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# Interpreting Landscape Change in High Mountains of Northeastern Oregon from Long-Term Repeat Photography

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and Arthur W. Sampson

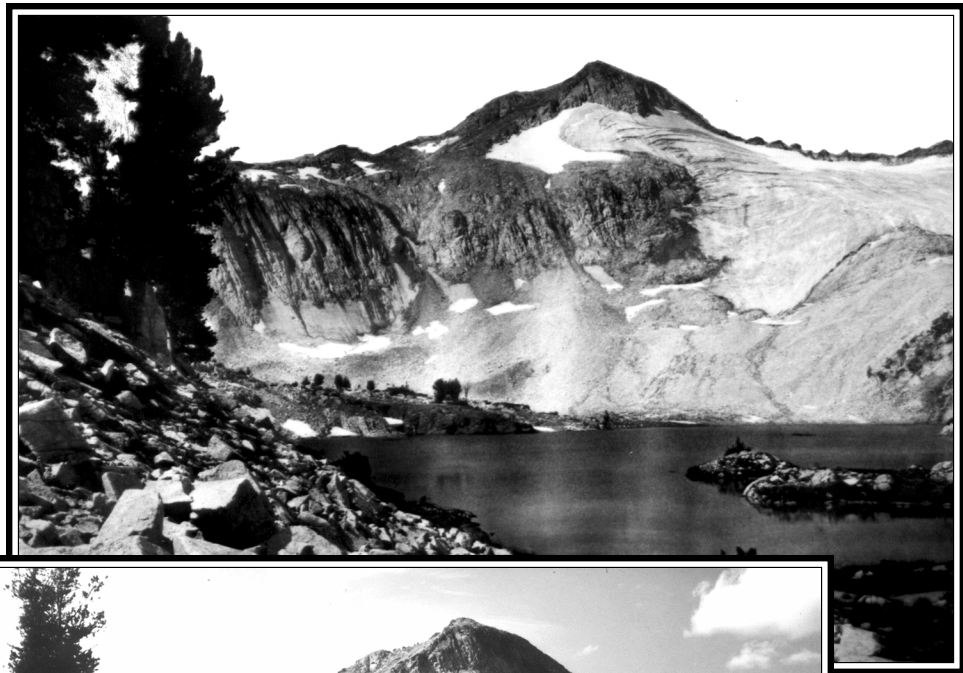


Photo by Harley Richardson

1920



Photo by David Jensen

1992



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## Cover Photos

Glacier Peak is a satellite point along Eagle Cap Ridge, which is the central watershed feature of the Wallowa Mountain batholith.

Upper—This photo of Benson Glacier looking south from Glacier Lake was taken in about 1920. The conspicuous glacier flow lines and crevasses affirm its activity, which had been in recession since about 1870 after the end of the Little Ice Age in about 1850. Harley Richardson captured the Benson Glacier on film when it was in rapid retreat. A mountaineering expedition in 1914 named this glacier for Frank W. Benson, an early Oregon governor. The glacier probably did not outlast Benson very long as it has been suggested that it disappeared in the drought period of the mid-1920s. (Photo courtesy of Wallowa Lake Lodge)

Lower—This repeat photo taken in 1992 shows only a snow field where the glacier had been. Other landscape changes are a shift in erosion patterns on the buildup of glacial till across the lake and an increase in whitebark pine on the low ridge leading down to the lake beyond the far left shore. (Photo by David Jensen)

## Abstract

**Skovlin, Jon M.; Strickler, Gerald S.; Peterson, Jesse L.; Sampson, Arthur W. 2001.** Interpreting landscape change in high mountains of northeastern Oregon from long-term repeat photography. Gen. Tech. Rep. PNW-GTR-505. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 78 p.

We compared 45 photographs taken before 1925 to photographs taken as late as 1999 and documented landscape changes above 5,000 feet elevation in the Wallowa, Elkhorn, and Greenhorn Mountains of northeastern Oregon. We noted the following major changes from these comparisons: (1) the expansion of subalpine fir into mountain grasslands, (2) the invasion of moist and wet meadows by several tree species, (3) a loss of whitebark pine from subalpine habitats, (4) continued soil erosion stemming from livestock grazing long since discontinued, and (5) a high rate of natural gravitational mass wasting. The most important factor contributing to changes in woody vegetation has been a reduction in fire frequency. Fires that occurred before 1925 were nine times more frequent than those that occurred at the end of the 20th century. Historical land uses and origins of place names are described.

**Keywords:** Wallowas, Elkhorns, Greenhorns, Oregon, photography (repeat), photo history, land use, long-term change, landscape ecology, tree encroachment, whitebark pine, recreation, Eagle Cap Wilderness Area, erosion, fire frequency, climate, subalpine ecosystem.



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## Introduction

Today's forest and rangeland ecosystems differ greatly from those developed throughout the prehistory era. For over a hundred generations, the Nez Perce and Cayuse Indians and their ancestors used the resources of the mountains of northeastern Oregon for subsistence livelihood, causing little disturbance to the natural ecosystem. In the past four generations, nonindigenous people have suppressed fire and extracted these same resources through mining, heavy grazing, and logging, disrupting the former ecological state and altering evolutionary trends.

After nearly a century of development and exploitative practices in these mountains, resource planning on Federal lands is changing. Attitudes, economic conditions, and administrative rules have changed. Exploitation of resources has largely given way to restoration of resources. Planning for sustainable use and healthy forests emphasizes watershed protection. The planners and managers concerned with subalpine and related ecosystems strive to meet goals peculiar to those ecosystems such as providing for clean water, wildlife habitat, and increased recreational demand.

Because the natural patterns of secondary succession have changed across these mountain landscapes, planners must understand activities driving secondary succession in order to design projects that lead toward future desired conditions.

A rapid technique for reconstructing the historical mix of activities that changed landscapes is long-term repeat photography. This method provides an immediate visual comparison of patches and patterns of succession without the more tedious reconstruction of fire history and other disturbance features across innumerable landscapes.

Long-term repeat photo analysis can help identify many problems that affect subalpine and related ecosystems and the processes of change and recovery. These include alteration of wildlife habitat, tree encroachment, effects of fire suppression, insect outbreaks, disease epidemics, and human impacts on dispersed recreation sites.

With this in mind, the Blue Mountains Natural Resources Institute along with the Wallowa-Whitman National Forest of the USDA Forest Service initiated a project to retake a series of early-day photographs depicting various landscapes throughout the high mountains of northeastern Oregon.

## Review of Literature

Studies of the subalpine ecosystems of northeastern Oregon have produced a rich database. The first ecological research of subalpine ecosystems in the United States was conducted by A.W. Sampson. He worked on the Standley Allotment of the Minam River drainage beginning in 1907 (Sampson 1909, Strickler and Hall 1980).

The first botanical studies in the Wallowa Mountains (hereafter called the Wallowas) began with those of botanist William Cusick of Union, Oregon, who collected and classified plants from 1896 to 1910. Several taxa he collected have not been found since. Whether these have not been relocated or simply have since disappeared because of heavy grazing or climate change is not known.

Reid (1941) documented stages of secondary plant succession from his early studies of the Wallowas. Vegetation within these mountains has since been variously studied and classified (Cole 1977, 1982; Hall 1973; Head 1959; Johnson 1959; Mason 1975; Peck 1947; Pickford and Reid 1942a, 1942b; Reid and Pickford 1946; Reid and others 1980, 1991; Skovlin and Thomas 1995; Strickler and Hall 1980).

Several studies are specific to management problems caused by disturbances in this subalpine region. Arno (1986), Pickford and Reid (1943), and Thomas (1987) wrote about the alteration of wildlife habitat. Skovlin and Thomas (1995) described tree encroachment and other woody plant invasion of subalpine meadows and uplands.

Mehring (1997) studied the contents of sediment layers to reconstruct historical fire frequency near Lost Lake in the Greenhorn Mountains (hereafter called the Greenhorns), and Beck (1996) did the same at Twin Lakes in the Wallowas. Hansen (1943) analyzed pollen layers at Mud Lake in the Elkhorn Mountains (hereafter called the Elkhorns). The effects of fire suppression were investigated by Mutch and others (1993) and Heyerdahl and Agee (1996). Huff and others (1995) applied repeat aerial photography to link vegetative characteristics to potential fire behavior in eastern Oregon and Washington.

Filip and others (1996) looked at insect and disease factors throughout the Blue Mountains. Insect outbreaks were assessed by Wickman (1992), and disease conditions were charted by Bedwell and Childs (1943) and Filip and Schmitt (1990).

Human impacts on dispersed recreation sites were described by Cole (1981, 1986) and Hall and Shelby (1994).

A recent set of repeat photos from the nearby Blue Mountains showed early conditions and the drastic conversion from grassland to forest, which appeared after about 80 years of secondary succession (Skovlin and Thomas 1995). A similar photostudy comparison on the Tenderfoot Allotment of the Imnaha drainage in the eastern Eagle Cap Wilderness Area was begun in 1937 (Strickler 1961). Results showed relatively slow recovery owing to severe erosion (Reid and others 1991).

The first application of fixed-point time-lapse photography to study changes in landscapes occurred in 1888 when Professor S. Finsterwalder mapped glacier changes in the eastern Alps in Europe (Hattersley-Smith 1966). The most exhaustive photoseries project was perhaps that of Hastings and Turner (1965) who used 100 old photo pairs and early journals to reconstruct ecosystem changes throughout the Southwestern United States.

Common uses of photos to measure cause-effect events in ecosystems range from short- to long-term time lapse. Lyon (1976) did a short-term study of postfire succession with fixed-point photos taken biannually for a decade after the Sleeping Child Burn in western Montana. Johnson (1998) conducted similar studies in the Blue Mountains of Oregon. Gruell (1980) analyzed long-term habitat changes in the Jackson Hole area of western Wyoming with over a century between photo pairs.

Guidelines and tips for depicting habitat changes with repeat photography have been suggested by Magill and Twiss (1965). One of their applications is identifying change in dispersed outdoor recreation sites affected by human use over time. Colwell and Marcus (1961) outlined specifications for special-purpose photography.

## Study Area Description

### Political

The area covered in this report consists of mountains in northeastern Oregon above the 5,000-foot level. It includes the Wallowa<sup>1</sup> (formerly Eagle or Eagle Creek Mountains), Elkhorn, and Greenhorn Mountains. The Wallowas consist of about 360,000 acres in Wallowa, Union, and Baker Counties. The Elkhorns include 65,000 acres largely in Baker County with a small section in Union County. The Greenhorns cover 6,000 acres near where Baker, Grant, and Umatilla Counties join.

In 1930, the core area of the Wallowas was called the Eagle Cap Primitive Area. That soon incorporated the Wallowa Mountain Sheep Refuge (Rocky Mountain Bighorn Sheep Refuge), which consisted of about half of the original primitive area. With passage of the Wilderness Act in 1964, this all became part of the National Wilderness Preservation System with the primary purposes of preservation and providing outdoor recreation. The boundaries of the Eagle Cap Wilderness Area since have been enlarged to incorporate additional ecosystems along distinct drainages.

In contrast, the Elkhorns and Greenhorns have no such congressional designation and are public domain under the jurisdiction of the U.S. Department of Agriculture, Forest Service. These lands are designated for multiple-use management. Some withdrawals have been made for particular purposes such as the Baker City Watershed, the Anthony Lakes Ski Area, and many mineral claims, patents, and mines.

### Economic

Since the late 1800s, grazing by introduced livestock, mostly sheep, has been pervasive throughout the high-elevation mountains. It was light and spotty for the first 5 to 10 years but became heavy for the next half century. This removed fine fuel (grass) and litter by which fire spread and stripped off the vegetative cover that protected the soil from water and wind erosion.

After the 1860s, mining and the need for mine timbers, lumber, and fuelwood generated another set of disturbance factors around the large mining districts of Granite, Sumpter, and Cornucopia. Perhaps 25 small towns such as Alamo City, Greenhorn, Bourne, Sparta, and Susanville were operational for 25 years or more. Canals and flumes, most now defunct, carried water to mining operations, and dredging altered the riparian ecosystems of streams. Tailings remain as evidence of underground operations of the mines.

Several mountain streams were dammed and their waters diverted from natural drainages. The reservoir at Goodrich Lake impounds water for Baker City, one of only two large city water supplies in Oregon that do not require filtration. The present dam was completed in 1963 after two earlier dams broke, causing disastrous wash-outs. Mehlhorn and Fish Lake are but two of the reservoirs near Halfway that hold water for downstream irrigation. The dam at Fish Lake broke out once in about 1924, causing a memorable flood (PineValley Echo 1979).

Recreation opportunities attract increasing numbers of visitors to these mountain areas. Hunting, fishing, hiking, and camping with attendant saddle and pack stock always have been popular. Cross country and downhill skiing and snowmobiling are enjoyed during winter months.

The Elkhorns and Greenhorns also are used for commercial logging, livestock grazing, fuelwood harvesting, and recently, commercial mushroom picking. Many amenities available here but not permitted in the Wallowas include roads, use of motorized equipment, concessions, and improved camp sites. Livestock grazing is permitted to some extent in all three areas.

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<sup>1</sup> The 6th edition of Oregon Geographic Names by Lewis A. McArthur is the authority for the origin of most geographic names used in this report.



## Physical

Most watershed subbasins in the area drain into the Snake River between Oregon and Idaho. The Wallowas are drained to the north by the Wallowa River, to the east by the Imnaha River and Pine Creek, to the south by Eagle and Catherine Creeks, and to the west by the Minam River. The Elkhorns are drained on the north, east, and south by the Powder River and on the west by the Grande Ronde and John Day Rivers. The Greenhorns are drained entirely by the John Day River system.

Climate at these upper elevations is harsh. Low temperatures and high amounts of precipitation in the form of snow ensure a short growing season. Above 5,000 feet to nearly 10,000 feet, in the areas under study, precipitation, mostly snow, can reach 65 inches annually (over 5 feet of water). Vegetation begins growth after snow recedes and temperatures rise above 40 °F, but no months are frost free.

Geology of all three mountain ranges is diverse (Lindgren 1901). They contain igneous, sedimentary, and metamorphic rocks formed during the last 300 to 350 million years. The oldest rocks are rare Devonian and Pennsylvanian limestones. Most of the older rocks are metamorphosed Permian and Triassic lavas and sedimentary rocks. These were uplifted and eroded, and then they sank below sea level where deposits of lime and clay were changed to limestone and rock sediments. These were then again uplifted and eroded.

Jurassic granitic magmas intruded and now form core areas in the Wallowas, Greenhorns, and Elkhorns. From 16 to 14 million years ago, Columbia River basalt extruded from fissures in the Earth's crust. Faulting uplifted the post-Miocene Wallowas, Elkhorns, and other ranges in the Blue Mountains. Continued uplift and erosion have removed much of the Columbia River basalt from atop the Wallowas. During the Pleistocene, most alpine areas in the Blue Mountains supported ice caps and glaciers, which left U-shaped corridors with many hanging valleys, scoured ridges, and outwash moraines.

Soils from these parent materials are formed from erosion in place or have been transported to sediment or alluvial deposits often of mixed origin. Basaltic soils in the Wallowas (Barlow 1983) surround the granitic and sedimentary central batholithic dome. Some of the central dome consists of soils derived from calcarious limestone and some noncalcarious sediments, which influences certain elements of the associated vegetation (Cole 1981).

About 7,600 years ago, Mount Mazama erupted showering these high-elevation areas with several feet of volcanic ash, some of which became incorporated into the residual soil. During this same period, a thermal maxima occurred when temperatures were much higher than they currently are.

## Biological

Life zones in these high mountain areas are the upper Canadian, Hudsonian, and Arctic-Alpine (Bailey 1936). Depending on north or south aspects, the upper Canadian Zone occurs between 5,000 and 7,500 feet and the Hudsonian between 7,500 and 8,500 feet, after which the Arctic-Alpine continues to the uppermost peaks. For information on common animals in these zones, Bailey (1936) prepared the first comprehensive life histories and distribution maps for the more conspicuous mammals. Gabrielson and Jewett (1940) provided a similar treatment for birds.

