. H. Chapman.

Plate 71b (September 3, 1981) **80 years later**

Camera has been elevated to an opening on a ridge that allows a partial view of original scene. Dense Douglas-fir and lodgepole pine now cover most of the area that was formerly open.

Photograph by R. F. Wall.

Plate 72a (1872) **Fire Group 6: Moist Douglas-fir.** **Elevation 6,400 ft (1 951 m)**

From Madison River Canyon at site now occupied by Campfire Lodge Resort (below Hebgen Lake), the view is north-northeast toward outlet of Cabin Creek. Mountain big sagebrush dominates flats. Toe slope at left supports a multi-aged aspen stand. Fallen snags and sizes of young conifers on toe slope and lower part of opposite slope indicate a wildfire swept this locality several decades earlier. Increment cores from Douglas-fir suggest that trees on lower slope and bottom become established following a fire in about 1840. Trees on right apparently died following insect attacks.

USGS photograph 230 by W. H. Jackson.

Plate 72b (July 15, 1981) **109 years later**

Structures made it necessary to move camera to left of original position. Canyon bottom shows evidence of having been cultivated earlier. Smooth brome and fireweed comprise a significant portion of lush herb cover that includes little sagebrush. The aspen present in earlier view is deteriorating because of competition from the maturing Douglas-fir forest.

Photograph by G. E. Gruell.

Plate 73a (1926) **Fire Group 6: Moist Douglas-fir.** **Elevation 5,600 ft (1 707 m)**

Looking west into the Gallatin Canyon from a point on Squaw Creek 1.5 miles above its confluence with the Gallatin River. Lower east-facing slope in distance and canyon bottom supports many shrubs and young aspen. Young conifers are also conspicuous. This area burned around 1890.

USFS photograph 209839 by K. D. Swan.

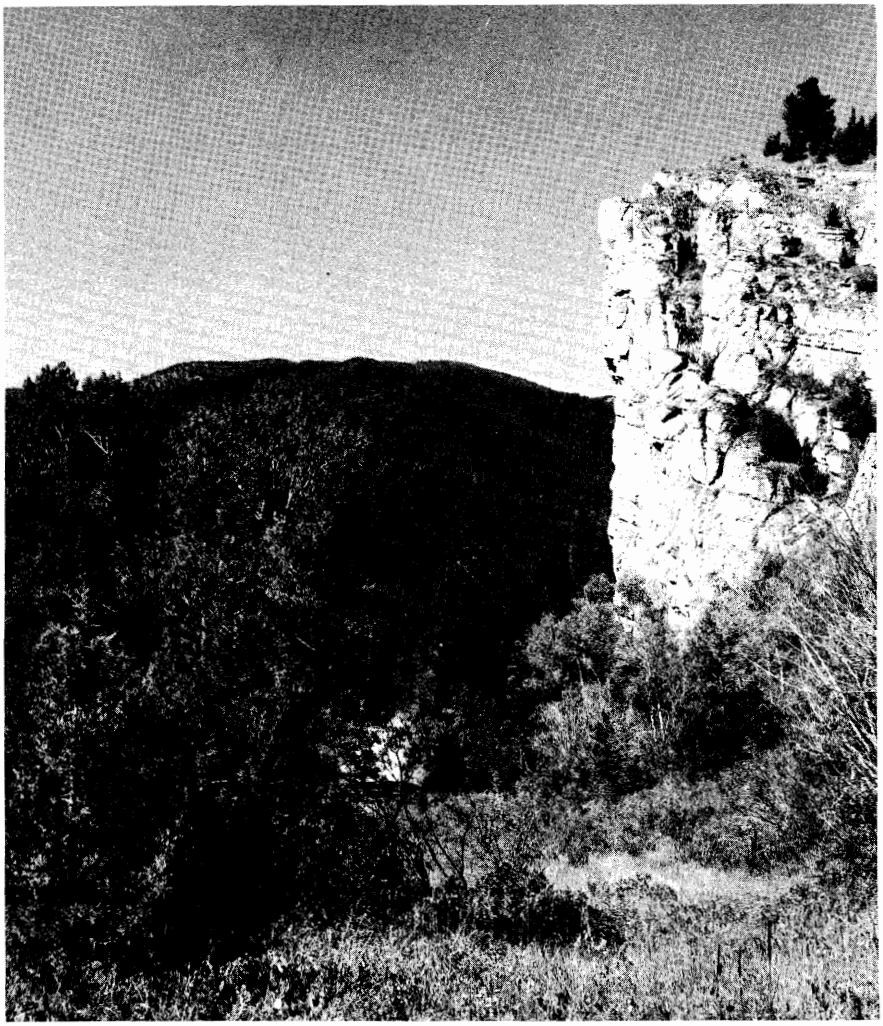


Plate 73b (August 29, 1979) 53 years later

Camera point was moved forward approximately 30 feet to avoid juniper and Douglas-fir that screened original view. Mature cottonwoods now partially obscure view of far slope where Rocky Mountain juniper and Douglas-fir are outcompeting aspen, willow, and other tall deciduous shrubs and herbs. Photograph by W. J. Reich.

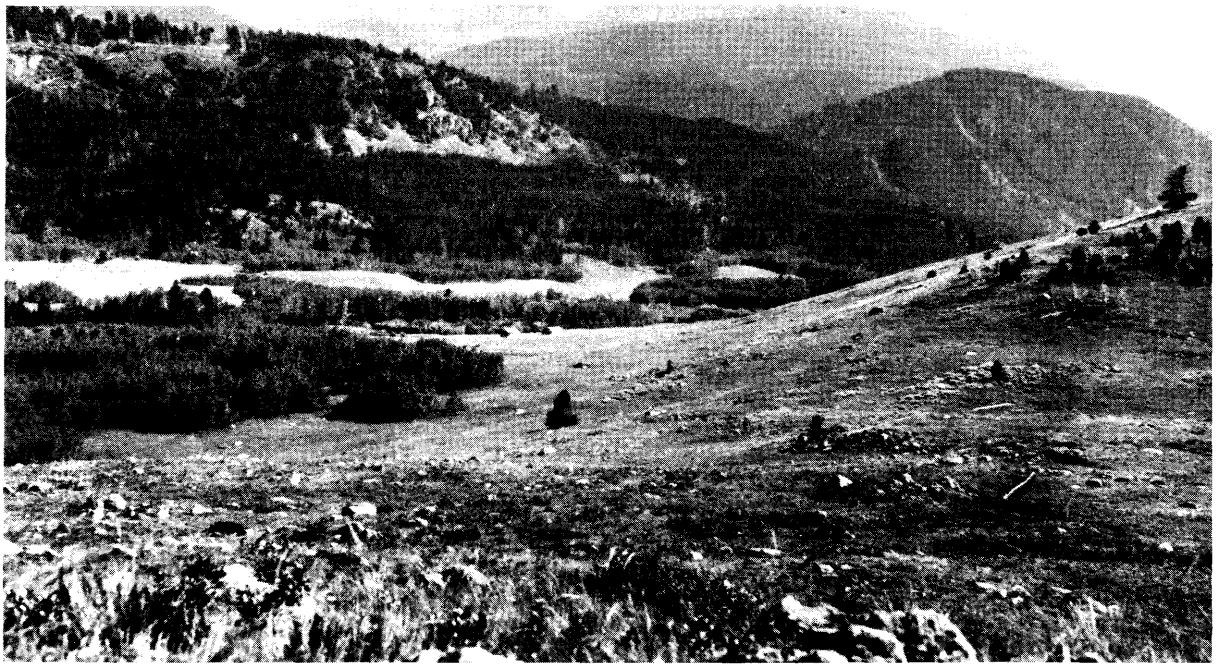


Plate 74a (July 8, 1931) **Fire Group 6: Moist Douglas-fir.** **Elevation 6,100 ft (1 860 m)**

Looking south-southeast across the south fork of Spanish Creek from a point 1.5 miles north of the Gallatin National Forest boundary. Open slopes in foreground and midground support herbaceous plants in association with scattered shrubs including chokecherry, rose, and mountain big sagebrush. Aspen predominates along Spanish Creek and below conifers in distance. Young conifers and mosaics in various localities indicate an early stage of succession following wildfire.

USGS photograph 2185 by W. C. Alden.

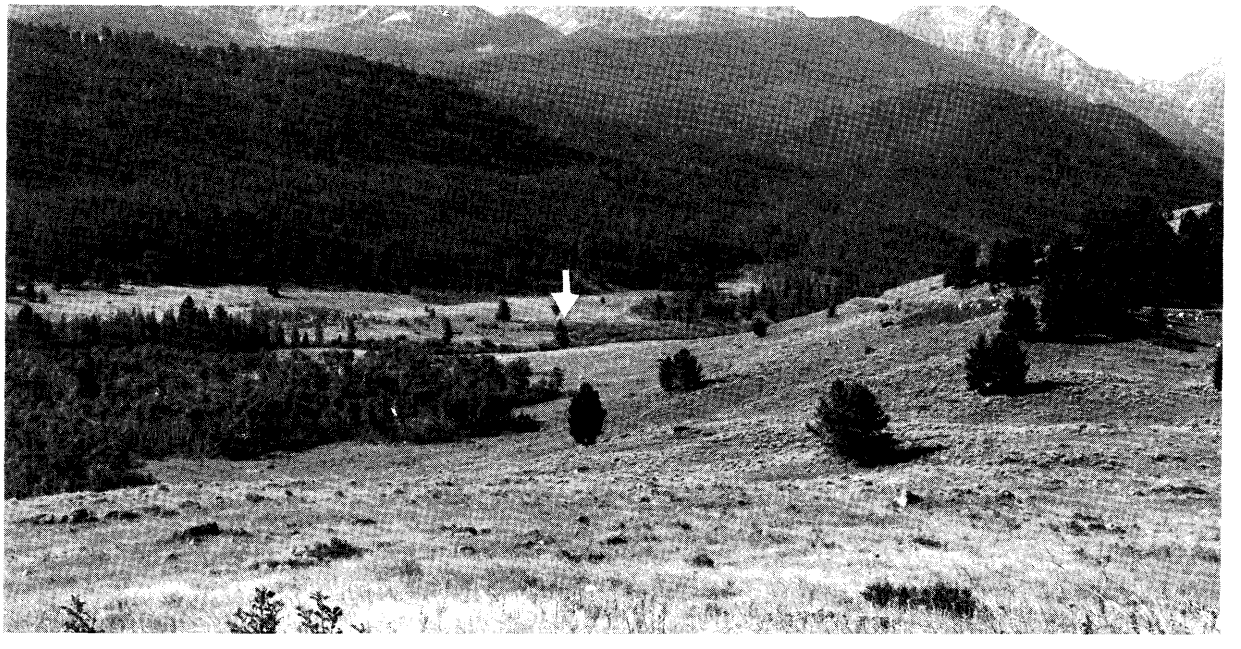


Plate 74b (July 28, 1981) **50 years later**

Boulders visible in 1931 scene are largely obscured by vegetation that had not been grazed by livestock at the time of the retake. Sagebrush has increased. The large aspen stand at left midground has deteriorated, but root suckering has allowed regeneration in portions of the stand where aspen losses allowed increased sunlight. Considerable loss of aspen has occurred in stands across river (arrow) and on other sites where it is seral to conifers. The absence of fire for many years has allowed Douglas-fir to form dense stands on distant slopes which still show evidence of early fire mosaics.

Photograph by G. E. Gruell.

Plate 75a (1871) **Fire Group 5: Cool-dry Douglas-fir.** **Elevation 6,500 ft (1 982 m)**

The camera faces southwest at a point which is now approximately 0.25 miles below the Mystic Lake Dam site, Bozeman-Gallatin Ranger District. Open southeast facing slope at right appears to support a high complement of bluebunch wheatgrass. Conifers on the cooler exposure at left appear to have been thinned by fire.

USGS photograph 66 by W. H. Jackson.

Plate 75b (July 29, 1981) **110 years later**

Camera was moved forward to avoid trees that screened original view. Douglas-fir and lodgepole pine occupy the formerly open slope at right evidently because of a prolonged absence of fire. A closed canopy stand of conifers prevails on the slope at left.

Photograph by R. F. Wall.

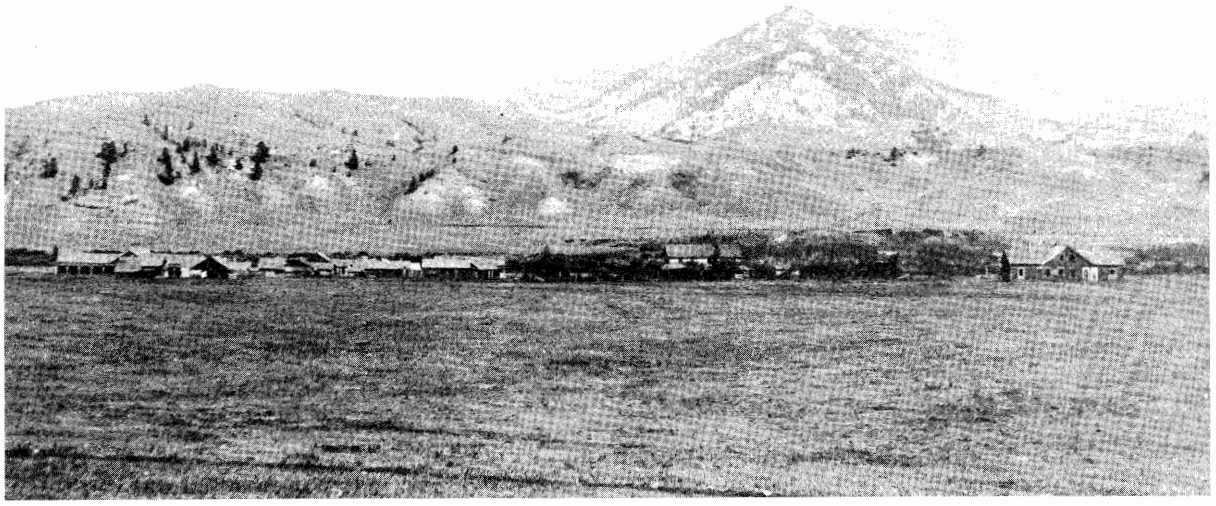


Plate 76a (ca. 1894) **Fire Group 4: Warm-dry Douglas-fir.** **Elevation 4,900 ft (1 494 m)**

The camera faces northeast toward Fort Ellis, formerly located approximately 3 miles east of Bozeman, Mont. A few mature Douglas-fir and limber pine occupy scattered sites on near slopes behind fort. Young conifers are also evident in the vicinity of these older trees. The patchy distribution of conifers on Bridger Mountains in distance reflects effects of cutting and wildfires.

Photograph by M. H. Duane, courtesy of Montana Historical Society.

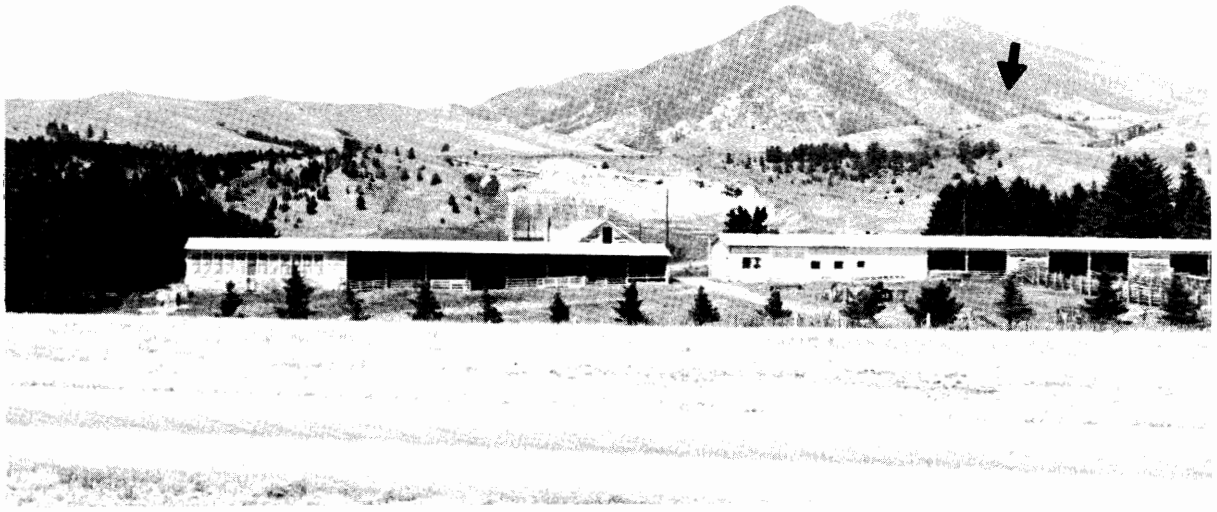


Plate 76b (July 18, 1981) **87 years later**

Site of Fort Ellis now is occupied by Montana Agricultural Experiment Station. Closest slopes show a considerable change in occupancy and growth of conifers. Conifer encroachment is also evident in Bridger Mountains, particularly on the smoother slopes below the two peaks at right of photo (arrow).

Photograph by R. F. Wall.

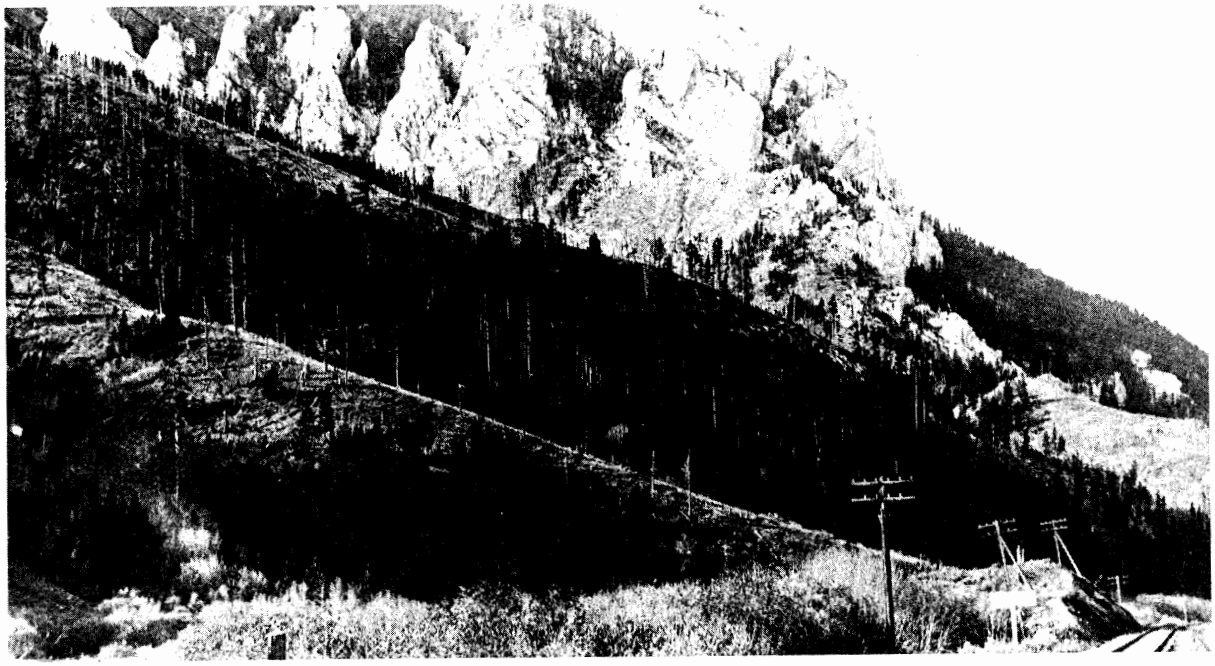


Plate 77a (1903-04) **Fire Group 6: Moist Douglas-fir.** **Elevation 5,100 ft (1 555 m)**

Camera faces west-southwest at a point near Bozeman Pass on Interstate 90 about 6 miles east of Bozeman. Slopes show effects of past wildfire and cutting.

Photograph courtesy of W. R. McGee, Livingston, Mont.

Plate 77b (July 19, 1981) **About 77 years later**

A long period free of disturbance has allowed development of a dense stand of Douglas-fir mixed with lodgepole pine.

Photograph by R. F. Wall.