Ecosystems found in high mountains of eastern Oregon are both forested and nonforested. Among the forested are the lodgepole pine, the spruce-fir, and the subalpine fir.<sup>2</sup> Nonforested stringer grasslands occur interspersed with stands of subalpine fir. A minor ecosystem component is mountain hemlock.

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<sup>2</sup> Scientific names of plants and animals are shown in the appendix.

Nonforested grasslands include the subalpine grassland of the arctic-alpine ecosystem and mountain meadow ecosystem (Garrison and others 1977). Meadows can be classed as dry, moist, and perennially wet. An example of the dry meadows is Catherine Creek Meadow and of the wet meadows is North Minam Meadow.

Barrens with little vegetation occur throughout elevations above timberline, as do rock avalanche paths, scree, talus, and exposed bedrock.

## Methods and Materials

Techniques for this study were simple. As nearly as possible, the exact camera position was found, and a black-and-white large- or medium-format picture was repeated at the same time of day and season of year as the original photograph. Field notes were made on changes that were apparent when the new photograph was viewed with copies of the original print. Notes were made on species composition, vegetative cover, relative production, and forage use. A 35-mm color slide was taken for future use in reconstructing details such as variations in plant species and development.

The equipment used for data collection were press-type camera bodies of the Crown, Speed Graphic, or Century Graphic series by Graflex.<sup>3</sup> Lenses were usually a standard 135 mm. Filters were seldom used except to block haze. Exposure meters were either General Electric PR-I or Grossen Luna Pro; film was either Kodak PlusX, TriX Pan, or "T" max. The original and most repeat photos were processed in the same format, preferably 4 by 5 inches (12.7 by 17.8 centimeters), to assist in analyzing change. Some 2¼- by 2¼-inch (5.7- by 5.7-centimeter) film formats were used as backup photos in case field or processing mistakes occurred.

Interpretation of change was not so simple. A shift in plant composition, for example, can result from many interacting forces. A conversion from forest or shrubland to grassland can be brought about by weather, ungulate grazing, fire, insects, disease, rodents, or other agents, singly and in combinations. For this paper, the obvious changes were analyzed based on personal knowledge of the sites. Local users and resource managers were interviewed, when available, to gain an understanding of the history of management and recent events that might have a bearing on landscape changes. Readers are encouraged to study the photographs and make interpretations based on their own knowledge.

Nearly all original photos chosen for this report were taken before 1925. The photographs that were used came from government archives, collections from the Baker County Library, and personal collections. Photos were selected for their quality and for representation of typical ecosystem landscapes.

## The Photographic Record

In the presentation of the following time-lapse photo sites, we tried to interpret the status and health of the landscape by describing the condition and trend of the vegetation. The terminology for describing status and health has changed over time. For example, forested and nonforested rangeland in poor, fair, good, or excellent condition now can be expressed as early-, mid-, or late-seral stages, and climax, respectively (Range Inventory Standardization Committee 1983, Society for Range Management 1989). Climax communities recently have been redefined as "potential natural communities evolved in the absence of human influence." For the purpose of simplicity in this report, however, the terms poor, fair, good, or excellent will be used.

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<sup>3</sup> The use of trade, firm, or corporation names is for the information and convenience of the reader. Such does not constitute an official endorsement by the U.S. Department of Agriculture of any product or service to the exclusion of others that may be suitable.

There is general agreement that nearly pure stands of green fescue depict excellent to good condition in uplands. Fair condition is exemplified by grasses such as bottlebrush squirreltail, California oatgrass, or Columbia needlegrass mixed with such forbs as tailcup lupine, gland cinquefoil, strawberry, or various penstemons. Poor condition here is indicated by the near absence of any such grasses and the presence of weedy species such as pokeweed fleecflower, western coneflower, yarrow, pussytoes, or clustered tarweed. Wire rush, Baltic rush, and some annual grasses also may be present on certain sites.

Subalpine mountain meadows in excellent to good condition have 75 percent or more of the ground surface covered by vegetation, most of which will be tufted hairgrass. Lesser amounts of perennial species might include thin grass, beaked or Nebraska sedge. Few forbs exist in such meadows. Meadows in poor condition have considerable bare spots between clumps of weedy-type forbs. Kentucky bluegrass sod and annual grasses may be common.

The accompanying maps (fig. 1, a and b) show the geographic location of the time-lapse photos used in this study. The numbering sequence on the maps corresponds to that in the text.

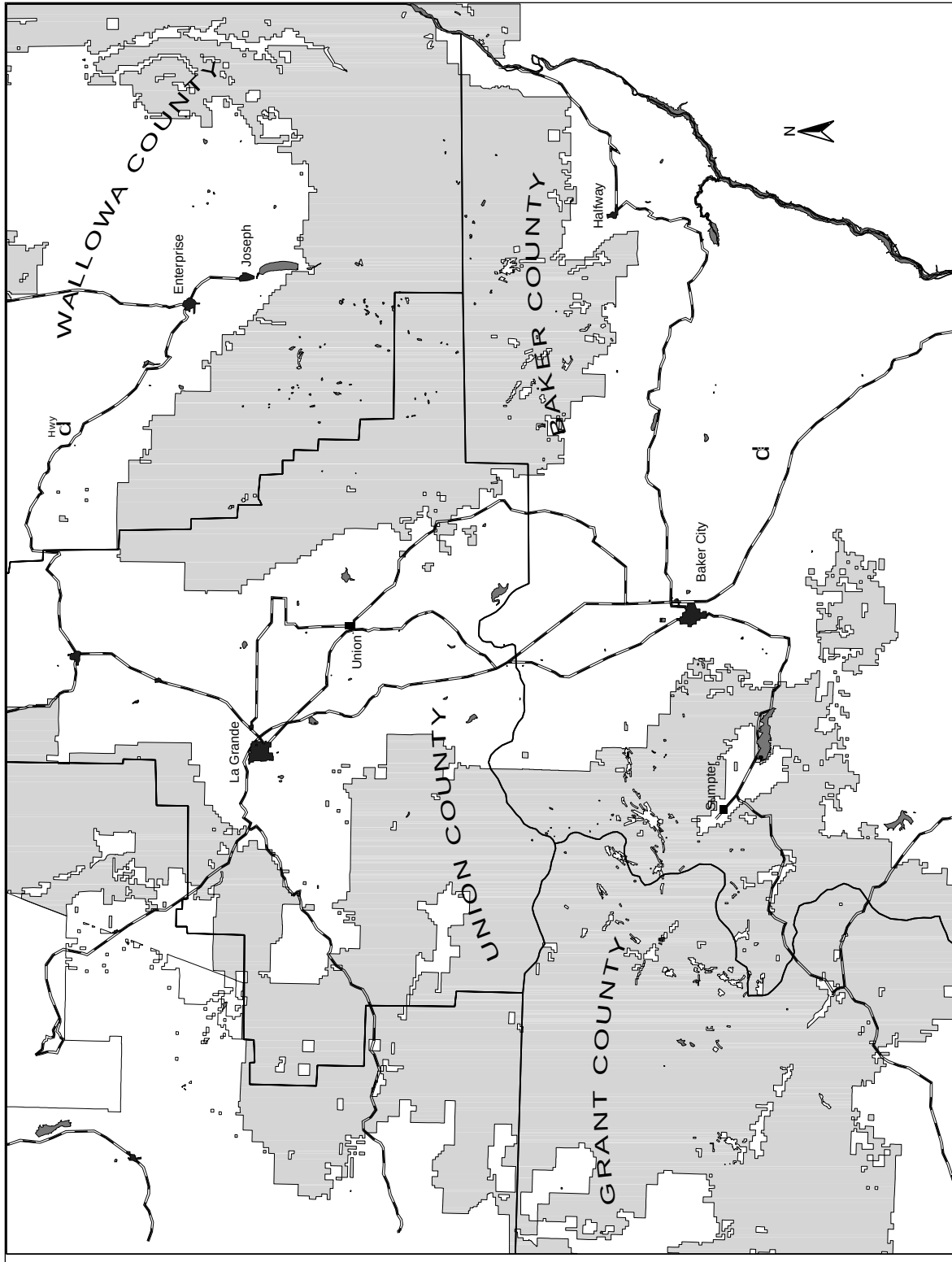


Figure 1A—Map of northeastern Oregon.

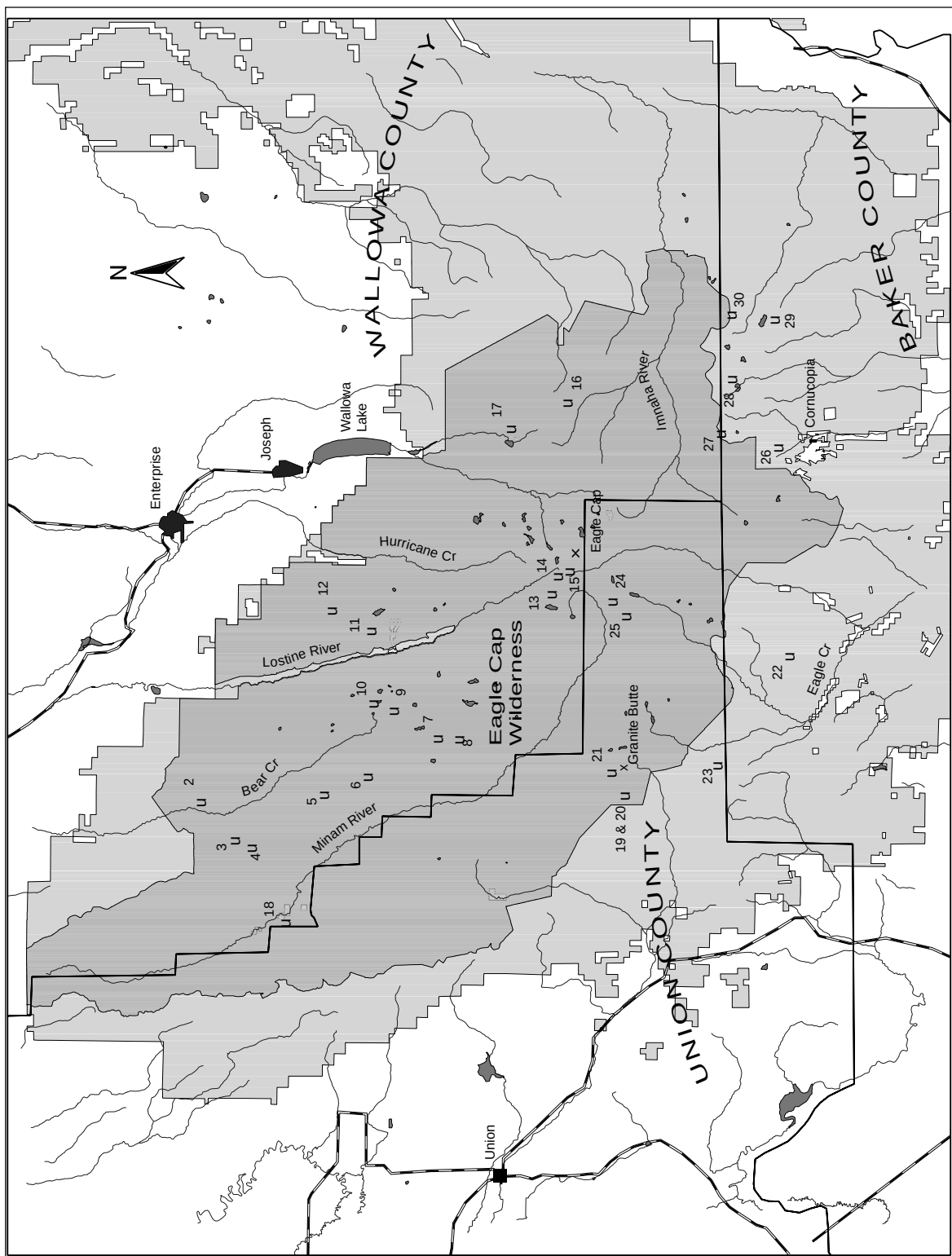


Figure 1B—Enlarged maps showing detailed location of photo points (♦). Gray area is National Forest.

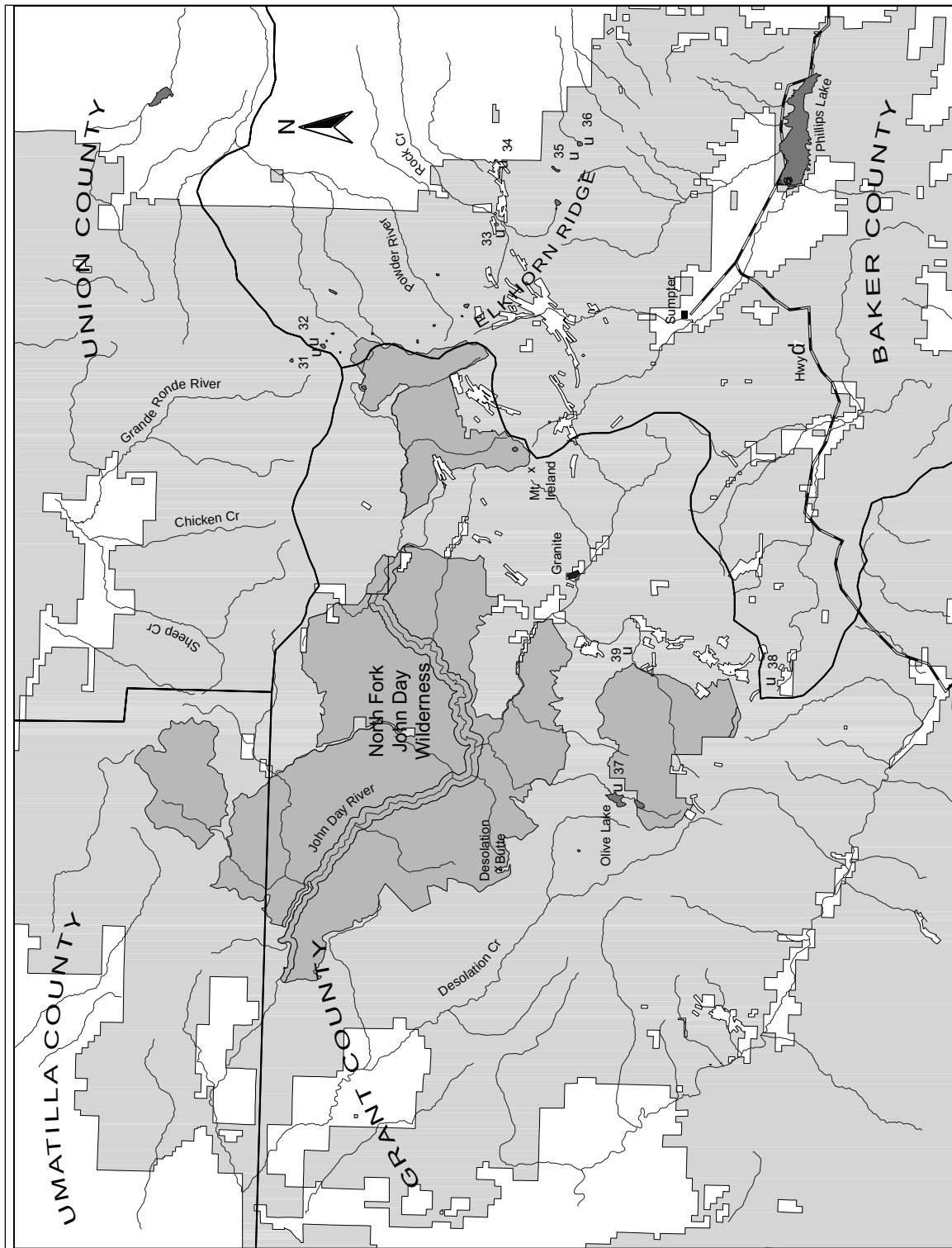


Figure 1B—Continued

# The Wallawas

The Wallawas are bounded on the north by the Wallowa Valley and to the west by the Grande Ronde Valley. On the south is the Powder Valley and Pine Creek, and far to the east are the Imnaha and Snake Rivers. Watersheds draining from the Wallawas are the Wallowa River system (north), the Minam (west), Eagle Creek (south), and Imnaha (east). Many minor streams including Big and Little Sheep, Bear, Hurricane, and Catherine Creeks drain into these systems.