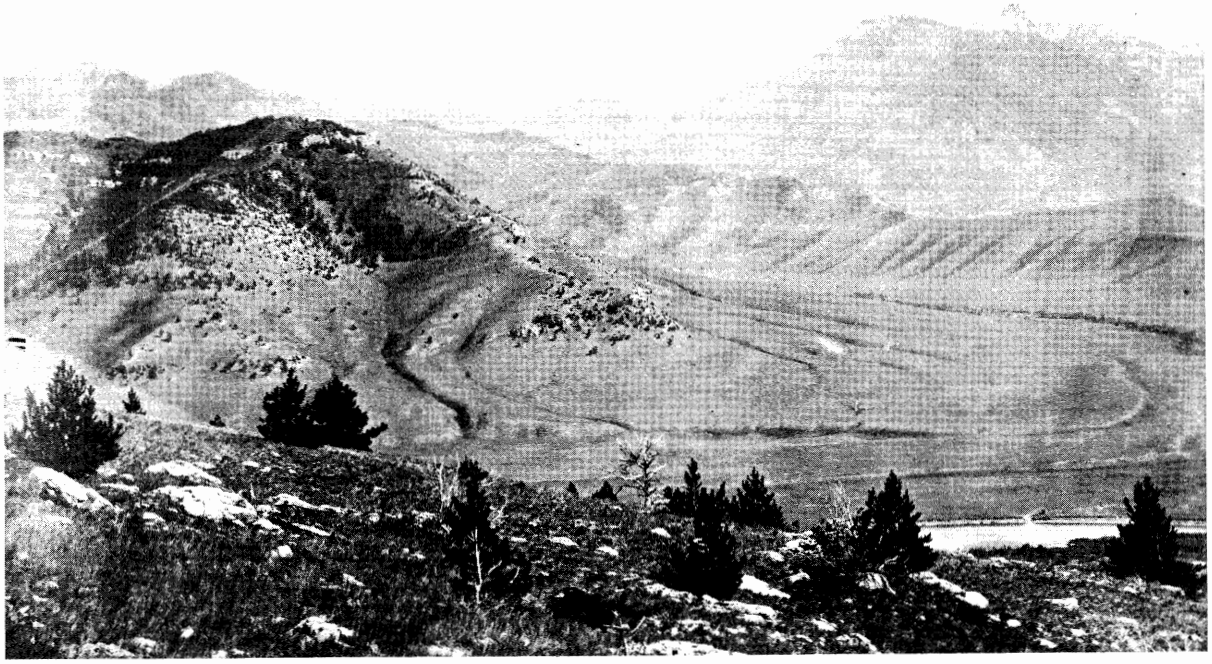


Plate 78a (1871) **Fire Group 5: Cool-dry Douglas-fir.** **Elevation 6,200 ft (1 890 m)**

High on the slopes above the Yellowstone River 10 miles southeast of Livingston, the view is east toward the head of Suce Creek. Snags and age of young limber pine on near slope indicate locality was swept by wildfire several decades earlier. Based on present plant composition, ground cover was apparently dominated by Idaho fescue and bluebunch wheatgrass. Fire mosaics are evident in distance.

W. H. Jackson photograph 57-HS-1213 courtesy of National Archives.

Plate 78b (July 27, 1981) **110 years later**

A dense stand of Douglas-fir, limber pine, and Rocky Mountain juniper now occupies near slope shown in original view. The grass cover on this slope has been largely eliminated by tree canopy closure. Camera was moved approximately 100 yards down slope to allow unobstructed view of distant slopes. Tree cover on distant slopes has increased dramatically.

Photograph by R. F. Wall.

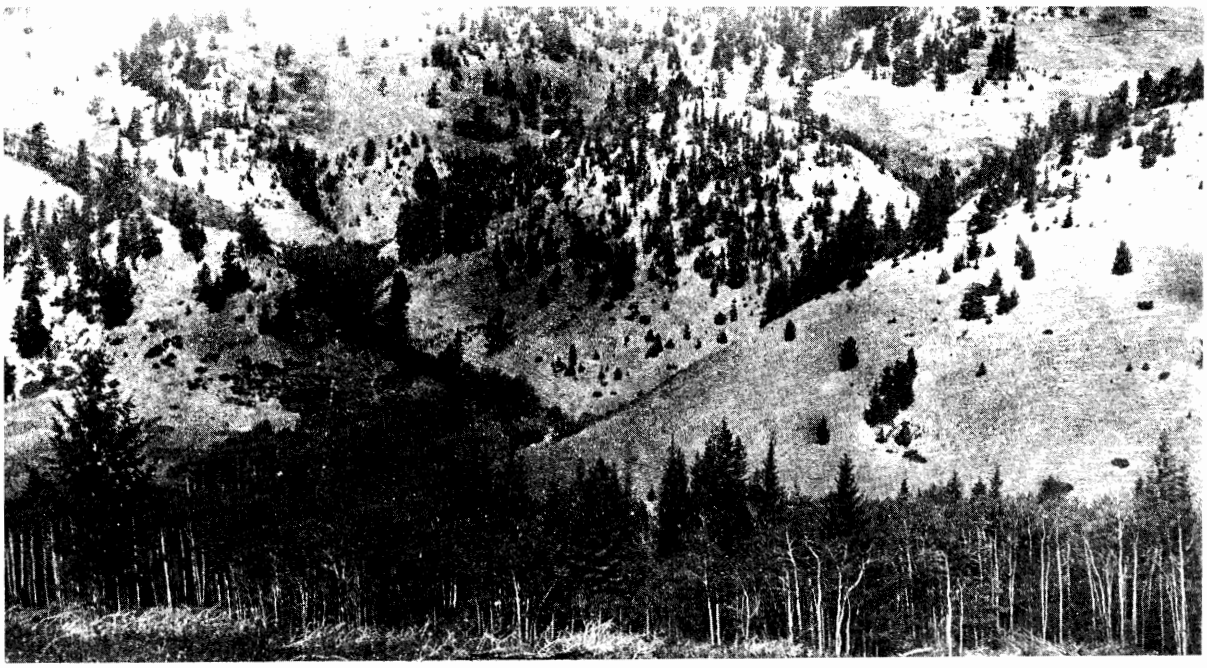


Plate 79a (1911) **Fire Group 5: Cool-dry Douglas-fir.** **Elevation 5,400 ft (1 646 m)**

Camera faces northwest across the Suce Creek tributary of Yellowstone River at a point approximately 2 miles east of Forest Road 469. Downed aspen in foreground were apparently cut during clearing operations for conversion into hay land. Young conifers indicate that a surface fire swept a large portion of the far slopes in the latter 1800's. Considerable evidence of past fires was noted in this locality. Some timber was also cut.

USGS photograph 482 by W. R. Stone.

Plate 79b (July 27, 1981) **70 years later**

Absence of wildfire has allowed Douglas-fir, limber pine, and Rocky Mountain juniper to regenerate on all slopes. On more productive sites, tree canopy closure has resulted in deterioration of deciduous trees and shrubs including aspen, Rocky Mountain maple, willow, chokecherry, and serviceberry.

Photograph by R. F. Wall.

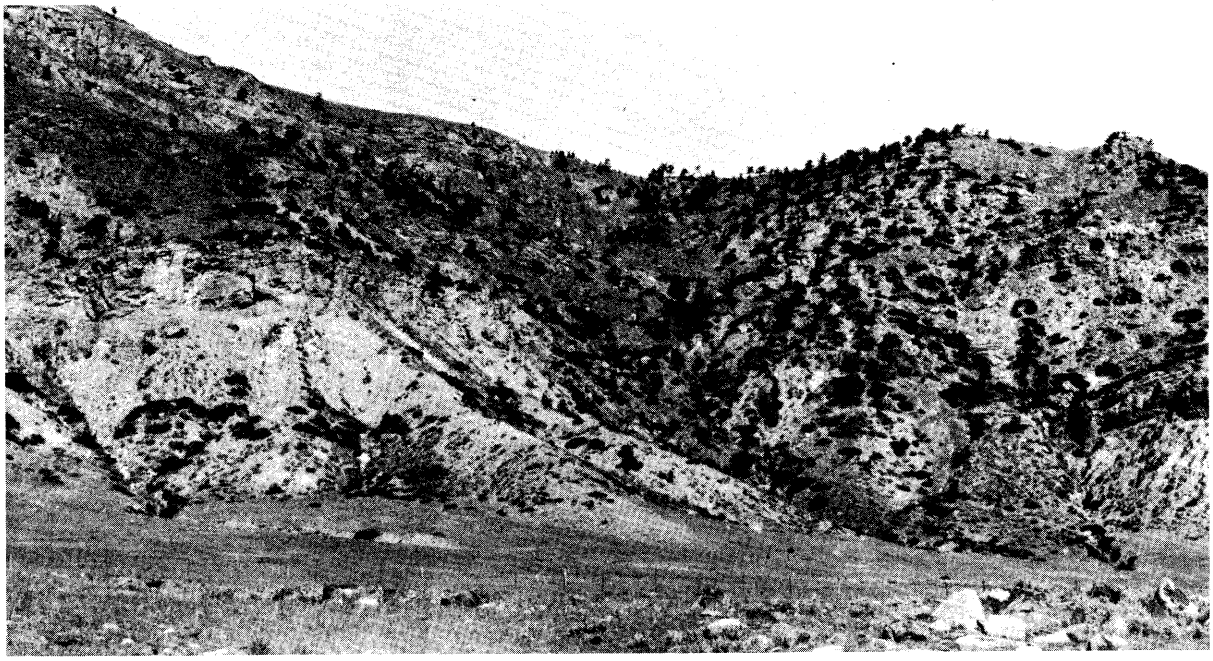


Plate 80a (ca 1909) **Juniper Fire Group.** **Elevation 5,000 ft (1 524 m)**

Looking northwest at the Coal-Mine Rims area on State Highway 298, 4 miles south of McLeod, Mont. Perennial grasses predominate in foreground and midground, while the dry southeast-facing slopes support sagebrush, common juniper, and scattered limber pine.

USGS photograph 73 by W. R. Calvert.

Plate 80b (July 20, 1981) **About 72 years later**

Camera point does not precisely duplicate original. Scene shows strong encroachment of sagebrush on the flats and some encroachment on the near slopes. Common juniper and limber pine have increased.

Photograph by R. F. Wall.

Plate 81a (September 16, 1921) **Fire Group 1: Dry limber pine.** **Elevation 6,100 ft (1 860 m)**

A north-northeast view across Rocky Creek Canyon 5 miles south of Red Lodge, Mont. Aspen, cottonwood, chokecherry, willow, and other deciduous shrubs and trees predominate along drainage. Slopes below rock outcrop on left and beyond creek at right support perennial grasses, sagebrush, and scattered limber pine.

USGS photograph 1158 by W. C. Alden.