The central montane portion is a mixture of granitic and sedimentary rock often capped by Columbia River basalt volcanics extruded through basaltic dikes. Less than 10,000 years ago, it was covered by glaciers, which formed the U-shaped valleys and created the existing landforms that today support a relatively recently colonized mantle of subalpine vegetation.

The name Wallowa is the Nez Perce word for a tripod of poles that hold a rack or fish weir in a river to stop migrating salmon. Nonnative settlers to this northeastern corner of Oregon adopted the name for the river where the tripods were once conspicuous. Eventually, the name was attached to a town, a valley, a county, and the mountains.

## Figure 2—Bear Creek Ranger Station Horse Pasture, Wallowa County, OR.

The Bear Creek watershed had a stand replacement fire in late summer 1889. Area vegetation has been in postfire succession for over 100 years. Smaller, less disastrous fires have burned in this large watershed every few years. Bear Creek drainage, from Bear Lake to the confluence of Little Bear Creek, is about 58 square miles. Annual water yield average for 61 years was 82,590 acre feet with an annual discharge of 114 cubic feet per second.<sup>4</sup> The name was adopted after James Tulley reported in fall 1878 that three grizzly bears and many black bears had been killed as cattle were gathered up Bear Creek.



Photo by A.W. Sampson

Figure 2a—1909. (Looking east) Timothy grass was planted in the old burn area in fall 1907. This photo on the last of July 1909 shows timothy headed out. Other grasses are mountain brome and pinegrass. Many weedy species such as yarrow and goldenrod also occupy the site. Young Douglas-fir saplings (in the middle ground) are about 15 years old and corroborate the date of the fire.

<sup>4</sup> Reckendorf, Frank. 1996. Bear Creek fish habitat enhancement. Salem, OR: Reckendorf and associates. Unpublished report. On file with: Wallowa Soil and Water Conservation District, 209 NW First, Enterprise, OR 97828.



Figure 2b—1998. The position of the camera point of this retake is exact. This site was originally a mature grand (white) fir-twinflower-pinegrass community before the fire about 110 years ago. It has reverted to an early phase of that community. The understory also contains elk sedge and western fescue. There is no trace of the introduced timothy. This 30-acre pasture once used for horses has provided forage for wildlife only since about 1950.



### Figure 3—Dobbin Creek Basin, Wallowa County, OR.

Dobbin Creek Basin in the northwest Wallowas was a part of the Standley Sheep Range. This range, claimed by John H. Standley in about 1885, was later used by Jay H. Dobbin. Before the National Forest was created in 1906, a band of about 1,200 head of adult wether sheep would graze a month or more in this basin. By the late 1960s, smaller bands of 850 to 900 ewes and lambs would stay 10 days grazing over the equivalent range. Today, largely for economic reasons, no sheep graze in the Wallowas.



Photo by W.L. Dutton

Figure 3a—Around 1924. (Looking north) Large patches of snags, remnants of former fires, are seen across the landscape. A fire watch was once posted in a tree house in the top of a tall whitebark pine snag some 15 to 20 yards from this camera point, although at this early date, fire suppression in the high mountains was not very effective. A telephone line to the ranger station in Wallowa had only recently been installed.



Photo by W.B. Hall

Figure 3b—1974. A striking encroachment and closure of the forest can be discerned over the past 50 years. Subalpine fir has invaded much of the grassland in the lower basin. This is also noticeable on the bald ridge across the basin (right).



Figure 3c—1997. The Fox Point Fire of 1996 burned about two-thirds of the visible forest, thus placing it in about the same condition it was about the turn of the 20th century. Cover on the steep slope where the sheep were in 1924 appears to be somewhat more broken with open spaces between plant clumps. Today, pokeweed fleecflower is prevalent on the slope. This camera point was moved about 35 feet east to avoid a wall of trees that had grown up and obliterated the original view.



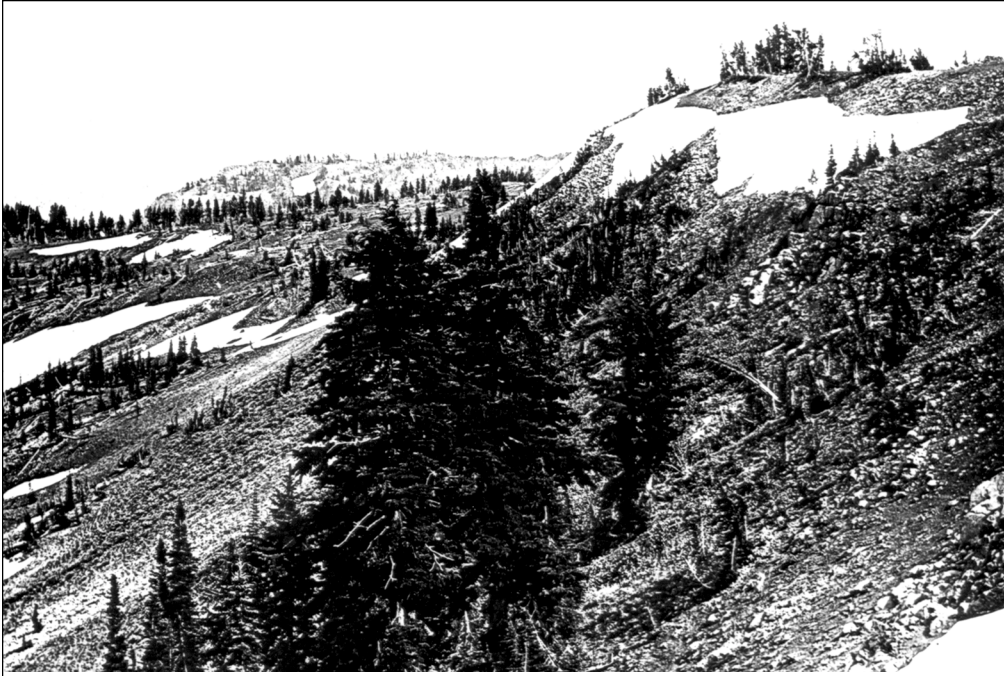


Photo by A.W. Sampson

Figure 3d—1908. (Looking south) On July 25, 1908, large snowdrifts still persist in pockets and on north-facing slopes of the Dobbin Creek watershed. Many downed snags can be seen beyond the left midground snow fields, giving evidence of earlier fire. Judging from the advanced stage of regenerated subalpine fir, the fire would probably have occurred during the mid-1800s.



Figure 3e—1998. This photo was taken in late August but at the same location at the foot of the original tree house lookout. The first lookout was in a large whitebark pine snag that still stands today (fig. 3f). The subsequent tower was on the point of the ridge (upper right). It was dismantled in 1955. The background of the repeat photo shows heavy subalpine fir crown spread and considerable basal expansion. The two larger subalpine fir trees in the photo center appear to have improved in health and must be nearly 200 years old.



Figure 3f—1998. Tree house lookout.



**Figure 4—Standley Sheep Range, Wallowa County, OR.**

South of Dobbin Basin (fig. 3) lies the Standley Sheep Range, which centers at Standley Spring. About 200 feet from the spring is Standley Guard Station, and east of the spring, perhaps 700 feet, was the Standley Lookout Station, a small glass house on a 40-foot pole tower. South and west of these sites is a gently undulating subalpine grassland of about 250 acres. Beginning in about 1885, this area was grazed by sheep in numbers that by 1910 had devastated the perennial plant growth. Here in 1908, A.W. Sampson (1909) conducted range research at what was the first USDA Forest Service experimental site.



Photo by A.W. Sampson

Figure 4a—1907. (Looking southwest) This sheep camp and bed ground was about 450 feet west of Standley Spring, which is the headwaters of Trout Creek (locally called Black Canyon). The band of about 1,200 wethers daily grazed the surrounding range in clockwise fashion all summer. Close herding and night corralling were necessary for protection from predators, which were still numerous. Often large bonfires were maintained at night if there was a chance of attack by bear.





Photo by A.W. Sampson

Figure 4b—1907. (Looking southeast) Above the camp and bed ground, ewes and lambs rest after a morning's grazing down Cougar Ridge. The foreground is a rather "tramped out" weed patch with no visible remaining grass after being subjected to about 20 years of heavy grazing.



Figure 4c—1997. Grass, a mixture of green fescue and Columbia needlegrass, has become reestablished in substantial amounts. The island of timber in the left midground was not in evidence 90 years before.





Photo by A.W. Sampson

Figure 4d—1907. (Looking southwest) About 350 yards beyond the camera point of 3a and 3b is the low divide between water that sheds into the Minam River (beyond man with seeder) and that which sheds into the Wallowa River (this side of man with seeder). No vegetative cover remains on the soil mantle. Because the soil surface is nearly level, however, little runoff has occurred. The lower A horizon remains although the upper has been lost largely to wind erosion.



Photo by G.S. Strickler

Figure 4e—1973. This fair-condition stand, 63 years later, shows remarkable reestablishment of perennial forbs and several grass species, including green fescue. Large gaps of bare soil occur between bunchgrass plants, a component of the pioneer type species. None of the seeded grasses remain.



Figure 4f–1998. Pioneer forbs have given way to grasses and grasslike plants, and the vegetative cover has nearly doubled. No bare spaces can be seen where the archer now stands. Green fescue seedlings are common, whereas mosses and lichens have developed on bare parts of the soil mantle. Some seedlings of subalpine fir have become established in the grassland.





Photo by A.W. Sampson

Figure 4g—1907. (Looking northeast) This scene lays just beyond the distant horizon of the previous photo. The same ewes and lambs are being grazed out in a different direction from Standley Spring. Hummocks in the foreground are remnant root masses of dead green fescue plants. Interstices containing a low weedy cover and depressions, such as in the lower left foreground, are bare soil and erosion pavement.



Figure 4h—1998. Tree cover has changed little in the past 90 years except for some regeneration of subalpine fir and whitebark pine. The grass has recovered substantially, although most of the topsoil is gone from the site.

**Figure 5—Chaparral Creek, Wallowa County, OR.**

Chaparral Creek drains into the Minam River and heads on the divide between Bear Creek (beyond the distant ridge and left) and the Minam River (below and right). The Washboard Trail between Standley Meadows and Sturgill Basin traverses this ridge. Because of its rough nature, this trail has probably accounted for the demise of more saddle and pack stock than any other similar stretch of trail in northeastern Oregon. Chaparral Creek is about midway between Standley and Sturgill Basin. These landmarks were named for John H. Standley and Jacob Sturgill, partners in the early wool growing business.



Photo by W.L. Dutton

Figure 5a—1924. (Looking south) Much of the north side of the Minam River is characterized by steep, rough canyon walls only suitable for sheep and ungulate wildlife. The dark slope beyond the trees in the foreground appears to be devoid of herbaceous vegetation.



Figure 5b—1998. The Washboard Trail was about 450 feet higher in 1924. Most of the large unconsolidated angular rock to the left of the trees has fallen off into the Minam Canyon. Dark shrubs above and to the left of the lone tree in the foreground are prostrate juniper and bush cinquefoil. The light clumps nearer the camera are a mixture of phlox, gooseberry, and false horse mint. Except for the prostrate juniper, these species were not apparent in the earlier photo. The midground slope that appears bare in the 1924 photo now has a considerable stand of bluebunch wheatgrass. The hazy condition was caused by smoke from a distant forest fire.



## Figure 6—Sturgill Basin, Wallowa County, OR.

The headwaters of Sturgill Creek, named after pioneer wool grower Jacob Sturgill, were a secondary research area for A.W. Sampson. Sturgill Basin is 5.5 miles southeast of Standley Spring. It is reached by the trail along Washboard Ridge between the Minam and Bear Creek drainages. Before Sturgill arrived with sheep in the mid-1880s, the outlaw, Hank Vaughan, held stolen horses in this secluded basin (Skovlin and Skovlin 1996).



Photo by A. W. Sampson

Figure 6a—1908. (Looking northeast) The weedy foreground was an experimental area protected from sheep grazing for a year and planted to timothy grass in expectation of range revegetation. Beyond the fence, no natural forage remained. This 3- to 4-acre plot was about 400 yards above (north) Sturgill Springs, a favorite bed ground during the early days of free-range grazing.



Figure 6b—1998. Grazing was closed off in Sturgill Basin in 1941, and the basin has not been used for sheep grazing since. Rocky Mountain elk now graze the area in substantial numbers, especially since the early 1960s. The barren area in the foreground is covered with a heavy growth of perennial grasses. Green fescue is common, and western needlegrass is present but in lesser amounts. Umber pussytoes is the common forb, and Hood sedge is scattered throughout the area. No evidence of the earlier planted grasses exists. The remnant forest in 1908, once retarded by frequent fires, has developed into a veritable wall of trees consisting of both subalpine fir and whitebark pine.



Photo by A. W. Sampson

Figure 6c—1909. (Looking north) This picture was taken at Threemile Creek where a field assistant is collecting green fescue seed using a seed comb stripper. This seed was later used in revegetation studies in Sturgill Basin, which is about a mile above this collection site.

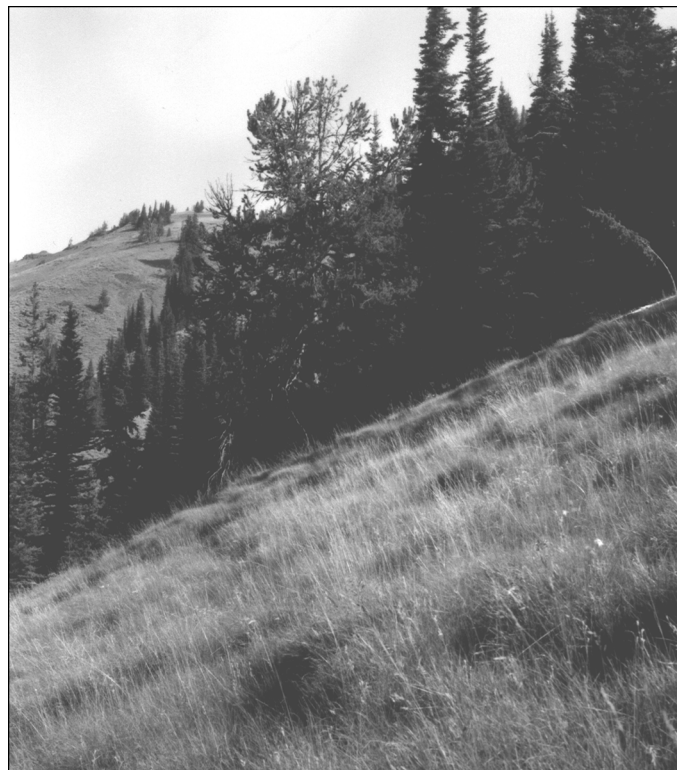


Figure 6d—1998. Little cover or vegetative change could be detected on this site after nearly 90 years. Over 80 percent of the grass and grasslike cover was green fescue, and nearly 10 percent was elk sedge. Bare area accounts for about one-half of the surface. This site has been in a near climax stage for centuries as it was almost impossible to herd sheep here.





Photo by A.W. Sampson

Figure 6e—1907. (Looking northwest) Upper Sturgill Basin, about 450 feet north of figure 6a showed nothing but remnant pedestals of green fescue and erosion pavement. In the left foreground, even the pedestals had eroded away from constant trailing and bedding of sheep.



Photo by G.S. Strickler

Figure 6f—1955. From the same camera position, the background landscape appears to have recovered to a major extent, but the subsoil pavement in the foreground does not support vegetation even after 15 years of closure to grazing. The arrow points to a seedling of whitebark pine growing between pedestalled plants.





Photo by G.S. Strickler

Figure 6g—1973. This area has now been closed to sheep grazing for 32 years. The tree seedling is a well-established sapling, but the green fescue plants in front of it have succumbed to their droughty exposure and have given way to erosion pavement.



Figure 6h—1998. The sapling shown in 1973 is dead from unknown causes. Some reinvasion of Columbia needlegrass and general thickening of grass and grasslike cover has occurred. The alarming prospect, however, is the deep gully erosion showing in the foreground that was hardly visible in 1973. The open-grown lodgepole pine can be seen on the left horizon in the three most recent photos.

**Figure 7—North Minam Meadows, Wallowa County, OR.**

These meadows and the basin above are the major tributary to the Minam River. This wet meadow is the largest (about 225 acres) of its kind in the Wallowas. It is fed by a drainage of about 6,000 acres containing three large lakes, Swamp, Long, and Steamboat. Minam is the Nez Perce word for biscuitroot, a large carrotleaf plant abundant in the area.

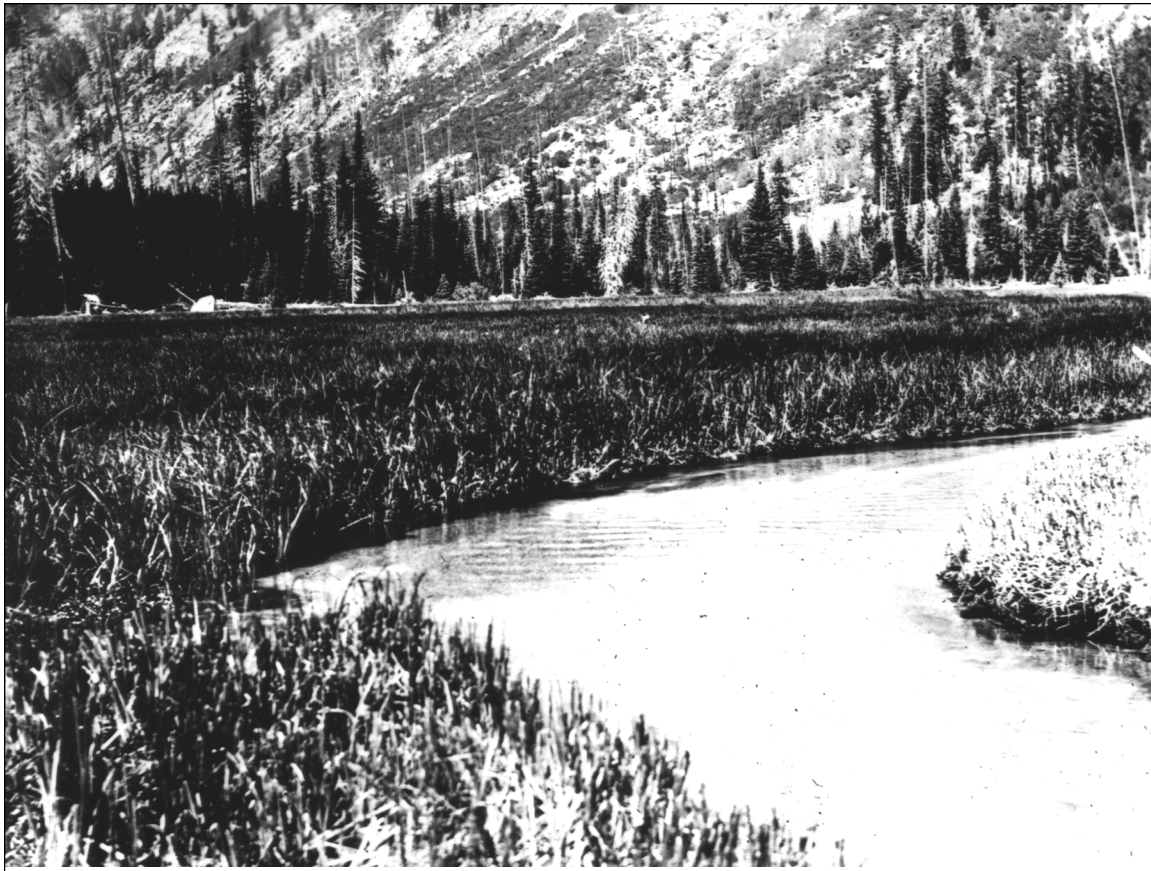


Photo by A.W. Sampson

Figure 7a—1911. (Looking northwest) At the time of this photo, the North Minam River ran through the north (right) side of the meadow before exiting in the middle distance. The tall grasslike plant is water sedge. Trees along the fringe of the meadow include Englemann spruce, lodgepole pine, grand fir, and some western larch. Many standing dead trees surround the meadow at the timber's edge. The far slope burned off several decades before as evidenced by many standing snags and no regeneration. The tall shrub was most likely snowbush ceanothus.





Figure 7b—1997. The old course of the river is now only a muddy marsh, and the new main channel is about half way (450 feet south) to the edge of the forest in line with the angular rock. The condition of the sedge is largely unchanged because sheep do not naturally graze wet meadows. Recreation stock and elk are about the only ungulates using these meadows. Other grasses are red fescue and thin bentgrass. Tree composition also appears to be much the same with perhaps slightly more spruce encroachment. The distant slope has spotty regeneration, mostly Douglas-fir with an understory of Scoulers willow, vine maple, and some snowbush ceanothus. Snags that were abundant now have fallen. Some old stumps show evidence of beaver activity perhaps 40 or 50 years ago.

**Figure 8—North Minam Basin from Hazel Mountain, Wallowa County, OR.**

This area drains into the North Minam Meadows, making it a large lake in early spring. This is a highly diverse recreation area with many attractions to outdoor enthusiasts. The photo pair is taken atop Hazel Mountain (8,360 feet) on the south side of the basin. In 1913, Forest Ranger N.J. Billings named the nearby lake for Hazel Taylor of Milton, Oregon, who was camped nearby. Eagle Cap (9,595 feet) is the highest mountain on the far horizon (right).

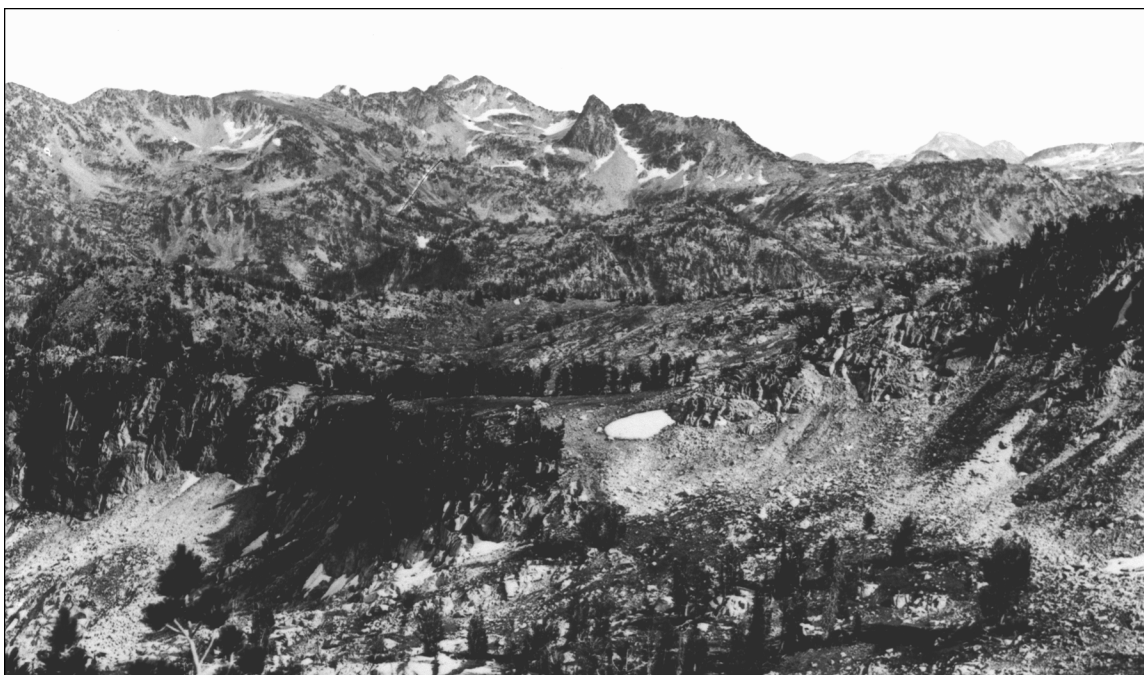


Photo by A.W. Sampson

Figure 8a—1907. (Looking east) This photo, taken in late August, shows some of the more desirable sheep range of the Wallowas. Green forage is available here until fall snows begin in October.



Figure 8b—1997. The snow pattern around Elkhorn Peak, the highest distant peak, was similar both years. Snow drifts in the immediate basin (below), however, are in somewhat different patterns. The whitebark pine patch beyond the bench to the left of the round snow drift in figure 8a has burned and since regenerated. Nearly all of the trees in this landscape are whitebark pine.



**Figure 9—Wilson Pass, Wallowa County, OR.**

This pass is on the low divide (7,650 feet) between Wilson Basin and Brownie Basin on the Bowman Trail. John Henry Wilson was an early miner who maintained a camp near John Henry Lake. Robert Bowman also had nearby mining interests.



Photo by Kenneth Tulley

Figure 9a—1921. (Looking south) A fish planting expedition was returning from stocking John Henry Lake. The man is probably Forest Ranger N.K. O'Brien. Just beyond his head can be seen a 10-gallon cream can lashed to a pack horse, which was used to transport fingerling fish. Wilson Pass was a heavily used sheep trail for about 75 years, and little ground cover remains.



Figure 9b—1999. In 1921, the trees and snags on the right (west) were mostly whitebark pine, and those on the left (east) were subalpine fir. This situation remains in 1999. From the sweep of the trees, the strong prevailing winds are from the west (right to left). Although considerable bare ground still exists in this pass, a dense, low-growing vegetation has developed near where the mules are tied; sedge and rush predominate. Blister rust has infected many whitebark pine trees in the surrounding area.

**Figure 10—Chimney Lake, Wallowa County, OR.**

This lake (7,600 feet) is on the west rim of the Lostine Canyon and above the mouth of Brownie Basin. It is approached from the Bowman Trailhead. The name for this lake was probably taken from a stone chimney used by marten trappers in a dugout or tent camp near the lake. The time of year for a repeat photo of this picture pair was intentionally changed because snow pattern was irrelevant for snag comparison.



Photo by Kenneth Tulley

Figure 10a—May 1922. (Looking east) Near the beginning of the 20<sup>th</sup> century, a considerable fire raged up the side of Lostine Canyon and topped out on the ridge above Chimney Lake. The fire burned back down toward the lake and left a wall of snags on the ridge.



Figure 10b—August 1999. Many of the original snags can be seen above the tall canopy of subalpine fir, which has now become dominant. The large broken-top snag beyond the couple embracing on the snow field (lower left of 1922 photo) has hardly lost a branch during the 77-year interval.



**Figure 11—Francis Lake, Wallowa County, OR.**

Samuel W. Lilly, miner and trapper, and others named this lake, formerly called Lost Lake. It drains down Lake Creek about 4 miles into the Lostine River near the Lake Creek Guard Station. The Lillyville Camp site at the Bowman Trailhead commemorates Mr. Lilly.

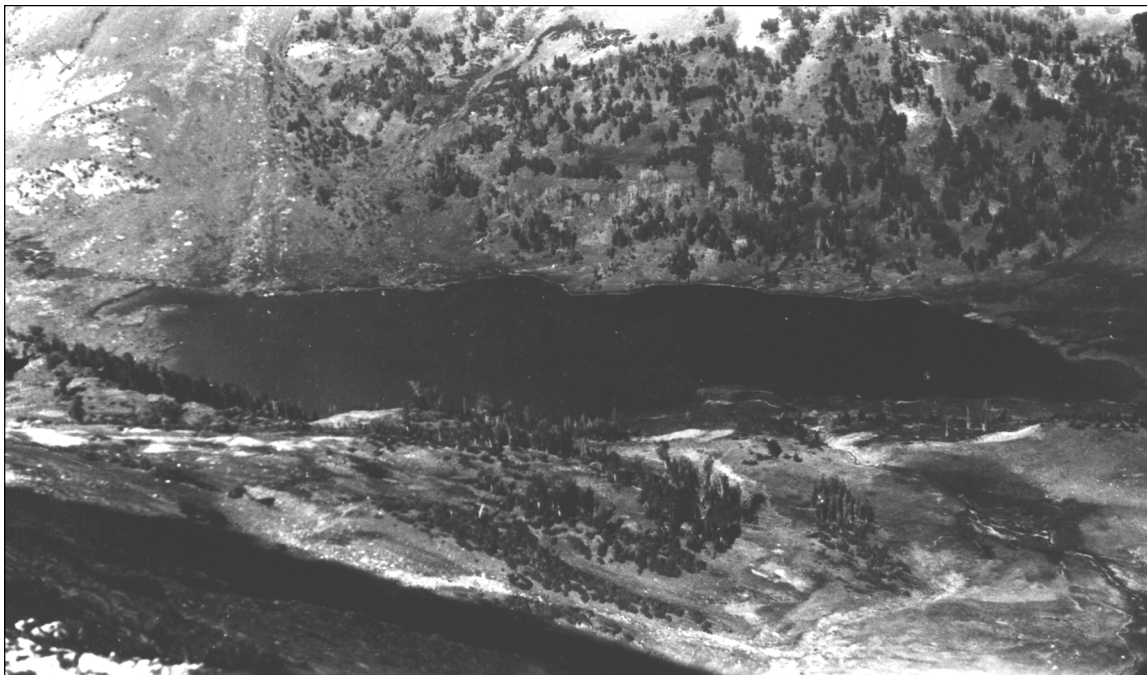


Photo by Kenneth Tulley

Figure 11a—1922. (Looking east) The above camera point was on a rather precarious peak called Marble Point on the ridge west of the lake. It shows a thick row of whitebark pine snags, which were perhaps victims of the 1910 mountain pine bark beetle epidemic that was prevalent throughout the northern Wallowas.



Figure 11b—1999. This camera point is about 3/8 mile north of the 1922 photopoint, but it depicts the same landscape as the original photo. The snags have largely fallen and been replaced with a healthy stand of young whitebark pine trees. Apparent on the right side of the pine stand is a fairly recent burn that has regenerated to subalpine fir during the last 30 years.



**Figure 12—Francis Lake from the north, Wallowa County, OR.**

The view of Francis Lake from the north, at a slightly higher elevation (about 8,420 feet) looks across the east fork of Lake Creek, due south into the huge cirque behind Francis Lake. Access to this photopoint begins at the lime quarry above Alder Slope south-west of Enterprise and proceeds to Murray Saddle, then around the head of Silver Creek and across Traverse Ridge into the Lake Creek drainage. This camp tender's pack trail supplied sheep camps that enabled use of Bailey Maxwell's Wildsheep Allotment.



Photo by J.L. Peterson

Figure 12a—1926. (Looking south) A crown fire, probably of the disastrous 1910 fire season, has blown up the east fork of Lake Creek and topped out on the level terrain where live forest remains in the center foreground. Left, below the light streak, an arm of fire has killed the trees and destroyed the ground cover; however the trees, probably lodgepole pine, remain upright. Trees across the east fork have all fallen, but the understory has not yet gained a foothold in the rocky talus.