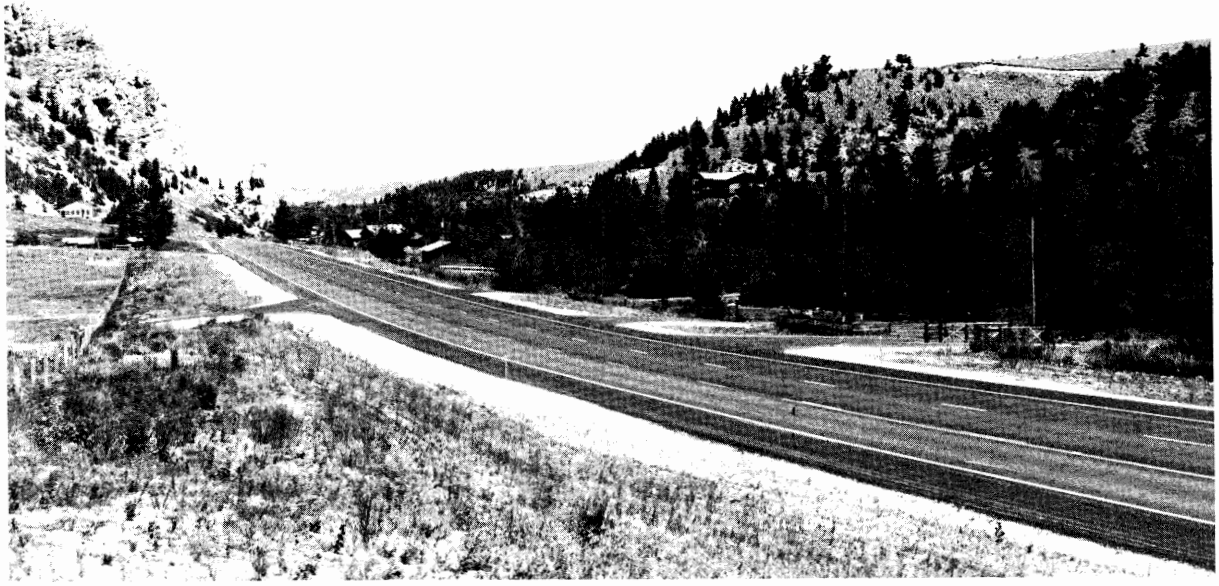


Plate 81b (July 8, 1981) **60 years later**

Camera point was moved across U.S. Highway 212 in order to avoid trees which screened original view. Deciduous vegetation along stream course is being replaced by Douglas-fir and spruce, while slopes in distance at left and beyond Rock Creek show a significant increase in density of limber pine.

Photograph by R. F. Wall.

Southeast Plains Region

The Southeast Plains Region (fig. 5) (plates 82-86) includes the extensive ponderosa pine forests on lowlands and hilly terrain (mostly 2,800 ft [854 m] to 4,400 ft [1 341 m] elevation) in the northern Great Plains. It covers the lower Yellowstone River drainage as far upstream as Big Timber. The region extends up the Musselshell Valley to Harlowton, and its northern boundary includes the northernmost pine groves in the vicinities of Roundup, Miles City, and Baker.

Southeastern Montana has a continental climate. Summers are longer, hotter, and more humid than those in the mountainous forest regions. The majority of the annual precipitation, ranging up to 18 inches in moist forest areas, comes as spring and summer rains.

Approximately 20 percent of this region supports forests (Arno 1979). These forests are largely situated on the Crow and Northern Cheyenne Indian Reservations and the Ashland and Sioux Divisions of the Custer National Forest. The remainder of the region is largely Great Plains grassland.

Although ponderosa pine (Rocky Mountain form, *Ponderosa ponderosa* var. *scopulorum*) is the only forest tree, it occurs in rather diverse types. The driest of these forest sites have open stands of short trees with grassland undergrowth. Conversely, moist north-facing slopes have dense stands of taller ponderosa pine, with a luxuriant shrub and herb understory, including many species characteristic of the mountain forests far to the west. Draws and gullies (ravines) that support many crown-sprouting hardwood trees and shrubs also dissect the landscape.

Prior to settlement, the region was apparently subjected to frequent wildfire. Fires on grasslands may have been similar to those George Catlin saw in the spring and fall during the 1840's north of present day Sidney, Mont. (Catlin 1891). He reported that these fires resulted from accidental ignitions by white men and Indians, "but...many more...were voluntary done for the purpose of getting a fresh crop of grass, for grazing of their horses, and also for easier traveling during the next summer." In the 1840's Denig (Ewers 1961) reported the "firing of the prairies...burned up old grass, fallen timber, and underbrush in the points."

Presettlement wildfires in the low mountains of southeastern Montana were thought to be common. The influence of early fires in the Black Hills of South Dakota, where conditions are comparable to those in the Southeast Plains Region, is evident in photographs taken during the Custer Expedition in 1874 (Progulske 1974). Raynolds (1868) observed fresh burns and smoke in the Black Hills during July 1859. Raynolds (1868) also reported extensive fires in the Little Big Horn drainage and the Wolf Creek Mountains of southeastern Montana during late August and early September 1859. He believed that these fires had been set by Indians. In 1863, Stuart (1902) noted a smoky atmosphere in the Hardin, Mont., locality and observed Indian-set fires in the Big Horn drainage to the southwest.

Large areas within the Southeast Region are occupied by Wyoming big sagebrush. This subspecies has apparently been a component of the climax plant cover as suggested by study of soil productivity potential and climatic relationships by Ross and Hunter (1976). Reduction of sagebrush by fire results in release of associated perennial grasses which may predominate for several decades. Circumstances for proliferation of sagebrush were enhanced in the early 1870's by the advent of domestic livestock grazing and the relocation of Indians to reservations. In the mid-1880's, sagebrush was apparently well represented on many sites favorable to its growth (plates 83 and 84).

Rocky Mountain juniper occupies localized rocky sites or heavily dissected topography. Prior to settlement, junipers were evidently restricted to sites that burned

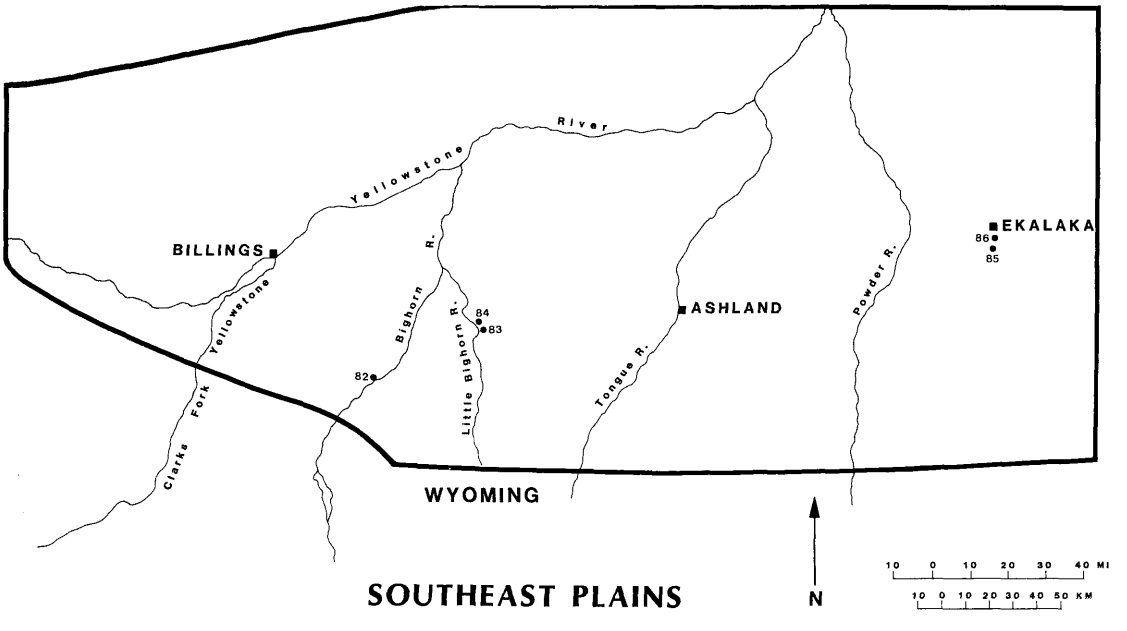


Figure 5.—Southeast Plains Region.

infrequently because fuels were sparse. Encroachment onto sites with deep soils was not likely because of frequent fire. The absence of fire has apparently allowed juniper to become established on deeper soils (plate 83).

Curlleaf mountain-mahogany is present in the Southeast Region, but distribution is largely confined to localized dry sites on the Big Horn River drainage. As in the western part of Montana, this fire-sensitive shrub was small in early photos, and its distribution was restricted to rocky outcrops or areas of sparse fuels where fire occurred infrequently. The absence of fire has apparently allowed regeneration of mahogany seedlings on sites with deep soils that were formerly swept by fire. Established plants have also grown considerably (plate 82).

Ponderosa pine forests within the Southeast Region fall into two fire groups. The dry habitat types are represented by Fire Group 2 while moist sites (usually ravines and north slopes) are included in Fire Group 3. Both groups respond similarly to fire in the Southeast Plains Region.

Presettlement fire frequencies in southeastern Montana have not been determined. Work in comparable pine types in the Black Hills compiled by Crane (1982) suggests frequencies of 13 to 31 years.

On the dry forest sites, fire maintained open ponderosa pine stands and suppressed establishment of trees on adjacent grasslands. Livestock grazing and the absence of fire have allowed the open forests to thicken, while former grasslands have become forested as a result of ponderosa pine invasion (plate 85). Crown-sprouting shrubs such as snowberry, which occupy moist sites, were apparently in good condition in earlier years. It appears that grazing and the long absence of fire resulted in the deterioration of snowberry.

Ponderosa pine stands on moist habitat types seem to have been kept open by frequent low-intensity surface fires. These sites have good potential for supporting shrubs. Frequent fire promoted crown sprouting but may have been too frequent in some areas to allow full development. The absence of fire allowed shrubs to reach full potential; but with extended periods without fire, crown closure of overstory trees has resulted in a decline in shrub condition (plate 86).

Plate 82a (ca. 1920) Mahogany Fire Group. Elevation 3,300 ft (1 006 m)

Looking south-southwest toward the mouth of the Bighorn Canyon about 0.5 miles west of Fort Smith, Mont. Two thousand cattle are gathered on a grassland bench recently dusted by snow. Primary shrub cover on far slopes is curlleaf mountain-mahogany.

Photograph by E. Kopac, courtesy Library of Congress.

Plate 82b (July 10, 1981) About 60 years later

Current scene contrasts with early landscape by presence of Yellowtail Dam, powerlines, and highway. The once open bench now supports a few widely scattered trees. Curlleaf mountain-mahogany on near slope at right are more dense than formerly, while distant slopes on left show a reduction in mahogany as a result of highway construction.

Photograph by R. F. Wall.

Plate 83a (June 25, 1886) **Sagebrush/Grass Fire Group.** **Elevation 3,100 ft (945 m)**

A north-northeast view of Major Reno's retreat crossing of the Little Bighorn River adjacent to Custer Battlefield. Young cottonwood trees occupy foreground. Bottomland shrub cover appears to be predominantly Wyoming big sagebrush, while slopes support Rocky Mountain juniper and shrubs.