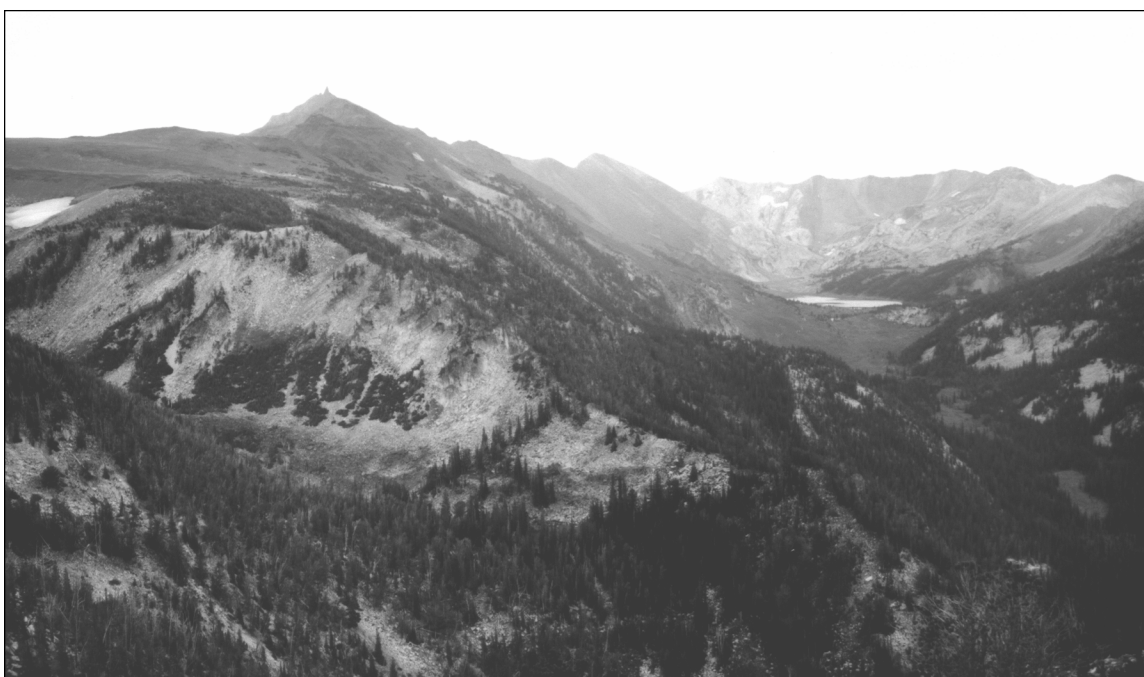


Figure 12b—1998. Both burned areas have regenerated into stands of mostly subalpine fir. Little else has changed except that the pothole lake seen below Francis Lake in 1926 has been masked by growth of subalpine fir. The pattern of prostrate juniper on the opposite talus slope (left) has filled in slightly.

### Figure 13—Carper Pass, Wallowa County, OR.

The Carpers homesteaded in the Promise area of northern Wallowa County. They were ranchers, trappers, packers, and rangers, many of whom worked for the USDA Forest Service in the Wallowas. Carper Pass connects the Lake Basin area with Minam Lake, headwaters of both the Minam River and the west fork of the Lostine River, locally called the South Fork of the Wallowa River. Early photographers took pictures from near the top of the pass in 1909, 1914, and 1929, but only the 1909 and 1929 shots were retaken in 1998.



Photo by N.J. Billings

Figure 13a—1929. (Looking northeast) This scene (shown here and in fig. 13b) was taken from the same camera point as the following panorama by A.W. Sampson (left frame). It was taken at an elevation of about 8,400 feet and has been a popular photo vista. The open south-facing slope in line with the Matterhorn shows a slight increase in young tree cover since the 1909 A.W. Sampson photo. That picture shows evidence of a hot fire some few years earlier.



Figure 13b—1998. Little change is apparent after nearly 70 years. There is perhaps some thickening of the scattered forest across the canyon on the lower (right) steep slope. Also colonization of vegetation has occurred, mostly Parry's rush and buckwheat from the center foreground to the upper left part of the photo. The trail used today (lower right) is the same one used in the 1920s.





Photo by A. W. Sampson

Figure 13c—1909. Panorama left. (Looking northeast) Matterhorn (9,826 feet), the white columnar mountain, is a significant feature on Hurricane Creek. Far to the right is the canyon of the west fork of the Wallowa River, which lies about 7 miles south of Wallowa Lake. Most of the scattered forest in the middle ground is whitebark pine. To the left, in line with the Matterhorn, a fairly recent fire has eliminated much of the tree cover. The dark bare patch to the lower right of photo center is also a fire disturbance.



Figure 13d—1998. Panorama left (north). Trees of whitebark pine that did not appear in the foreground in the 1909 photo now are healthy young trees capable of producing cones. The fire patches visible in 1909 are healed over with a young mixed stand of subalpine fir and whitebark pine trees.





Photo by A. W. Sampson

Figure 13e—1909. Panorama right. (Looking east) The upper lake basin shows Upper Lake (lower right), Mirror Lake (center), and about half of Moccasin Lake (left of center). Pete's Point is the largest dark mountain on the far horizon (in shadow). The slope behind Moccasin Lake shows only a scattering of trees.

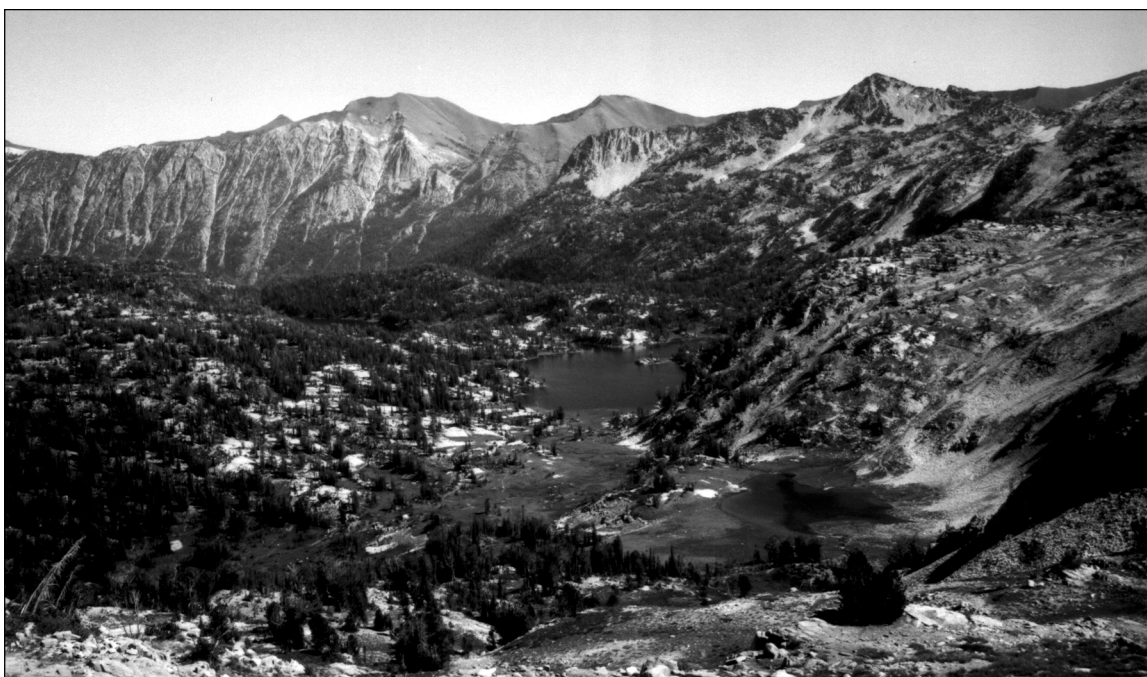


Figure 13f—1998. Less snow remained in late August of 1998 than at the same time in 1909; 1998 was considered to have had a heavy winter snow pack. Much of the mixed forest, largely subalpine fir, to the left of Moccasin Lake has closed its canopy to the extent that the lake is hardly visible. Several young whitebark pine trees have appeared in the extreme lower right foreground.

## Figure 14—Upper Lake, Wallowa County, OR.

Upper Lake is the westernmost lake in the Lake Basin and, though it is in the head of the east fork of the Lostine River, it drains into Mirror Lake and then into the west fork of the Wallowa River. It lies at the foot of the trail over Carper Pass leading to Minam Lake.



Photo by J. L. Peterson

Figure 14a—1912. (Looking northeast) This photo shows the remains of a hot fire that burned off about half of the forest on the distant slope. Many burned snags have fallen, but no advanced regeneration is yet noticeable; the burn, therefore, is probably not much older than 25 years. Upper Lake, in the foreground, is half covered by a large snow field (on ice). Winter snows, driven by southwesterly winds, eddy across the ridge and fall out creating a great snow mass in the huge cirque below.



Figure 14b—1998. It is hard to discern the boundaries of the fire now because of the heavily stocked stand of subalpine fir trees that has regenerated in the past 85 or so years. Several stock trails can be seen through the meadow to the left and beyond the lake. An older trail parallels the new straight trail across the meadow. This meadow is presently in poor to fair condition owing to historical heavy stock use by both sheep and recreation pack animals. The deep snow accumulation allows a short growing season here, which also retards vegetative recovery.



**Figure 15—Eagle Cap Mountain, Union County, OR.**

Eagle Cap Mountain (9,595 feet), one of the higher mountains in northeastern Oregon, is central to all drainages in the Wallowas. It is the eroded central upthrust of the Wallowa Batholith. Eagle Cap Wilderness Area takes its name from this significant landmark.

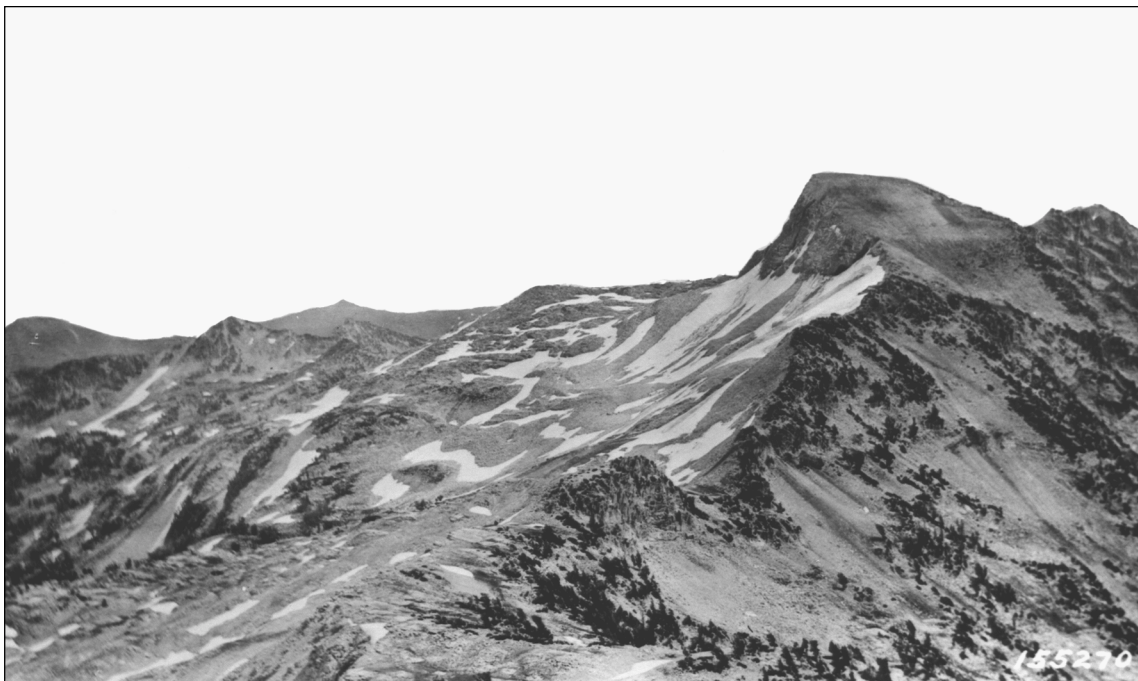


Photo by J.L. Peterson

Figure 15a—1914. (Looking southeast) Horton Pass, the low saddle beyond the rock palisades (low center) separates main Eagle Creek of Baker County from the several drainages flowing north into Wallowa County (that is, the Wallowa River and the Lostine River, formerly South Fork Wallowa River).



Figure 15b—1998. Because this region is largely above timberline, natural erosion and weathering are intense. Vegetation is tenuous, though some slight increase in foliar cover can be found in pockets of whitebark pine and prostrate juniper. No significant changes are obvious other than possibly smaller snow fields.



**Figure 16—Mount Nebo, Wallowa County, OR.**

Mount Nebo (8,275 feet) is about 2 miles north of the confluence of the north and south forks of the Imnaha River. Presumably, the name Nebo came from the biblical high ground from which Moses viewed the promised land. The mountain, the highest for miles around, had an early-day fire lookout. The surrounding area was used mostly in early summer and late fall when sheep were trailed to and from summer range. The camera point is on the wagon road that traversed the basin to the Tenderfoot Mine, which had been “salted” with gold for an investment hoax.



Photo by J.L. Peterson

Figure 16a—1915. (Looking east) Mount Nebo has a sparse stand of subalpine fir mixed with some Engelmann spruce and scattered lodgepole pine. There are small pockets of whitebark pine near the summit. This photo shows several small recent burn patches and an open grassy south-facing slope.



Photo by W.B. Hall

Figure 16b—1974. Mountain big sagebrush has invaded most of the open grassy slope. Subalpine fir has invaded the burned areas, and seedlings are rapidly colonizing the former open grassland slope in the center (left and below the 5-acre burn patch).



Figure 16c—1996. About 22 years later, the advance of sagebrush seems to have stabilized. Subalpine fir regeneration has advanced to sapling and pole size and will fully occupy this former grassland site within 40 to 50 years if no intervening events like fire or slashing occur.



**Figure 17—Aneroid Mountain, Wallowa County, OR.**

This distinctive basalt mountain (9,700 feet) was named for the nearby lake, named Aneroid by Hoffman Phillips of the U.S. Fish Commission who made a determination of the elevation of the lake using an aneroid barometer in 1897. Before then, it was called Lake Anna Royal.



Photo by H.D. Langille

Figure 17a—1903. (Looking north) This photo, looking across the headwaters of the east fork of the Wallowa River, was taken on July 15 when an unusual accumulation of snow remained. The photopoint is only a few yards off the original trail to Tenderfoot Pass. The photographer wrote, "Grass almost destroyed by early grazing. Snow hardly gone but sheep have run over the hills through mud." Aneroid Mountain is almost entirely clothed with whitebark pine. The foothills are covered with dead mature whitebark pine, which probably indicates a severe fire rather than bark beetle damage.



Figure 17b—1998. Few of the original whitebark snags remain standing. Considerable green fescue covers the low hills in the valley below; mountain heather appears as dark patches in the immediate foreground. Indian paintbrush and owl's clover are the protruding forb stalks. Whitebark pine seems to have regenerated in the areas it occupied before the fire. The largest whitebark pine recorded in Oregon was found several years ago in a small basin beyond the skyline ridge in the extreme right of the photo.



**Figure 18—Minam Horse Ranch, Wallowa County, OR.**

The original horse ranch had a two-story building well south of the present-day lodge structure. This land, homesteaded in about 1900 by A.W. Adams, had earlier been used as a holding pasture for stolen horses (Skovlin and Skovlin 1996). This site does not fit our established elevation criteria but has been included because it is a significant landmark and point of Wallowa Mountain wilderness entry.



Photo by W.L. Dutton

Figure 18a—1924. (Looking west) On the forested slope above the cabin, many snags are protruding through a low canopy of Douglas-fir trees that appear to be about 25 to 30 years old, indicating a fire in the late 1880s or early 1890s. The trees on the bottomland appear unaffected.



Figure 18b—1997. The dark stake in the grassland is the calculated southeast porch corner of the log cabin in the earlier photo. A vigorous stand of mixed Douglas-fir and ponderosa pine occupies the distant slope. The broad spreading trees to the right of the center midground are black cottonwood that were not noticeable in the 1924 photo.