Photograph 111 SC 94056 by J. F. Berry, courtesy National Archives.

Plate 83b (July 2, 1981) **95 years later**

Camera is on edge of cultivated field behind original camera point. A few cottonwoods in foreground grew into large trees. Sagebrush continues to predominate on bottomland. Vegetation of slopes appears much the same except for establishment of juniper in draws.

Photograph by R. F. Wall.

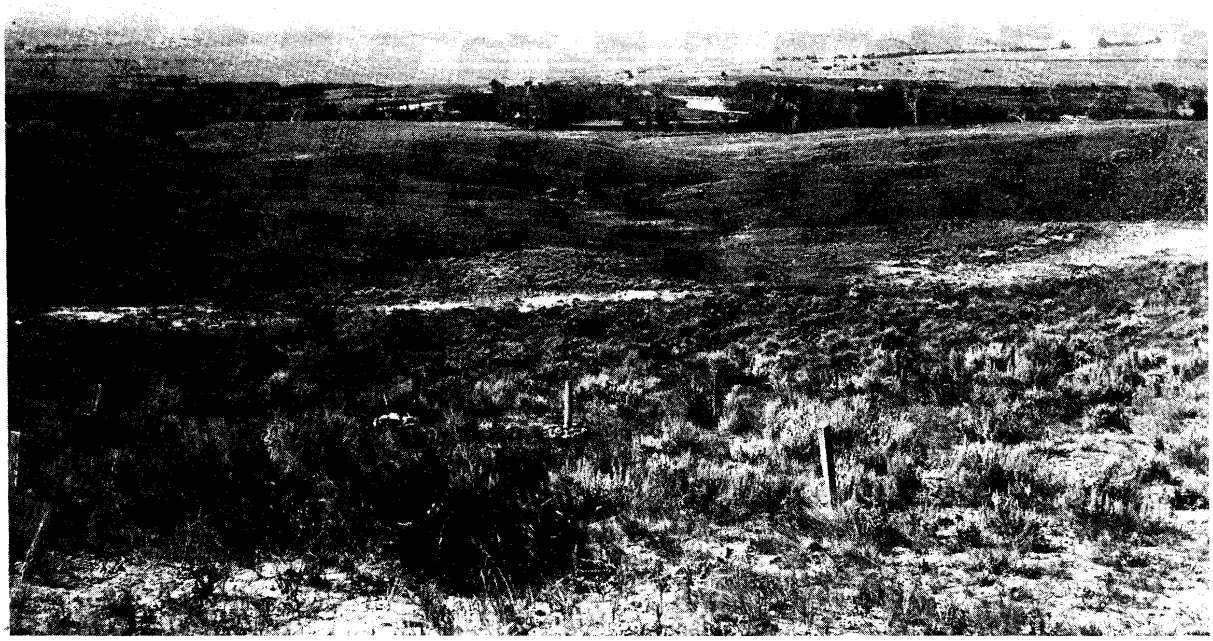


Plate 84a (June 25, 1886) Sagebrush/Grass Fire Group. Elevation 3,300 ft (1 006 m)

Looking south-southwest at posts marking locations where soldiers died during Custer's last stand 10 years earlier, Custer Battlefield National Monument. Ground cover in foreground and midground is an association of perennial grasses and Wyoming big sagebrush. The Little Bighorn River flows through bottomlands below.

Photograph 165-FF-6D-1 by J. F. Barry, courtesy of National Archives.

Plate 84b (July 2, 1981) 95 years later

Foreground has been protected from livestock grazing for about 80 years. Though relocation of camera point is not precise, scene does suggest an increase in herbaceous cover and reduction in sagebrush. Cottonwoods below on Little Bighorn River are more dense.

Photograph by R. F. Wall.

Plate 85a (May 27, 1946) **Fire Group 2: Warm-dry ponderosa pine.** **Elevation 4,000 ft (1 220 m)**
View is south-southeast in the Ekalaka Hills, Custer National Forest, about 1 mile north of the A. Peabody Ranch. Photo was taken for purposes of recording encroachment of ponderosa pine into grasslands and camera point marked by iron stake. Dark shrubs in midground are snowberry. Condition of vegetation suggests that livestock had not grazed this locality at time photograph was taken.
USFS photograph 439987 by K. D. Swan and S. Eckert.

Plate 85b (July 1, 1981) **35 years later**
Scene approximates original due to removal of iron stake reference point. Absence of wildfire has allowed ponderosa pine to occupy former grasslands which have been subjected to intense grazing. Snowberry in center of photo has deteriorated over the past 35 years.
Photograph by R. F. Wall.

Plate 86a (1917) **Fire Group 3: Warm-moist ponderosa pine.** **Elevation 3,800 ft (1 159 m)**

This south-southeast view shows the Lantis sawmill located about 6 miles south of Ekalaka, Mont., on the Custer National Forest. Two age classes of ponderosa pine are evident on slope in distance.

Forest Service photograph, photographer unknown.

Plate 86b (July 1, 1981) **64 years later**

Site occupied by sawmill is now densely covered by a variety of herbs and shrubs. Deciduous shrubs and trees include snowberry, hawthorn, wild plum, aspen, and mountain ash. Ponderosa pine overstory has been harvested.

Photograph by R. F. Wall.

INTERPRETATION AND MANAGEMENT IMPLICATIONS

This study provides visual evidence of vegetative and cultural changes during the period 1871-1982. None of the early photographs were taken before settlement, but several depict conditions during the early stages of settlement when the impacts of European man were minimal. A large number of the early photographs show postsettlement impacts including the effects of livestock grazing, mining, and logging.

Fire and Vegetation

The photo record shows that early stages of plant succession were more common on Montana and Idaho landscapes in the period from 1870-1940 than today. Moist coniferous forests exhibited fire mosaics of young growth interspersed within mature forests. In drier forest types, stands were quite open. Rangelands had a "smoother" appearance, with continuous grass cover and fewer shrubs and trees than in recent times.

Most early photographs show evidence of wildfire. Early narratives document wildfires in various regions of Montana and Idaho, and studies of fire scar patterns have recorded the dates of many fires. The data show that, except for double burns in northern Idaho, fires were infrequent (50 to 250 years) in cool, moist forest habitat types. Warm-dry and cool-dry forest habitat types and range types burned frequently (5 to 40 years).

Historically, the effect of fire on vegetation varied by region. In moist forest habitat types in northern Idaho, western Montana, and at higher elevations elsewhere in Montana, infrequent surface or stand-replacing fires thinned the forest and produced openings. This process resulted in early successional vegetation where shrubs and herbs flourished. Aspen was particularly well represented. In contrast, in dry habitat types frequent surface fires inhibited development of shrubs and conifers and favored grasses. The net result was a landscape that supported fewer shrubs and trees.

European settlement ultimately resulted in a marked reduction in frequency and extent of wildfire's influence on the landscape. Cultural practices including road building and development of irrigated pastures broke fuel continuity. Introduction of domestic livestock on rangelands resulted in yearly consumption of fine fuels that formerly allowed fires to carry over extensive areas. Indian ignitions were eliminated by relocating tribes to reservations. Fire suppression became truly organized in the 1930's, which brought the prompt extinguishing of small fires that had potential to reach large size.

Vegetation has changed significantly because of the marked reduction in acreage burned. As photo-retakes of these scenes show, the most striking change has been the widespread increase in distribution and density of conifers. In moist habitat types, this has resulted in tree canopy closure that intensified competition with early successional herbs and shrubs. This change is subtle because it occurs slowly. Long-term consequences include deterioration and loss of some important wildlife habitats. The decline in condition of aspen has been of particular importance. These trees are seral on most sites, and without periodic disturbances deterioration is inevitable.

The absence of fire in warm-dry and cool-dry forest and range habitat types allowed fire-sensitive shrubs including big sagebrush, bitterbrush, and curlleaf mountain-mahogany to increase. Widespread growth and development of conifers has also taken place. Conifer competition and biotic factors have subsequently resulted in the loss or decline of the fire sensitive and other shrubs in many localities. Perhaps the most striking change has been the encroachment of Douglas-fir into former grasslands or sagebrush/grass types. Extensive areas that formerly supported few, if any, trees have become essentially Douglas-fir forests. On many sites the successional sequence has been bunchgrass followed by sagebrush, which was subsequently replaced by Douglas-fir.

Cutting of conifers for house logs, posts and poles, firewood, mine timbers, railroad ties, and small logs between 1870 and 1920 was also instrumental in initiating changes in vegetation. The level of logging varied regionally depending upon availability and need. In some localities, such as around Butte and Helena, extensive forests were cut for mine timbers and fuel. The impact of this removal was particularly severe in many localities because of low stand density following earlier fires. In ranching and farming regions, heavy cutting occurred where there was easy access. The net result of logging was moderate disturbance of the soil surface and elimination of many conifers that were competing with understory plants for space. It appears that this disturbance was favorable for establishment and growth of understory plants that flourished.

Fire and Wildlife

This historical perspective shows that fire was formerly a major disturbance to vegetation. Vegetative patterns resulting from these fires were optimal for some wildlife species, but marginal or detrimental for other species. Because of environmental changes and current management objectives, historical fire regimes will not recur. In many ecosystems land managers may not want to replicate presettlement conditions. Nevertheless, we should know the role fire played in these ecosystems and the consequences of using or not using fire to meet management objectives.

It is generally accepted that wildfires create vegetative diversity and therefore enhance wildlife habitat. But because of the wide range of fire environments and differing responses of plants to fire in the Northern Rockies, fire effects on wildlife habitat vary considerably. From research, it is evident that infrequent fires (50- to 150-year fire interval) in moist habitat types benefit elk (*Cervus elapus nelsoni*), ruffed grouse (*Bonasa umbellus*), snowshoe hares (*Lepus americanus*), and other species whose habitat requirements include early stages of forest succession (Dimock 1974; Leege and Hickey 1977; Scotter 1964). Although some wildlife species such as pine marten (*Martes americana*) and cavity-nesting birds that require mature and old-growth forest habitats are displaced and sometimes destroyed by wildfires, long-term benefits result to these species (Conner 1978;

Koehler and Hornocker 1977). Periodic fire assures regeneration of important seral conifers and provides snags and downed logs on which these and other species are dependent.

The historical influence of frequent fire on dry ecosystem wildlife habitats has not been adequately studied. It seems probable that grass- and forb-eating herbivores (including bison, pronghorn antelope (*Antilocapra americana*), and bighorn sheep (*Ovis canadensis*), without strong requirements for abundant cover, were favorably influenced by the results of fire. We could expect that fires would have also had a favorable influence on wintering elk, which are primarily grass foragers in these ecosystems (Kirsh 1962; Rouse 1957; Stevens 1966). Small mammals including deer mice (*Peromyscus maniculatus*) and ground squirrels (*Spermophilus* spp.), various raptors, and sharp-tailed grouse (*Pediocetes phasianellus*) dependent on or associated with grassy habitats would have been benefited by fire (Amman 1957; Baker 1940; Davis 1976; Dimock 1974; Kirsh and Kruse 1972). Frequent fires in montane forests, forest/grassland ecotones, and on mountain slopes and benchlands were apparently detrimental to cover dependent species such as cottontail rabbits (*Sylvilagus* spp.) and Brewer's sparrows (*Spizella breweri*). Also frequent fires inhibited the development of shrubs and young conifers important to wintering mule deer (*Odocoileus hemionus*) and whitetail deer (*Odocoileus virginianus*). It appears that, historically, mule deer were largely confined to breaks and rough terrain where shrubs were protected from fires. Whitetail deer frequented riparian bottomlands that were less susceptible to frequent fire.

Wildlife responses to changes in their habitat are largely determined by species' requirements and frequency of disturbance. In the absence of fire, advancing succession has had profound effects upon the capability of habitat to support wildlife. For example, in moist West-Side forest habitat types, elk, mule deer, whitetail deer, bighorn sheep, and other herb- and shrub-dependent species no doubt benefited in terms of food and cover during early stages of forest succession. In deep snow country, where trees provide critical snow interception and thermal cover, optimum habitat may not have been reached for 30 years or more after fire. But, the absence of fire for 50 years or more, with subsequent conifer encroachment, canopy closure, and deterioration of herbs and shrubs has resulted in deterioration of big game habitat (Lyon 1966). Successional changes, however, have been favorable for cavity-nesting birds that require conifer, aspen, or cottonwood snags for nesting. Advanced successional stages supporting conifers are also essential habitat for small mammals, including redback voles (*Clethrionomys* spp.), tree squirrels (*Tamiasciurus hudsonicus*), and pine marten (Gashwiler 1970; Halvorson 1981; Koehler and Hornocker 1977). Closure of the forest canopy has been detrimental to other small mammals and birds including deer mice, snowshoe hares, ruffed grouse, and blue grouse (*Dendragapus obscurus*) (Bendell and Elliott 1967; Dimock 1974; Fox 1978; Gullion 1967; Hooven 1969).

The absence of fire in dry West-Side and East-Side forest and range habitat types has allowed successional development to proceed further than was possible during presettlement times. During earlier stages, diversity apparently improved in this vegetative complex because of development of woody plants on grassland sites and lightly stocked forests. The establishment of conifers and fuller development of fire-sensitive sagebrush, bitterbrush, curlleaf mountain-mahogany, and other shrubs were particularly beneficial to mule deer. In recent decades, however, further successional changes have resulted in a decline and loss of forage plants on many of these sites. Increased cover seems to have benefited whitetail deer that now occupy heavily forested areas (Gruell and others 1982). These areas formerly supported few if any whitetails and apparently were marginal habitat because of cover limitations. Increases in cover would seemingly benefit elk in many localities where cover has been limiting. Development of trees and shrubs on grasslands and lightly stocked forests should favor foliage feeders and nesters such as Brewer's sparrow, mountain chickadee (*Parus gambeli*), and ruby-crowned kinglet (*Regulus calendula*). Continued long-term succession leading to continuous forest cover would displace grassland species including the vesper sparrow (*Pooecetes gramineus*), Savannah sparrow (*Passerculus sandwichensis*), sharp-tailed grouse, and whitetail jackrabbits (*Lepus townsendii*).

Prescribed Fire

Ecologically, fire converts vegetation from an old stage or decadency to a young stage. Fire is the first and oftentimes essential step in long-term development of vegetation. Fire effects depend upon climate, plant species on the site, and the fire characteristics. Fire severity is important because it influences plant species composition and landscape patterns. A severe fire will kill many plants, but it also allows regeneration of other desirable plants that require a seedbed of mineral soil for establishment. Fire can be used to improve wildlife habitat and other resources. The challenge, however, is to see that application of fire is consistent with demonstrated needs and predictable response.

Use of prescribed fire to improve productivity of wildlife habitats has varied among forest regions. Almost all the effort to date in northern Idaho and Montana has been confined to forest habitat types that support few if any conifers. By far the largest acreage treated has been in the productive seral shrubfields in warm-moist habitat types of northern Idaho. These shrubfields largely developed following large wildfires between 1910 and 1935, but have deteriorated with advancing succession. The objective of burning has been to improve availability and palatability of shrubs on southerly exposures by killing aerial stems and stimulating crown sprouting. Ash beds on mineral soil from some of the hotter burns have also allowed establishment of shrub seedlings.

Prescribed fire has been utilized east of the Continental Divide in localities where big sagebrush has invaded

former grasslands. Most of this burning has taken place on the Beaverhead National Forest, an area that supports some of the most extensive successional sagebrush stands in Montana. Prescribed fire has largely replaced use of herbicides and has resulted in reduction of big sagebrush and stimulation of herbaceous plants. Such conversion has enhanced elk spring and winter ranges.

Prescribed burning has also improved spring ranges utilized by mule deer. Some prescribed burns have had short-term negative effects on mule deer habitat by removing big sagebrush, an important winter forage. There are widespread opportunities to improve the long-term productivity of big game winter and spring ranges by judicious use of prescribed fire. Opportunities are evident where extensive decadent big sagebrush stands are intermixed with deciduous shrubs. The size of these burns should be dictated by season of use by wildlife. If cover is not of major concern, burns on spring ranges, where sagebrush is not an important food item, could be larger than those on winter ranges.

There are also opportunities to use fire in various conifers. To date, most effort has been associated with broadcast and pile and burn treatments on commercial forest lands for purposes of reducing fuels for silvicultural purposes (Noste and Brown 1981).

Progress is being made applying surface fire in standing timber. Good results have been attained where ladder fuels have not been excessive. Over 20 year's experience in using surface fire beneath ponderosa pine, Douglas-fir, and larch on the Rexford Ranger District, Kootenai National Forest, has resulted in considerable refinements in the fire prescription and application (personal communication, George Curtis 1982).

Perhaps the greatest challenge for use of prescribed fire is on East-Side bunchgrass and juniper habitat types that have been invaded by Douglas-fir. The Deerlodge National Forest has placed these warm-dry, and cool-dry habitat types in the noncommercial category because of their low timber producing potential (less than 20 ft^3/acre annually). Here, increased distribution of early successional Douglas-fir should be of concern to land managers. Thinning of tree canopies by use of prescribed fire is appropriate, and reliable prescriptions are being developed. Past prescribed burning experience in this type and response of vegetation to earlier wildfires provide a basis for formulating prescriptions. It is evident that where trees are dense or of value (as firewood, posts and poles, or house logs) removal before ignition would be logical. Leaving unutilized material could enhance fuels and allow fires to carry across areas where fuel continuity was lacking. These treatments may require acceptance of short-term setbacks to achieve long-term benefits for wildlife habitat.

A large percentage of wildlife habitat in the mountains is located in moist Douglas-fir habitat types and cool habitat types dominated by lodgepole pine that are usually classified as commercial forests. These habitat types have a high potential for production of shrubs and herbs during early and middle stages of succession. Aspen are a major component in various localities. Past logging practices on these lands have been both detrimental and beneficial for wildlife. The principal detrimental effect has been that of building roads that have provided increased access of people. Elk use of clearcuts has been severely depressed by the presence of roads and inadequate cover at the edge of openings (Lyon and Jensen 1980). Where roads have been closed, removal of timber has enhanced wildlife habitat by allowing elk to utilize early successional plants.

There are widespread opportunities to utilize logging and prescribed fire to improve wildlife habitat on commercial forest lands. Land managers and resource specialists should become familiar with such opportunities in their area of concern. Priority areas include aspen/conifer associations where aspen has deteriorated as a result of successional changes. Wildlife biologists working with silviculturists have an opportunity to identify priority areas and the type of treatments that will yield the best results. Planning for wildlife concerns and fire concerns would determine placement of harvested blocks and access roads to facilitate use of broadcast burning. Fire should be an essential part of the prescription. For example, it would create a seedbed of mineral soil that would allow regeneration of pioneering species like Scouler willow and evergreen ceanothus.

A long-term increase in conifers and a decline in herbs, shrubs, and deciduous trees is an undesirable trend in wildlife habitat. Control of conifer growth by timber harvests and prescribed fire can be a powerful means of achieving productive wildlife habitat. A major challenge in managing wildlife habitat is bringing about a proper mix of young and old successional stages.

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APPENDIX I. FIRE GROUPS

Juniper Fire Group

The Juniper Fire Group is dominated by Rocky Mountain juniper. It is found locally in the North-Central and South-Central Regions in pure stands or in association with scattered limber pine or Douglas-fir. The understory is often sparse being comprised mostly of grasses and dry site forbs. Big sagebrush is often a major understory shrub. Sites occupied by juniper are dry, often being exposed bluffs, rocky outcrops, and rocky southern exposures where most conifers are unable to exist.

Sagebrush/Grass Fire Group

The Sagebrush/Grass Fire Group is widely distributed on nonforested lands (Mueggler and Stewart 1980). A large majority of the sagebrush component is nonsprouting mountain big sagebrush and Wyoming big sagebrush. Mountain big sagebrush predominates in the North-Central and South-Central Regions, while Wyoming big sagebrush is the common sagebrush in the Southeast Plains Region. Great Basin big sagebrush, the largest of the big sagebrush subspecies, is of limited distribution.

The composition and density of grasses and forbs associated with big sagebrush varies considerably because of site differences. On drier sites, big sagebrush often grows in association with grasses, while forbs and other shrubs are less common. Where soil moisture is good, sagebrush is usually mixed with varying quantities of herbs. Crown-sprouting shrubs and aspen are significant components on local moist sites.

The historical distribution of sagebrush in Montana has not been clearly defined. Early narratives and site potential evaluations suggest it has been a natural dominant (climax) on some sites. On others it appears to be successional (invader) (Morris and others 1976).

Curlleaf Mountain-Mahogany Fire Group

The Curlleaf Mountain Mahogany Fire Group is restricted to small isolated stands on local sites in all regions except the northern portion of the West-Side and North-Central Regions. Stands are often on dry, rocky, steep slopes with westerly exposures. Best development is in the South-Central Region where stands may be 20 acres (8 ha) or more.