## Figure 19—Sand Pass, Union County, OR.

The main trail from south Catherine Creek to Elk Creek on the upper Minam River goes over Sand Pass (8,120 feet). At this divide, an interface occurs between volcanic basalt topography to the west and granitic type to the east. The granodiorite is soft and erosive thus the name Sand Pass. This pass marks the contact between overlying Miocene basalt and underlying Jurassic granitic rocks.



Photo by A.W. Sampson

Figure 19a—1911. (Looking west) These five Forest Service officers were on a grazing reconnaissance of the Minam National Forest. This photo shows the sandy granite soil under foot and the volcanic rims behind. In the triangle between the man on the rock, the large whitebark pine with the heavy shadow, and the prostrate juniper bush above were about 14 large- and medium-sized boulders.



Figure 19b—1997. Significant natural erosion has occurred in the past 86 years. The upper left point of the huge granodiorite boulder (lower left) is missing perhaps because of freezing and thawing. A large slab of basalt rock on the right side of the crevice on the horizon above the boulder has fallen. Only nine boulders remain in the triangle. Finally, the heavy rock talus behind the man on the right (1911) has nearly disappeared.



**Figure 20—Burger Meadow, Union County, OR.**

From the previous camera point in Sand Pass, Sampson rotated his camera to point northeast and capture this scene of the head of Elk Creek and Burger Meadow 500 feet below. China Cap (8,655 feet) is the high mountain beyond the meadow.



Photo by A. W. Sampson

Figure 20a—1909. (Looking northwest) The meadow contained considerable standing water, but no snow remains. The west (left) side of the meadow and the tree island appear to be dry as does the area between the meadow edge and the timber edge. No sign of recent fires is evident.



Figure 20b—1997. Snow patches persist this year and yet the meadow shows much less standing water than in 1909. The bare space between the trees and the edge of the meadow seems to have closed with vegetation. Across the meadow and directly below (right center), there is significant tree regeneration. Up the hill and to the right, young subalpine fir have invaded the grassy avalanche chutes where avalanche activity has apparently subsided. Conversely, an avalanche in a chute near the top of China Cap had recently destroyed an advanced stand of subalpine fir, but sapling-sized fir had reoccupied the site of the former stand.



**Figure 21—Granite Butte, Union County, OR.**

The wall and Granite Butte (8,680 feet) form a ridge between Burger Meadow and Tombstone Lake. The latter lies in a basin between East and West Elk Creek. This camera point is at the junction of Elk Creek and Tombstone Lake Trails at about 6,500 feet elevation.



Photo by A.W. Sampson

Figure 21a—1909. (Looking south) Gnarled regeneration in the left foreground indicates a snow avalanche path with 20- to 25-year-old subalpine fir. The low vegetation covering the basement rock on the bench below the palisades (right) is prostrate juniper without much of a forest stand. Sitka alder and a willow species appear just left of the meadow.



Figure 21b—1997. Low prostrate juniper on the bench now has spires of subalpine fir protruding most along of its length. Dense young subalpine fir has emerged left of center in the midground. The Sitka alder and willow are still present along the stream. Boulders in the foreground have been conspicuously uncovered, probably from frost heaving. Repositioning of the camera tripod atop a large flat rock was exact.



## Figure 22—Bennett Peak, Baker County, OR.

Bennett Peak (7,040 feet) lies near the south end of the ridge between East Eagle Creek and Main Eagle Creek nearly 3 miles south of the wilderness area. It is about 2 miles east of Two Color Guard Station on Main Eagle Creek. Like Flagstaff Butte, it was a lookout that surveyed a broad area from the Powder River to Pine Creek near Halfway. In the mid-1870s, W.H. Coulton was one of the first wool growers to use this range, and his grandson, C.M. Coulton, was the last. Allotted cattle grazed south of Bennett Peak. Trespass cattle and allotted sheep grazed the landscape in this picture pair. No livestock have grazed here in over 30 years, but it is summer and fall range for many elk.



Photo by J.L. Peterson

Figure 22a—1914. (Looking north) The large basin draining west (left) is Two Color Creek. Beyond the grassy ridge to the east (right) is the East Fork of Eagle Creek. Several small (5 to 10 acres) snag patches indicate a fire history, but no large fires have occurred in recent times. The short growth of grass and exposed rocks in the foreground show that livestock have grazed the current year's growth.



Figure 22b—1992. Crown closure of subalpine fir is evident, but not much invasion of young fir has occurred. The foreground vegetation has thickened, and some green fescue plants are among the grasses. Forbs are abundant, and tailcup lupine is dominant.

**Figure 23—Flagstaff Butte, Union County, OR.**

An early-day lookout was located on Flagstaff Butte (6,510 feet), which overlooked a vast area draining into the Powder River Valley. Although this foothill region is about 2 miles south of the present wilderness area, it is characteristic of much of the Wallowas. The area was allotted to Powder Valley ranchers for cattle grazing for many years. Trailing sheep also grazed on and off the allotment.



Photo by J.L. Peterson

Figure 23a—1915. (Looking northwest) Considerable grass, probably Columbia needlegrass, appears in the foreground, but large bare patches are visible across the draw. No forbs can be seen in the foreground, which indicates some historical sheep grazing occurred. Sheep may have grazed here shortly before the photograph was taken.



Figure 23b—1967. Rest and reduction in grazing pressure started the recovery process and placed the area in poor to fair condition with an abundance of pioneer perennial grasses and some forbs. Considerable bare ground still exists in the interstices. The forest behind the next ridge has grown and nearly masks the horizon, whereas the snags seen in 1915 have almost disappeared.





Figure 23c—1997. The Flagstaff Butte area, closed to grazing since the previous photo, is now in a secondary weed stage and is considered in fair condition. Columbia needlegrass relinquished dominance, green fescue plants are common, and tailcup lupine is the dominant forb. Rocky Mountain elk graze the area in considerable numbers.

**Figure 24—Hidden Lake, Union County, OR.**

Hidden Lake is at about 6,950 feet elevation on the headwaters of East Eagle Creek and is one of few lakes along the entire drainage. The basin containing this and adjacent Moon Lake has gentle topography and is well watered, thereby making it excellent sheep range. About a mile away is the trail junction to the Lake Basin over Horton Pass or to the Minam River over Frazier Pass.



Photo by A. W. Sampson

Figure 24a—1908. (Looking east) About 700 sheep can be seen in this afternoon setting. A considerable burn of about 25 to 30 years ago can be seen beyond the left point of the lake. The far half of the fire has regenerated, but the near half has not. The isolated subalpine fir snags in the otherwise green forest indicate the trees may have succumbed to insect attack.





Figure 24b—1997. Major changes are a pronounced recovery of the young stand of subalpine fir beyond the left arm of the lake. The near half has failed to regenerate after 89 years. Perhaps some condition of the soil has prevented tree growth. At the base of the talus slope below the camera point (left), the forest has extended across the lower slope where no trees grew before. Scarred and misshapen trees of invading subalpine fir (right midground) show that occasional snow avalanches occur here.



**Figure 25—Needle Point, Union County, OR.**

The conical tip of Needle Point is about 9,020 feet elevation. In the basin to the right of the mountain lies Eagle Lake, the headwaters of the creek by the same name. The pass (8,170 feet) behind the camera point permits travel down Trail Creek to the main Minam River. Cached Lake is just below the first horizon in the foreground.

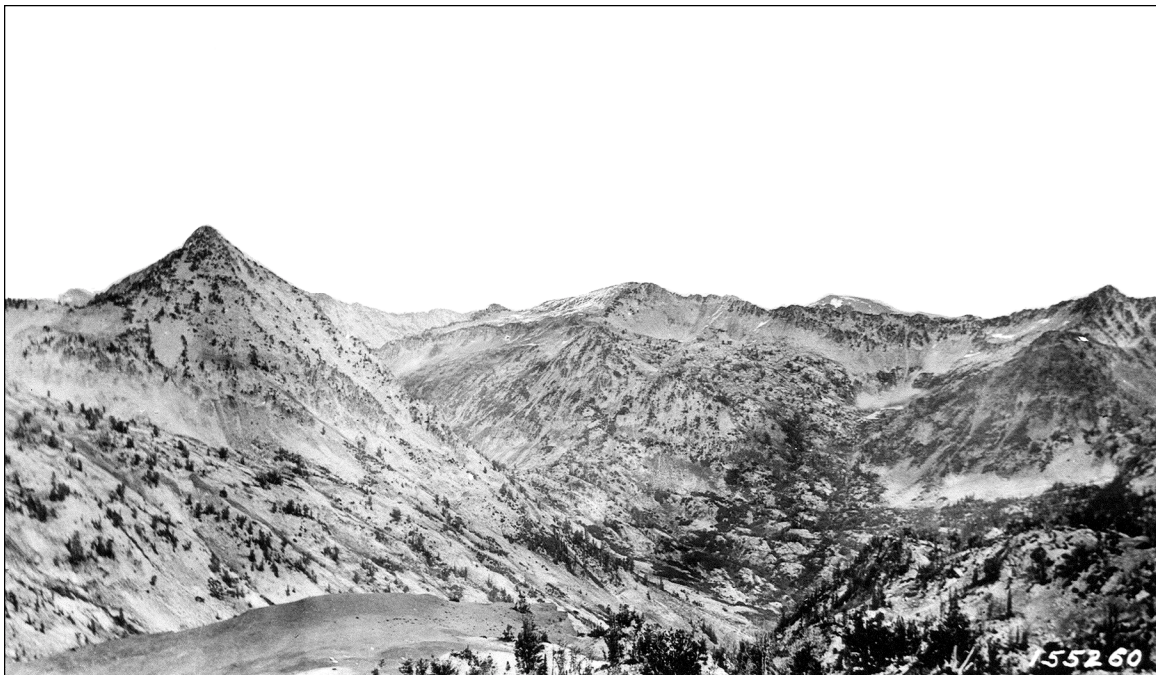


Photo by J.L. Peterson

Figure 25a—1914. (Looking northeast) Sparse tree cover, nearly all whitebark pine, produces a bleak, ghostly landscape. Little ground cover or available soil exists at this elevation.

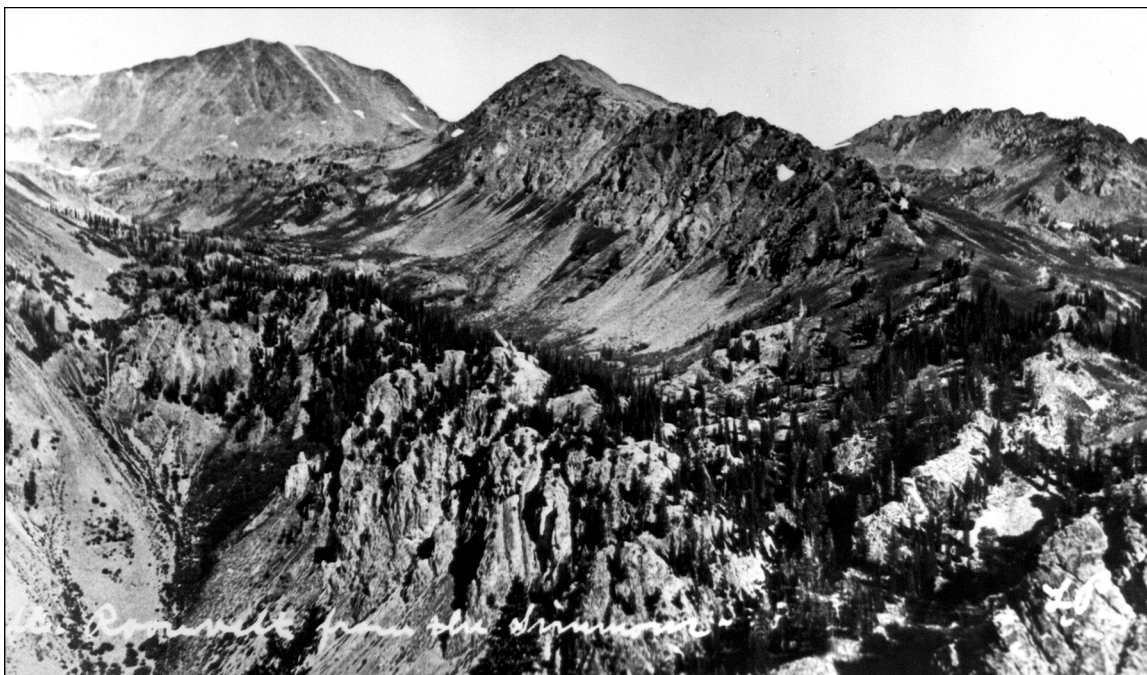


Figure 25b—1997. The apparent change is some thickening and crown spread of whitebark pine at upper elevations but substantial ingrowth of subalpine fir in the canyon bottomland. Only a few phlox and buckwheat plants have become established on the dark volcanic erosion pavement in the left foreground. Just beyond the white granitic rock, several whitebark pine trees have gained release from their stunted condition of 1914.



**Figure 26—Norway Basin, Baker County, OR.**

Red Mountain, formerly Mount Roosevelt, at 9,555 feet elevation is the tallest peak on the far horizon. It lies between Cliff Creek (west) tributary of the Imnaha River and Norway Creek (east) tributary of Pine Creek. The hanging valley below Red Mountain is the Middle Fork of Pine Creek that passes near the mining ghost town of Cornucopia about 3 miles below the camera point.



McCord Collection, photographer unknown

Figure 26a—Around 1916. (Looking northwest) This camera point overlook (7,140 feet) displays rugged terrain with scattered trees and little else but low shrubby vegetation.



Figure 26b—1998. Little change can be detected in this landscape. This area has one of the greatest accumulations of snow in the Wallowas and thus a short growing season. Sparse vegetation provides inadequate fuel loads to carry fires that can alter landscape patterns.



**Figure 27—Blue Creek Cutoff, Baker County, OR.**

Blue Creek empties into the Imnaha River east of Cliff Creek. The Cutoff Trail leaves Blue Creek Trail about two-thirds of the way to the summit ridge. This photo pair is at the ridge top near where the Cutoff Trail crosses the Ridge Trail and continues south down east Pine Creek to Cornucopia. This locality is the west end of the Pine Valley Cattle and Horse Association allotment. North Pine Creek is along the eastern end of the allotment. In the early 1900s, about 3,000 cattle and 5 bands of sheep grazed this area, whereas today there are less than 1,000 cattle and no sheep. The camera point is one-half mile south of the wilderness boundary.



Photo by J.L. Peterson

Figure 27a—1914. (Looking northwest) The range survey crew has just topped out on the Cutoff Trail. Scattered trees on the ridge (left) indicate most of the dead whitebark pine have been killed by bark beetles. This heavy infestation began in 1907 and was widespread to the north of the upper Imnaha River. Grassy slopes and the bottom foreground show wide and frequent bare ground spaces that indicate heavy past trailing and grazing use.



Figure 27b—1997. The seedling and saplings shown in 1914 have now matured and mask the open exposed ridge (left). More fir regeneration has moved down slope and invaded the open meadow. A cluster of six lodge-pole seedlings (3 to 5 years old) has gained a toehold to the left of where the trail disappears in the shadow. The meadow grassland is healthy with no bare areas. The predominant grass is mountain oatgrass along with some green fescue and scattered sedges.



**Figure 28—Mehlhorn Reservoir, Baker County, OR.**

A high forested plateau lies between Pine Valley and the Imnaha River. It contains many small pothole lakes that have been dammed to increase storage for late-season irrigation in Pine Valley. Mehlhorn Reservoir is one such modified lake lying at about 6,880 feet elevation. The present dam was raised in 1939, and the lake drains into Clear Creek, which flows south into the Pine Creek Valley. Most of this plateau is covered with a mixture of Engelmann spruce, subalpine fir, lodgepole pine, and some western larch. This reservoir was named for Albert Mehlhorn, a pioneer Pine Valley farmer and rancher.