Site characteristics vary regionally. Stands at low elevations in the Bitterroot Valley and the Big Belt Mountains are associated with ponderosa pine. Those elsewhere are either associated with Douglas-fir or limber pine or are on nonforested sites where surface soil moisture deficiencies preclude conifers. These stands are typically dominated by mahogany with bunchgrass understories of varying cover development that fit the *Cercocarpus ledifolius/Agropyron spicatum* habitat type (Mueggler and Stewart 1980).

Curlleaf mountain-mahogany is a fire-sensitive species that has a low potential to regenerate vegetatively. Nevertheless, sprouts do occur on stems that survive fire, and fire scars may form on partially killed stems. Stands usually regenerate by seeds that have rather short 2- to 3-year viability. Many curlleaf mountain-mahogany stands in Montana appear to be uneven aged (Duncan unpublished; Lonner unpublished).

Fire Group 1—Dry Limber Pine Habitat Types

Fire Group 1 habitat types occupy some of the driest sites capable of supporting trees. With few exceptions, this group is found east of the Continental Divide. Stands are usually dominated by limber pine but can include considerable Douglas-fir, Rocky Mountain juniper, and common juniper.

Group 1 stands are best developed in the foothills along the Rocky Mountain front on the edge of the Great Plains in north-central Montana. Stands are also widely dispersed, oftentimes being restricted to steep, rocky slopes at lower to middle elevations in the North-Central and South-Central Regions. Bluebunch wheatgrass dominates the understory at lower elevations on drier sites. With increasing moisture, either Idaho fescue or rough fescue predominate. Because of low soil moisture, shrub production is inherently low.

Fire Group 2—Warm-Dry Ponderosa Pine Habitat Types

Fire Group 3—Warm-Moist Ponderosa Pine Habitat Types

Fire Groups 2 and 3 are found in the North-Central, Southeast Plains, and West-Side Regions. Fire Group 2 habitat types consist of ponderosa pine stands with a predominantly grass understory. Sites are typically hot, dry, south- and west-facing slopes at low elevations, forming the lower timberline. These are habitats that formerly existed as open ponderosa pine stands on fire-maintained grassland. Today they support ponderosa pine in varying density. Stands are oftentimes extensive on flats and rolling terrain. Moisture stress is a critical factor for plant growth during summer months. Because of this the potential for shrub development is low.

Fire Group 3 habitat types are more moist and slightly cooler than Group 2. They are usually found in ravines or on north slopes where the availability of soil moisture is higher. Because of better growing conditions, these sites have good potential for production of shrubs and ponderosa pine. Rocky Mountain juniper can also compete successfully. Ponderosa pine stand structure varies from dense, doghair stands to those that appear to be all aged, with scattered regeneration or even two or three size classes (Pfister and others 1977).

Fire Group 4—Warm-Dry Douglas-Fir Habitat Types

Fire Group 4 consists of droughty Douglas-fir habitat types that are favorable for production of bunchgrasses. These types are largely found in the West-Side and North-Central Regions. Ponderosa pine usually occurs as a major seral or climax associate at lower elevations. At higher elevations in the upper Clark Fork and east of the Continental Divide, ponderosa pine are absent and Douglas-fir is the major conifer.

The understory is usually sparse because of low available surface moisture. Major herbs include bluebunch wheatgrass, rough and Idaho fescue, pinegrass, arrowleaf balsamroot, western gromwell, junegrass, and spreading dogbane. Shrubs may include common snowberry, kinnikinnick, white spiraea, bitterbrush, sagebrush, chokecherry, serviceberry, and common juniper. On the East-Side, Rocky Mountain juniper may be a minor climax species on PSME/AGSP h.t.'s, and accidental limber pine may occur.

Fire Group 5—Cool-Dry Douglas-Fir Habitat Types

Fire Group 5 habitat types support Douglas-fir during all stages of succession. They are found in all regions except the Southeast Plains. These sites are generally too dry for lodgepole pine and too cold for ponderosa pine. Stand age and density vary. Most stands are less than 120 years old. On north- and northeast-facing slopes, however, dense stagnant stands have developed in the absence of fire.

The understory in most Group 5 habitat types is primarily comprised of forbs and grasses. Representative forbs include pussytoes, heartleaf arnica, timber milkvetch, arrowleaf balsamroot, virginsbower, strawberry, sweet cicely, cleftleaf groundsel, and western meadowrue. Common grasses include bluebunch wheatgrass, pinegrass, elk sedge, Idaho fescue, rough fescue, Wheeler bluegrass, and spike trisetum. Shrubs are a minor component. Representative species include big sagebrush, common juniper, wax currant, russet buffaloberry, white spiraea, and mountain snowberry.

Fire Group 6—Moist Douglas-Fir Habitat Types

Fire Group 6 habitat types occur in all regions except the Southeast Plains at elevations of slightly less than 5,000 ft (1 525 m) to about 7,000 feet (2 135 m). This fire group is dominated by Douglas-fir, which is both climax and a vigorous member of seral communities. It is not uncommon for Douglas-fir to dominate all stages of succession on Group 6 sites. Lodgepole pine is a major seral component. Whitebark pine is usually well represented at upper elevations and limber pine is common on limestone substrates on PSME/PHMA-PHMA sites in the South-Central Region.

Understory plant composition will vary by habitat type and phase. Because of abundant surface moisture, shrubs and moist site forbs are common. Pinegrass, beargrass, and elk sedge predominate on most sites.

Common shrubs include ninebark, common snowberry, white spiraea, oceanspray, blue huckleberry, grouse whortleberry, kinnikinnick, twinflower, and common juniper. Aspen and willow are also represented on many sites.

Fire Group 9—Moist, Lower Subalpine Habitat Types

Fire Group 9 is found in the cooler sites in all regions except the Southeast Plains. These habitat types represent a wide range of conditions in the subalpine and spruce series. They are most widely represented in the West-Side and North-Central Regions.

Fire Group 9 habitat types support a variety of conifers. Subalpine fir is the major climax dominant. Stands usually include Douglas-fir, lodgepole pine, and larch as major seral components. Western white pine is also a persistent seral component of many stands. Engelmann spruce functions as a resistant seral species on the more moist sites.

A wide variety of plants occur in the understory of Fire Group 9 habitat types. The more common grass and grasslike plants include bluejoint, pinegrass, elk sedge, and beargrass. Widely distributed forbs include broadleaf arnica, heartleaf arnica, queencup beadlily, sidebells pyrola, and darkwoods violet. Some of the more common shrubs are smooth menziesia, Sitka alder, prickly currant, thimbleberry, white spiraea, and blue huckleberry.

Fire Group 11—Warm-Moist Grand Fir, Western Redcedar, and Western Hemlock Habitat Types

This group is a collection of warm, moist habitat types, occurring on moist valley bottoms, benches, ravines, and protected exposures in the West-Side Region. Grand fir, western hemlock, and western redcedar are primary tree species. Associated trees include Douglas-fir, western larch, lodgepole pine, ponderosa pine, western white pine, subalpine fir, and spruce.

Understory plants include a rich assortment of herbs and shrubs that predominate for several decades after disturbance. Understory plants degenerate following forest canopy closure. Stands in advanced succession contain mostly shade tolerant herbs, and understory biomass is generally reduced.

APPENDIX II. PLANTS DISCUSSED IN TEXT

Common name	Scientific name
TREES	
Grand fir	*Abies grandis*
Subalpine fir	*Abies lasiocarpa*
Rocky Mountain juniper	*Juniperus scopulorum*
Western larch	*Larix occidentalis*
Engelmann spruce	*Picea engelmannii*
Whitebark pine	*Pinus albicaulis*
Lodgepole pine	*Pinus contorta*
Limber pine	*Pinus flexilis*
Western white pine	*Pinus monticola*
Ponderosa pine	*Pinus ponderosa*
Douglas-fir	*Pseudotsuga menziesii*
Western redcedar	*Thuja plicata*
Western hemlock	*Tsuga heterophylla*
Mountain hemlock	*Tsuga mortensiana*
SHRUBS AND SUBSHRUBS	
Mountain maple	*Acer glabrum*
Sitka alder	*Alnus sinuata*
Serviceberry	*Amelanchier alnifolia*
Kinnikinnick	*Arctostaphylos uva-ursi*
Silver sagebrush	*Artemisia cana*
Great Basin big sagebrush	*Artemisia tridentata tridenta*
Mountain big sagebrush	*Artemisia tridentata vaseyan*
Wyoming big sagebrush	*Artemisia tridentata wyomingensis*
Black sagebrush	*Artemisia nova*
Threetip sagebrush	*Artemisia tripartita*
Water birch	*Betula occidentalis*
Evergreen ceanothus	*Ceanothus velutinus*
Dogwood	*Cornus stolonifera*
Hawthorn	*Crataegus* spp.
Curlleaf mountain-mahogany	*Cercocarpus ledifolius*
Oceanspray	*Holodiscus discolor*
Common juniper	*Juniperus communis*
Twinflower	*Linnaea borealis*
Smooth menziesia	*Menziesia ferruginea*
Mockorange	*Philadelphus lewisii*
Ninebark	*Physocarpus malvaceus*
Shrubby cinquefoil	*Potentilla fruticosa*
Cottonwood	*Populus* spp.
Narrowleaf cottonwood	*Populus angustifolia*
Aspen	*Populus tremuloides*
Wild plum	*Prunus americana*
Chokecherry	*Prunus virginiana*
Bitterbrush	*Purshia tridentata*
Skunkbush	*Rhus trilobata*
Wax currant	*Ribes cereum*
Prickly currant	*Ribes lacustre*
Rose	*Rosa* spp.
Thimbleberry	*Rubus parviflorus*
Scouler willow	*Salix scouleriana*
Russet buffaloberry	*Shepherdia canadensis*
Mountain ash	*Sorbus scopulina*
White spiraea	*Spiraea betulifolia*
Common snowberry	*Symphoricarpus albus*
Mountain snowberry	*Symphoricarpus oreophilus*
Blue huckleberry	*Vaccinium globulare*
Grouse whortleberry	*Vaccinium scoparium*