Photo by J.L. Peterson

Figure 28a—1914. (Looking southeast) The rather open character of this landscape with many snags and downed woody material reflects recent fire activity. The pack string for the first range reconnaissance survey is traveling atop the old dam wall. The water level is perhaps the level of the original lake.



Figure 28b—1998. Eighty-four years have produced significant changes. A substantial increase in lodgepole pine has provided shelter for a surge in young subalpine fir. The grassy foreground in 1914 has given way to a sparse understory composed primarily of low shrubs. No fires have burned this area for at least 100 years. Cattle continue to graze this allotment. This area also contains excellent habitat for elk.



**Figure 29—Fish Lake, Baker County, OR.**

Fish Lake lies about 2 miles southeast of Mehlhorn Reservoir and also has been modified to hold water for late-season irrigation. It flows into the Fish Lake Branch of Lake Fork Creek. Several canals have been dug to divert water into upper Pine Valley rather than into its natural course into North Pine Creek below the valley. Elevation is about 6,600 feet. Damming in 1953 raised the lake about 22 feet from its original level. An earlier dam constructed about 1886 broke in 1924, sending a flood of water that reigned havoc on ranches clear to the mouth of North Pine Creek (Pine Valley Echo 1979). On the far horizon is Red Mountain (left) and Cusick Mountain (center). To the far right is Russel Mountain.



McCord Collection, photographer unknown

Figure 29a—1914. (Looking northwest) The lake outlet had not been completely dammed and therefore many islands and coves existed. The forested landscape had been burned except for patches of residual trees. A large meadow extends from the lakeside. The area is now grazed by allotted cattle.



Figure 29b—1998. Except for several hundred acres adjacent to the lake, the entire basin was affected by the Twin Lakes Fire of the mid-1990s. Most of the burn was in subalpine fir and spruce, although pockets of lodgepole also burned. The understory within burned areas is largely succulent pioneer forbs and sedges. The grasslands in the foreground are mostly green fescue with some deep-rooted perennial forbs, which places this particular site in near-climax condition. Although a few cattle are still permitted, they seldom venture to this elevation. Elk sign is plentiful.



### Figure 30—Russel Mountain Lookout, Baker County, OR.

The lookout on Russel Mountain (7,510 feet) is about 2 miles north of Fish Lake on the divide between tributaries of the Imnaha River and Pine Creek. It was one of the early lookouts on the Pine District of the Whitman National Forest. Presently, it is in the Eagle Cap Wilderness Area. The original lookout was about 50 feet tall. The new tower, large enough for living quarters, is about 70 feet tall.

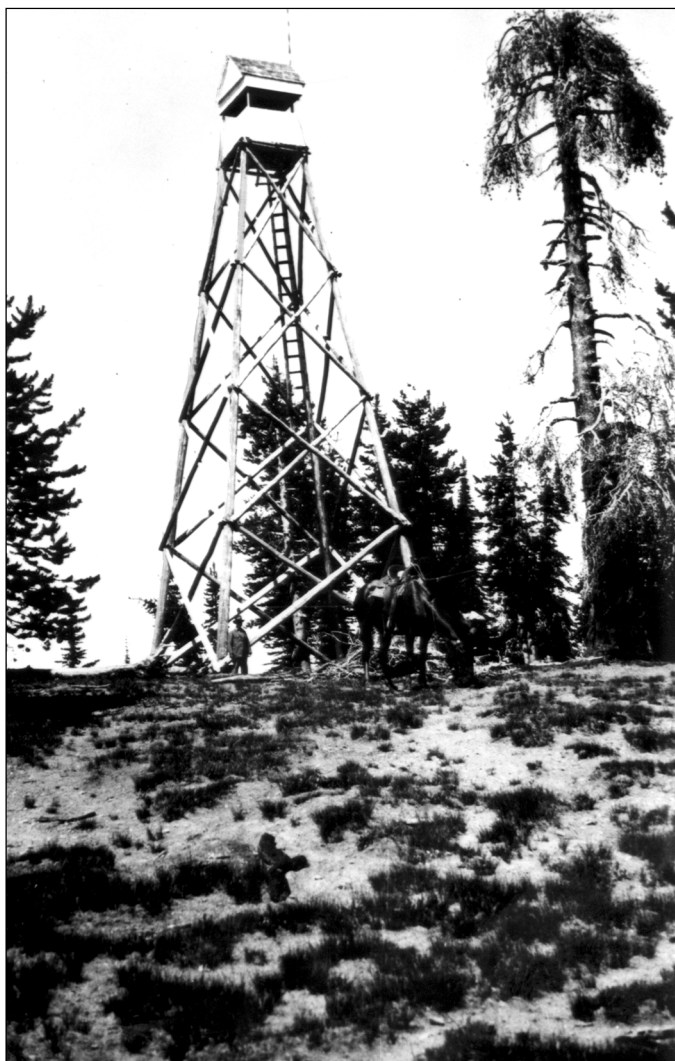


Photo by W. L. Dutton

Figure 30a—1924. (Looking north) The depleted grassland in the foreground was heavily eroded, and only pedestaled remnants of green fescue remain. The saddle horse of the photographer is grazing these tufts. The lookout fireman standing by the nearest support leg gives perspective to the surrounding landscape.



Figure 30b—1997. Ground cover has improved immensely, and bare areas are largely protected by perennial plant growth. The forb cover is dominated by tailcup lupine and the grass cover by young plants of green fescue. The Twin Lakes Fire burned to within about 200 feet of the tower (far side).

## The Elkhorns

This mountain range is composed of granitic and metamorphic rocks of the same ages, generally, as rocks of the Wallawas. It was a prosperous mining region beginning in the early 1860s with the gold discovery at Griffith Gulch and the founding of Auburn. The resulting gold rush brought a substantial nonindigenous population to the Blue Mountains, generating ranching and farming, as well as towns to support them. The mining districts and their prospects have been well described in the bulletin, "The Gold Belt of the Blue Mountains of Oregon" (Lindgren 1901), which also treated geology and mines in the southeastern part of the Wallowa Mountains.

The Elkhorns begin 3 to 5 miles southwest of Baker City and continue in a northwesterly direction for about 20 miles culminating in a butte called Chicken Hill in Union County. Like the Wallawas, this ridge is composed of granodiorite surrounded by foothills of basalt origin.

Boom towns that have sprung up and collapsed because of local mining activities include Sumpter, Granite, and Bourne. A branch line from Baker City, the Sumpter Valley Railroad, tapped the mining and lumbering resources of this region for many years.



[Click here for Figure 31](#)

### Figure 32—Anthony Lake, Baker County, OR.

The lake takes its name from the creek it produces, and the latter was named for William “Doc” Anthony who settled along its banks in Powder Valley in 1864. There are several small lakes in this same alpine basin, and at one time they were all referred to as the North Powder Lakes. Because of the elevation (7,130 feet) of the basin and ready road access, it has become a popular summer and winter outdoor sports area.



Photo by Cecil Ager

Figure 32a—1929. (Looking southeast) The nearly treeless granite slopes of Gunsight Peak, above the fishermen in the boat, appear to have had considerable avalanche activity. The lower part also appears to have burned fairly recently. The lake shore forest has many snags and spotty patches of dead trees.



Figure 32b—1998. The lake level has risen perhaps 1.5 feet and has inundated considerable grassy shoreline that was present above the fishermen nearly 70 years ago. The rocky shoreline (right) showing in 1929 has been masked from view by encroachment by young trees. The once nearly treeless granite slope hosts an advanced stand of subalpine fir regeneration.



**Figure 33—Rock Creek Meadow, Baker County, OR.**

Rock Creek Lake lies at the head of Rock Creek about 1.5 miles above Rock Creek meadow. The meadow is seasonally wet and thus escaped sheep grazing. Drier portions surrounding the wet areas, however, were heavily grazed until about 1925 when the area was closed to protect the Baker City watershed. Rock Creek is a major tributary to the Powder River.



Photo by Gifford Pinchot

Figure 33a—1901. (Looking northwest) In recent historical times, this meadow was occupied by large isolated Engelmann spruce trees that have died and fallen in the past 40 or 50 years. The distant forest has many standing snags of subalpine fir, Engelmann spruce, and perhaps lodgepole pine.



Figure 33b—1992. The meadow, which still has standing water, appears to be in good condition with an abundance of sedges in the foreground. The drier uplands show signs of substantial elk use but are also in good condition. The forest background, which is now subalpine fir with some Engelmann spruce and scattered lodgepole pine, is in a healthy if not overcrowded condition.



**Figure 34—Baisley-Elkhorn Mine, Baker County, OR.**

This mine and supporting village was located high in Elkhorn Gulch at 6,700 feet. The mine, discovered in 1882, became mechanized in 1889. Tunneling at several levels produced extensive mine tailings. This was one of the more promising mines in the district. During some years, ore output approached \$90,000 (Lindgren 1901).



Photographer unknown

Figure 34a—Around 1898. (Looking northwest) The town, which extended to the timbered ridge, included homes for more than a dozen families and several boarding houses for many single miners. The town site shows considerable disturbance of a rather open Douglas-fir forest and a heavy residual stand of mountain big sagebrush. Hunt Mountain (8,630 feet) in the background is almost devoid of trees.



Figure 34b—1997. Hunt Mountain has become strikingly covered in forest, especially at the lower reaches. The mine tailings, considerably larger than 95 years earlier, make an excellent reference point for the original town and mine buildings. Charred stumps and logs attest to the hot fire that destroyed much of the town. The forest that reinvaded the town site is composed of Douglas-fir and lesser amounts of subalpine fir with mountain big sage and elk sedge throughout the understory. A scattering of young whitebark pine has succumbed. Douglas-fir bark beetle activity is evident in several patches on the far slope.



**Figure 35—Goodrich Lake from west rim, Baker County, OR.**

This lake was named for A.O. Goodrich, an early surveyor and ditch contractor. The lake was raised by damming the outlet in the mid-1880s. It burst twice—once in 1888 killing all six members of the French family and again in 1956. The 65-foot-high dam constructed in 1963 comprises a significant part of the Baker City water supply, and the contributing watershed has Forest Service designation and protection for that purpose alone.



Photo by Burton

Figure 35a—Around 1915. (Looking southeast) An early June photo from the west shows considerable snow still occupying shaded parts of Goodrich Basin. The lake has not filled, and most of the mudflat is exposed back of the dam. Islands of ice about 2.5 to 3.0 acres still remain on the lake. Luxuriant grasses in the foreground show no evidence of sheep grazing. The patch of fallen snags of whitebark pine and subalpine fir to the left of the lake resulted from a crown fire over a century ago.



Figure 35b—1998. By late July 83 years later, little snow remains, and the lake is brim full. The snag patch of 1915 has largely disappeared. The excellent grassland consists mostly of green fescue maintained through protection from grazing. This ridge was difficult for sheep herders to access, and its condition improved quickly when the basin was closed to grazing in 1925.



**Figure 36—Goodrich Lake from east rim, Baker, County, OR.**

The ridge extending from Elkhorn Peak (8,930 feet) provided another photographer a good view of Goodrich Lake Basin. This Forest Service range surveyor was concerned with grazing trespass within the Baker City watershed. Water quality was good then and is judged excellent today.



Photo by W.A. Dutton

Figure 36a—1925. (Looking northwest) This late-season photo from the eastern rim of the basin shows Goodrich Dam drawn down to about its original configuration. The dam is the crescent-shaped feature to the right of the mudflat on the right of the lake. Nearly half of the forest beyond the lake has been burned in the last several decades. The appearance of whitebark pine snags on the steep slope in the right foreground attest to earlier repeated burning.



Figure 36b—1998. Most of the snags in the right foreground have disappeared, and a small stand of forest in the lower left has appeared in the last 73 years. Little or no evidence of the large burn beyond and to the right of the dam exists today. The lake is presently full. The white streak on the landscape beyond the lake is a cut bank that resulted from the removal of soil for the latest dam reconstruction.



## The Greenhorns

The Greenhorns occur at upper elevations between the headwaters of the North Fork and Middle Fork of the John Day River. This range culminates in a series of upland mountains and buttes around Greenhorn City and nearby Robinsonville. From there it runs northwest several miles to Vinegar Hill (8,130 feet) and continues in a series of peaks and passes along Sunrise Butte, Boulder Butte, and Indian Rock, all over 7,000 feet elevation.

The geology includes granitic rocks (Sunrise and Boulder Buttes) and serpentinite-matrix melange that includes metavolcanic and metasedimentary rocks of Devonian to Triassic age. The magnesium-rich serpentinite matrix covers extensive areas, including the south slopes of Vinegar Hill. This rock is generally inhospitable to vegetation.

The Greenhorns finally widen out and disappear into the forested uplands of the Blue Mountains forming low flat ridges and ravines striking in a northwest direction toward the village of Dale at the confluence of Desolation Creek and the North Fork of the John Day River.

### Figure 37—Olive Lake, Grant County, OR.

This lake provided the water that ran the Fremont Hydroelectric Plant to power mill machinery at Redboy Mine. The lake is about 10 miles west of Granite, and the power plant is about midway from that town to the lake. The present dam was completed in 1902, and the 8-mile flume and powerhouse was equipped in 1908. The powerhouse provided electricity until the mid-1960s. The lake, at about 6,000 feet, is drained by Lake Creek, which flows into the North Fork of the John Day River. About 3 miles south of Olive Lake is the Indian Rock lookout. Northwest of the lake about 2 miles is Lost Lake where pollen analysis has helped establish local fire frequency.



McCord Collection, photographer unknown

Figure 37a—1896. (Looking northwest) This late-summer photo depicts an early-day outing where women seem to outnumber men. It was taken before the lake level was raised to increase the water storage capacity for the Fremont Hydroelectric Plant. Scattered mature lodgepole pines create ample late-afternoon shade for this camp. The stumps in the foreground, also probably lodgepole, were cut incidental to mining and fuelwood demands.



Figure 37b—1997. The lake level has been raised by a 38-foot dam inundating the former camp site. Forest tree composition continues to be lodgepole pine with some larch and the occasional subalpine fir. The extremely hot Summit Fire of 1996 occurred to the west just left of the photo.



### Figure 38—Greenhorn City, Baker County, OR.

The gold and silver mining town of Greenhorn City was founded about 1900 although the area had been a mining district since the early 1860s. It took its name from a prominent rock or horn of greenstone. It lies about 2 miles east of Vinegar Hill, which is the easternmost point in the Vinegar Hill-Indian Rock Scenic Area. This area of about 6,600 acres continues west for about 8 miles along the high crest dividing Desolation Creek from the Middle Fork of the John Day River, which is perhaps one of the best remaining chinook salmon spawning grounds in the Columbia River system. Greenhorn City has the distinction of being the smallest and highest incorporated town in Oregon.



Photo by G.B. Sudworth

Figure 38a—1902. (Looking northwest) Dead wood from a recent fire, perhaps during the late 1880s, left Greenhorn City residents with ample fuel as evidenced by the many woodpiles. Vinegar Hill can be seen in the distant background (left). The predominant tree is subalpine fir mixed with some lodgepole pine and isolated larch trees. Understory is largely a shrubby mixture of low-growing woody species such as grouse wortleberry with pinegrass as the dominant grass.



Figure 38b—1998. Today, subalpine fir still dominates the open forest with scattered Douglas-fir and lodgepole pine. The understory has been converted to a carpet of sod grasses in an arrested state. Tree cutting and heavy cattle grazing has perpetuated the degraded condition of the site.



**Figure 39—Alamo City, Grant County, OR.**

Alamo City (5,050 feet) was an active mining town on Granite Creek at the turn of the 20<sup>th</sup> century. It lay about 7 miles southeast of Granite (formerly Granite City) in the central Blue Mountains. Little evidence of the community exists today. It was about one-half mile northeast of Alamo Hill, a prominent landscape feature shown on most modern maps. Alamo City was on the eastern edge of the southern part of the John Day Wilderness Area. This village was said to have been named after the nearby Alamo Mine, which took its name from the Spanish word for cottonwood.