Common name	Scientific name
PERENNIAL GRAMINOIDS	
Bluebunch wheatgrass	*Agropyron spicatum*
Smooth brome	*Bromus inermis*
Cheatgrass	*Bromus tectorum*
Bluejoint	*Calamagrostis canadensis*
Pinegrass	*Calamagrostis rubescens*
Elk sedge	*Carex geyeri*
Ryegrass	*Elymus* spp.
Idaho fescue	*Festuca idahoensis*
Rough fescue	*Festuca scabrella*
Junegrass	*Koeleria cristata*
Wheeler bluegrass	*Poa nervosa*
Spike trisetum	*Trisetum spicatum*
PERENNIAL FORBS	
Pussytoes	*Antennaria racemosa*
Spreading dogbane	*Apocynum androsaemifolium*
Heartleaf arnica	*Arnica Cordifolia*
Broadleaf arnica	*Arnica latifolia*
Timber milkvetch	*Astragalus miser*
Arrowleaf balsamroot	*Balsamorhiza sagittata*
Virginsbower	*Clematis pseudoalpina*
Queencup beadlily	*Clintonia uniflora*
Fireweed	*Epilobium angustifolium*
Strawberry	*Fragaria* spp.
Western gromwell	*Lithospermum ruderale*
Lupine	*Lupinus* spp.
Sidebells pyrola	*Pyrola secunda*
Cleftleaf groundsel	*Smilacina racemosa*
Western meadowrue	*Thalictrum occidentale*
Darkwoods violet	*Viola orbiculata*
Beargrass	*Xerophyllum tenax*

APPENDIX III. HISTORICAL EVIDENCE OF FIRE IN MONTANA

Observer	Reference	State	Locality	Date	Indian ignition	Remarks
Lewis and Clark	Thwaites 1959	Montana	Gate of the Mountains	July 20, 1805	X	...we saw the smoke arrise as if the country had been set on fire up the valley...we were at a loss to determine whether it had been set on fire by the natives as a signall among themselves...as is their custom....
			Three Forks, Missouri River	July 25, 1805	X	On the north side the indians have lately set the prairie on fire, the cause I can't account for....
			Clark Canyon Dam	Aug. 23, 1805	X	I also laid up the canoes this morning in a pond near the forks; sunk them in the water...hoping by this means to guard against...and that of fire, which is frequently kindled in these plains by the natives.
			Horse Prairie	Aug. 25, 1805	X	This part of the cove on the N.E. side of the Creek has lately been birned by the Indians as a signal on some occasion.
			Yellowstone River below Livingston	July 19, 1806		I saw a Smoke in the same direction with that which I had seen on the 7th ins.t & it appeared to be in the Mountains.
			Yellowstone River vicinity of Tongue River	July 30, 1806		Here is the first appearance of Birnt hills which I have seen on this river.
W. A. Ferris	Phillips 1940	Montana	Big Hole Valley	Sept. 1, 1831	?	...we were now on the borders of the Blackfoot country and had frequently seen traces of small parties, who it was reasonably inferred might be collected by smoke, which is their accustomed rallying signal...Clouds of smoke were observed on the following day curling up from the summit of a mountain...
			Upper Bitterroot Valley	Aug. 13, 1833	X	The indians with us announced our arrival in this country by firing the prairies. The flames ran over the neighboring hills with great violence....
George Catlin	Catlin 1891	Montana	Fort Union, Missouri River	1832		Every acre of these vast prairies (being covered for hundreds and hundreds of miles, with a crop of grass, which dies and dries in the fall) burns over during the fall or early in the spring....
Maximilian	Thwaites 1966	Montana	Upper Missouri	Sept. 1833	X	The Indians had used or burnt the hay that was in the prairies....
Osborne Russell	Haines 1865	Montana	Lower Hegen Lake	Sept. 10, 1835	X	They [Blackfeet Indians] commenced setting fire to the dry grass and rubbish with which we were surrounded...in a few moments the fire was converted into one circle of flame and smoke which united over our heads.

E. T. Denig	Ewers 1961	Montana	Fort Union area	1833-1855		The short summer season allows vegetation but little time to decay, and the firing of the prairies, which happens more less every year in different parts, burns up all old grass, fallen timber and underbrush in the points.
John Mullan	Mullan 1855	Montana	Near outlet of Little Blackfoot River	Sept. 1853		In Many places the valley has been burnt over, and the young green grass is growing abundantly.
			Big Hole River south of Melrose, Mont.	Dec. 30, 1853	X	Our trail, up to the crossing of the Wisdom river, lay through large patches of sage; in many places, however, burnt over by the indians.
			Divide locality	Dec. 31, 1853	X	We found the valley had been burnt over recently, showing that Indians had proceded us....
John Mullan	Mullan 1863	Montana	Coeur d'Alene Mts.	Aug. 22, 1859		The country was filled with smoke, and no extensive view could be gained....
				Aug. 23, 1859		...but the atmosphere still filled with smoke....
			Clark Fork, Thompson Falls locality	Aug. 26, 1859		An extensive fire was raging on the Clark's Fork.... The rain and wind had driven off the smoke, and fire lines, extending high up on the mountain slopes reaching, in some places, to the very tops of the ridges....
				Aug. 27, 1859		The opposite shore is in full blaze, and the wind blowing from the west drives the flames unfortunately in the direction which I have to follow.
John Mullan	Mullan 1861	Montana	Vicinity of Missoula	Mar. 10, 1860	X	The grass had been all burned by the indians along the Bitter Root river when we reached the Bitter Root crossing....
W. F. Raynolds	Raynolds 1868	Montana	Yellowstone River below Fort Sarpy	Aug. 14, 1859	?	Large fires are visable in the Wolf Creek mountains this afternoon, probably the signals of indians who are undoubtedly watching our movements....
			Soap Creek tributary Big Horn River	Sept. 9, 1859	?	Extensive fires have burned over much of this country, seriously injuring the grass, and as this seems to have been of recent occurrence, I imagine that it is the act of the Indians, who are thus seeking to impede our progress.
			Tributary to Big Horn River	Sept. 10, 1859		...continued over the next ridge hoping to find a suitable spot in the valley beyond, but upon reaching it no water could be discovered, and all the grass had been recently burned.

(con.)

APPENDIX III. (con.)

Observer	Reference	State	Locality	Date	Indian ignition	Remarks
W. F. Raynolds (con.)			Lodgegrass Creek tributary to Little Big Horn River	Sept. 10, 1859		I proceeded over the hill and was sadly disappointed as I looked down the valley to see the blackmarks of fire along the west side....
			Pass Creek tributary of Tongue River	Sept. 12, 1859		A large portion of the grass has just been burned over, and the surface of the country is therefore black and forbidding; but it is evident that, in the spring, the prospect is most beautiful from the exuberance of verdure and foliage.
			Tributary of Tongue River	Sept. 13, 1859		The general aspect of the country remains unchanged, but a thick smoky atmosphere has prevented our enjoying the full benefit of the scenery....
Granville Stuart	Phillips 1957	Montana	Clark Fork River	July 22, 1861	X	War parties of Bannocks have the mountains on fire in all directions.
				July 29, 1861		From here (Gold Creek) to Flint creek, about thirteen miles the land on the south side of the river has been all burned over along the face of the mountains, we do not know whether it was started by whites, Indians, or lightning. The fire is still going south towards Deer Lodge valley.
				July 31, 1861		Fire still coming down the creek.
				Aug. 14, 1861		Clear, warm, and nearly calm, very smoky....Fires still burning on the mountains.
				Sept. 5, 1861		Warm and smoky.
James Stuart	Stuart 1902	Montana	Near outlet of Little Big Horn	May 8, 1863		...then another low bench rising above the first and extending as far as the smoky atmosphere will admit seeing.
			Tributary of Big Horn River south of Fort Smith	May 16, 1863	X	...I noticed what I took to be an Indian Smoke signal. Seeing it a second time, I was satisfied it was a signal...and shortly after we saw several distinct signals, which I knew were intended to gather the Indians together for a attack on us.

Walter DeLacy	DeLacy 1902	Montana	South of Red Rock Creek	Aug. 8, 1863		On the 9th, we crossed the devide to Red Rock Creek, and on the 10th, made a long march to Dry Creek, in consequence of the grass having been burnt on the greater part of the days march.
			Lower Gallatin River	Sept. 18, 1863	?	After a toilsome march of five miles we came to a small flat, partially burnt....and passing through another canyon of four miles...the grass was partly burnt also on this flat. As this would seem to indicate that Indians might be near....
			Gallatin Valley	Sept. 18, 1863		The grass over the whole country had been burnt.
F. V. Hayden	Hayden 1872	Montana	Upper Gallatin River	1872		The fires frequently run over the mountains, killing the green pines, so that they soon after fall down covering the ground.
Captain V. Havard	Havard 1878	Montana	Eastern Montana	1877		These adverse circumstances may be several, but the main and all-important one is the prairie-fires which, every fall and spring sweep over immense areas....
Granville Stuart	Phillips 1957	Montana	Judith Mountains, Fort Maginnis locality	Sept. 16, 1881		Fires sprang up in all directions almost simultaneously and spread with alarming rapidity....Great columns of black smoke lolled up in every direction filling the air with ashes and cinders...For ten days every available man in the country, with wet gunny bags, fought the flames with desperation, some of them sinking in their tracks from exhaustion...In spite of almost superhuman efforts more then five hundred square miles of the finest grass land in eastern Montana lay a blackened waste.
			Judith Mountains	July 1885		In spite of every precaution range fires would start and as it was so hot and dry it was very hard to put them out when they did start. Big fires along the east of the Judith range and on the Musselshell filled the air with smoke and cinders. Crews of fire fighters were kept busy all summer.

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Gruell, George E. Fire and vegetative trends in the Northern Rockies: interpretations from 1871-1982 photographs. Gen. Tech. Rep. INT-158. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1983. 117p.

Interprets changes in forest and range vegetation resulting from the absence of fire. Eighty-six matched photographs covering the period 1871-1982 provide the basis for describing how vegetation has changed in various plant communities. These scenes show that woody vegetation has increased markedly as a result of reduced wildfire. An increase in conifers and deterioration of herbs, shrubs, and deciduous trees is resulting in loss of habitat upon which early and midsuccessional wildlife species depend. Implications on wildlife and opportunities for use of cutting and prescribed fire to improve wildlife habitat are discussed.

KEYWORDS: forest succession, sagebrush/grass, fire, wildlife, photographic record

The Intermountain Station, headquartered in Ogden, Utah, is one of eight regional experiment stations charged with providing scientific knowledge to help resource managers meet human needs and protect forest and range ecosystems.

The Intermountain Station includes the States of Montana, Idaho, Utah, Nevada, and western Wyoming. About 231 million acres, or 85 percent, of the land area in the Station territory are classified as forest and rangeland. These lands include grasslands, deserts, shrublands, alpine areas, and well-stocked forests. They supply fiber for forest industries; minerals for energy and industrial development; and water for domestic and industrial consumption. They also provide recreation opportunities for millions of visitors each year.

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