Photo by G.B. Sudworth

Figure 39a—1902. (Looking north) Tailings from placer mining line the banks of Clear Creek (formerly Granite Creek). Rooftops of Alamo City can be seen downstream (north). Old-growth ponderosa pine and Douglas-fir are prominent on the ridge above.



Figure 39b—1998. The open character of the forest on the ridge in 1902 has now closed, and much of the old growth has been logged. Heavy cutting above town for mining timbers has left some of the areas bare and without advanced regeneration. Dredging for gold has severely disturbed most of the creeks in the area, leaving original channels completely altered and biologically sterile for decades.



## Discussion

Although causes of change and their effects have been described under each photo pair, discussion of some general cause-effect scenarios that have and are influencing high-elevation landscapes throughout northeastern Oregon is appropriate.

The mini Ice Age subsidence mentioned in connection with the disappearance of the Benson Glacier reflected a global cycle. Regional weather phenomena have been documented through local tree-ring analysis (Keen 1937, Meyers 1934) that shows wet and dry cycles of about 22 years; 11 above normal and 11 below normal, on average. The mid-1890s began a wet period until about 1905, after which a dry cycle began. A full cycle carried on until the deep dry cycle of the mid-1930s. The late 1980s and early 1990s brought a minor drought period with large fires and insect epidemics. A moderately warm, moist condition was experienced through the period of this repeat photography. Because of the no-burn tradition and policy adopted over the past 100 to 125 years, wildfire frequency and intensity in the higher mountains did not necessarily reflect these drought cycles (Agee 1996).

Fire has been a potent force in both grassland and forested areas. Recent catastrophic fires have altered entire landscapes, whereas historical fires were mostly small, cool, and frequent. Native Americans periodically set fires that kept tree seedlings suppressed and favored endemic grasses over shrubs and forbs. With the establishment of the USDA Forest Service in 1906, a policy of fire suppression was instituted that covered even the remote upper elevation forests in northeast Oregon (Beck 1996, Heyerdahl and Agee 1996, U.S. Department of Agriculture 1907). Recent catastrophic fires have been attributed to heavy fuel buildup accruing from long-term fire-suppression policy (McIver 1998).

Insects and diseases are natural forces that cause landscape changes. Outbreaks are frequent disturbance features of most forests, whether the forests are healthy or unhealthy (Burke 1990, Wickman 1992). Insect epidemics may occur more often where fire frequency or natural insect predators become imbalanced. Forest diseases may be less affected by human activities in the high mountain conifer forests than elsewhere (Filip and Schmitt 1990), but presently disease introductions, such as blister rust, are significantly affecting whitebark pine (Linn 1994) and may already be affecting dependent wildlife in the subalpine ecosystem (Kendall and Arno 1990).

Human activities have profoundly affected both forest and nonforest wilderness habitats (Rogers 1996). Domestic livestock grazing was introduced into the mountains of northeastern Oregon in the late 1800s. More and more owners brought their flocks of sheep to feed on the free, abundant native grasses. Early economic returns from these sheep came from their wool, so the goal was rapid increase of herd size. Within 20 years, the wide-scale degradation of the grasslands and forests caused national concern, thereby resulting in the creation of the Forest Reserves. This designation of land set aside entire areas of the most fragile land and protected them from sheep grazing. Effects of unregulated use are still apparent in the higher mountains.

Wildlife in these same areas was also dramatically affected by efforts to protect domestic animals from predators. Extreme efforts were used to rid the mountains of black and grizzly bears, bobcats, cougars, coyotes, lynx, wolverines, and wolves. Trapping of fur-bearing animals was a lucrative livelihood and led to the near demise of marten, mink, and beaver. The marketing and sale of game meat and fish was also profitable until regulations were promulgated, refuges established, and game law enforcement became effective in the 1920s and 1930s.

Early settlers in the valleys commonly lived off the land, which resulted in depletion of elk, mule deer, white-tailed deer, mountain sheep, and pronghorn populations by the start of the 20th century (Irwin and others 1994). Steelhead trout and fall chinook salmon, which spawned in the headwater streams, were also favorite foods of the pioneer.

High mountains provided recreational opportunities for early settlers. During lulls in harvest activities, it was popular for family groups to pack and ride their horses to camp in the high country. These periods were combined with hunting and expeditions to harvest wild berries. After hatchery fish were planted in the high lakes in the early 1900s, fishing also became popular.

Outdoor recreation use seems to have nearly doubled over the past decade according to a report prepared for the Eagle Cap Ranger District (Hall and Shelby 1994). The report estimated that 11,350 groups or a total of 33,400 people visited the Eagle Cap Wilderness in 1993. Of these, almost three-quarters of the groups traveled on foot, and about 70 percent of these were day visitors. Almost half of the livestock users but only 18 percent of the hikers were from northeastern Oregon. Almost 30 percent of hikers came from the Willamette Valley area.

Several problems at these high mountain settings are being addressed administratively (Cole 1982). For example, camping on lake shores is prohibited, and campfires are not allowed close to certain high-elevation lakes. Riparian habitats near lakes and streams are being inventoried and protected. Attempts are underway to restore damaged camp sites at some of the most popular lakes (Cole 1990).

Subalpine fir trees have been encroaching into areas that formerly had little or no fir. The subalpine fir tree invasion has its roots in several historical conditions (Franklin and others 1971). The first is the heavy, depleting grazing that began before the end of the 19th century. This activity reduced herbaceous cover and provided a fertile, competition-free seedbed for tree regeneration. The associated elimination of fine fuel reduced the chances for wildfire that had naturally favored whitebark pine over subalpine fir.

Subalpine fir has thin bark, and the lower branches are in contact with the ground at grass level. The latter feature makes it susceptible to crown fires that destroy even the mature trees. This fir has a small seed with a large wing permitting it to spread long distances. Whitebark pine, on the other hand, has a large, heavy seed and depends on birds and animals for dissemination. Although it has rudimentary seed wings, they remain with the cone at dispersal time.

Subalpine fir and whitebark pine are not regular cone producers. For example, in 1997, cones of whitebark pine were abundant as were Clark's nutcrackers, the principal disseminator of their seed. In 1998, whitebark pine did not produce cones in the Wallowas. In 1999, the cone crop was moderate and spotty, and nutcrackers were common but not abundant. This lack of whitebark pine seeds presents problems because they are important to the wildlife of this high mountain area. They are prized food for squirrels and several species of birds, such as Clark's nutcracker and Stellar's jays. Bears, in turn, rob squirrel and bird caches and rapidly fatten on them just before hibernation. These interactions have been modeled in a study of whitebark pine stand dynamics (Keane and others 1990).

Whitebark pine has high value for watershed protection as well as for food and habitat for wildlife. At elevations above 7,500 feet, whitebark pine is about the only tree that persists under the harsh site conditions on many south-facing slopes. Some limber pine is found on peaks and ridgetops but only in scattered patches.

The loss of several age classes of whitebark pine at upper elevations is a recent and alarming condition, especially in the Wallowas. In several localized areas, this is the result of whitebark pine blister rust, a disease that has been detected here in only the past several decades (Linn 1994). The disease first produces a canker in branches and twigs and may take several years to kill the tree. The alternate host for this disease is gooseberries, several species of which occur throughout the Wallowas. Most common are prickly currant and sticky currant, which are common at 5,000 to 8,000 feet elevations. They spread rapidly through talus and avalanche paths and enter the altitudinal level of whitebark pine. One particular hot spot is the west slope of Brownie Basin and the head of John Henry Wilson Basin where mature and old-growth whitebark pine recently have died.

At lower elevations, regeneration of Engelmann spruce presents a problem by encroaching into wetter areas of meadows. Even lodgepole pine has invaded bare spots in these lower meadows. Subalpine fir becomes the bane of meadows at upper elevations, first by encroaching from surrounding stands along the tree-grass edge and second by regenerating well out into the natural meadow habitat. Probably a combination of factors has permitted this invasion, lack of fire being a chief factor. This invasion has increased and increasingly affects recreational use of the area where meadows provide prime camping sites and sources of forage for pack and saddle stock.



## Review

A retake of photographs in the high mountains of northeastern Oregon recorded the effects of a shift from resource exploitation toward one of resource restoration. We tried to recount the disturbance factors that brought about these changes.

Among the changes noted are that woody species are replacing herbaceous plants. Perhaps the most important examples of this are the wholesale encroachment of subalpine fir into areas that formerly had little or no fir and a rapid invasion of meadows by various woody species.

Subalpine fir has been aided in its expansion into new areas by past overgrazing, which created good seedbeds free from competition. Because it is a species susceptible to fire, subalpine fir also has prospered owing to fire-suppression policies. The invasion of woody species into grasslands is evident at Standley (fig. 4) and Mount Nebo (fig. 16) where heavy grazing by domestic sheep around 1900 stripped the ground of native grasses, laying it bare and receptive to the establishment of woody species. Protection from fires that were once deliberately set also has allowed trees to encroach on grasslands.

Diseases are suspected in the loss of whitebark pine. This species is being affected by blister rust, a disease that has been detected here only in the past several decades and that eventually kills the trees. These trees are important for watershed protection as they are often the only trees that persist above 7,500 feet under harsh conditions at sites on south-facing slopes. This tree also provides valuable wildlife food and habitat.

Insect outbreaks have become more frequent in the late 1900s, perhaps encouraged by less frequent burning. Several epidemics of western and mountain pine bark beetle have occurred, particularly in the Francis Lake (fig. 11) and Anthony Lake (fig. 31) areas where many acres of dead whitebark pines stand ghostlike.

Early grazing practices and subsequent fire suppression have allowed invasion of meadows by trees, which affects recreation opportunities. Meadows provide prime camping sites as well as forage for ungulate wildlife and pack and saddle stock (Mount Nebo, fig. 16; Blue Creek Cutoff, fig. 27; and Rock Creek, fig. 33).

Although changes resulting from recreation use are less widespread than changes caused by other disturbance agents, certain desirable locations in the Eagle Cap Wilderness Area have been damaged to the point where administrative action has been taken. Several photo pairs show pristine camping and hiking scenes in the early 1920s in areas that are now closed to camping with restoration efforts underway to reduce the effects left by years of overuse (Chimney Lake, fig. 10; and Upper Lake, fig. 14).

Accelerated erosion continues on former sheep driveways and old bed grounds, but the vegetative ground cover has increased, thereby improving watershed conditions in these high mountains. Anthony Lakes Divide (fig. 31) and Russel Mountain (fig. 30) are examples of good recovery.

Plant diversity has increased noticeably since the early 1900s. Early photos of grazing areas show only grass composition with few, if any, forbs and relatively few shrubs and trees (Flagstaff, fig. 23). This may reflect the fact that sheep selectively grazed forbs and shrubs, that fires were more frequent, which discouraged shrub and forb establishment, or both.

Several picture pairs show gravitational mass wasting of parent material and talus rock disappearance, notably at Sand Pass (fig. 19) and Chaparral Basin (fig. 5). Avalanche chutes and paths showed evidence of successive slides and subsequent tree replacement.

Large stand-replacement fires were common in the past decade in the Wallowas, Elkhorns, and Greenhorns. The Twin Lakes, Sloan Ridge, Tower-Summit, and Fox Point fires altered entire landscapes. Earlier stand-replacement fires were few and confined to sections in the Wallowas. Historical fires were mostly small, cool, and more frequent owing to the fire regime practiced by Native Americans. Of the landscape photos taken before 1925, recent fires showed up in 71 percent of the pictures. Conversely, in the repeat of the late 1990s, only 8 percent of the photos showed evidence of recent fires.

These time-lapse photographs provide a visual record of ecological changes that have occurred on a landscape basis in the high mountains of northeastern Oregon. Without the aid of long-term photography, slow ecological changes are difficult to detect. Old timers reminisce about how the countryside used to be more open, but recollections are not sufficient evidence on which to base management decisions. The foregoing time-lapse landscape photography, however, documents changes that would be difficult to illustrate, even with detailed measurements.

Decisionmakers require an understanding of factors influencing change in patterns of succession in these high mountain areas. With this knowledge, they can plan management activities to best meet the goals of protecting watersheds and providing for increased recreational demands.

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## English Equivalents

|                                       |                               |
|---------------------------------------|-------------------------------|
| 1 kilometer (km)                      | = 0.62 mile                   |
| 1 meter (m)                           | = 1.09 yards                  |
| 1 centimeter (cm)                     | = 0.39 inch                   |
| 1 millimeter (mm)                     | = 0.04 inch                   |
| 1 square kilometer (km <sup>2</sup> ) | = 0.39 square mile            |
| 1 square kilometer (km <sup>2</sup> ) | = 247.10 acres                |
| 1 hectare (ha)                        | = 2.47 acres                  |
| 1 liter (l)                           | = 1.06 quarts (liquid)        |
| 1 ton (metric)                        | = 1.10 tons (English)         |
| 1 kilogram (kg)                       | = 2.21 pounds                 |
| 1 ton (metric)/hectare                | = 0.45 ton (English) per acre |



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## Appendix—Common and Scientific Names of Species Mentioned

### Plants<sup>1</sup>

#### Trees:

|                                                 |                                                                  |
|-------------------------------------------------|------------------------------------------------------------------|
| Cottonwood (black)                              | <i>Populus trichocarpa</i> Torr. & Gray                          |
| Douglas-fir                                     | <i>Pseudotsuga menziesii</i> var. <i>glauca</i> (Beissn.) Franco |
| Engelmann spruce                                | <i>Picea engelmannii</i> Parry ex Engelm.                        |
| Grand (white) fir                               | <i>Abies grandis</i> (Dougl.) Lindl.                             |
| Limber pine                                     | <i>Pinus flexilis</i> James                                      |
| Lodgepole pine                                  | <i>Pinus contorta</i> Dougl. ex Loud.                            |
| Mountain hemlock                                | <i>Tsuga mertensiana</i> (Bong.) Carr.                           |
| Mountain maple, Douglas<br>maple, or vine maple | <i>Acer glabrum</i> Tor. ssp. <i>douglasii</i> (Hook.) Wesml.    |
| Ponderosa pine                                  | <i>Pinus ponderosa</i> Dougl. ex Loud.                           |
| Poplar                                          | <i>Populus</i> spp.                                              |
| Prostrate juniper                               | <i>Juniperus communis</i> L. var. <i>Montana</i> Ait.            |
| Sitka alder                                     | <i>Alnus sinuata</i> (Regel) Rydb.                               |
| Subalpine fir                                   | <i>Abies lasiocarpa</i> (Hook.) Nutt.                            |
| Western larch                                   | <i>Larix occidentalis</i> Nutt.                                  |
| Whitebark pine                                  | <i>Pinus albicaulis</i> Engelm.                                  |
| Willow                                          | <i>Salix</i> spp.                                                |

#### Shrubs:

|                        |                                                                 |
|------------------------|-----------------------------------------------------------------|
| Bush cinquefoil        | <i>Potentilla fruticosa</i> L.                                  |
| Gooseberry             | <i>Ribes</i> spp.                                               |
| Grouse wortleberry     | <i>Vaccinium scoparium</i> Leib.                                |
| Mountain big sagebrush | <i>Artemisia tridentata</i> vaseyana (Rydb.) Beetle             |
| Mountain heather       | <i>Cassiope mertensiana</i> var. <i>gracilis</i> (Bong.) G. Don |
| Mountain-mahogany      | <i>Cercocarpus ledifolius</i> Nutt. in T. G.                    |
| Phlox                  | <i>Phlox</i> spp.                                               |
| Prickly currant        | <i>Ribes lacustre</i> Pursh.                                    |
| Scoulers willow        | <i>Salix scouleriana</i> Barratt                                |
| Snowbush (sticky)      |                                                                 |
| ceanothus              | <i>Ceanothus velutinus</i> Dougl.                               |
| Sticky currant         | <i>Ribes viscosissimum</i> Pursh.                               |
| Willow                 | <i>Salix</i> spp.                                               |

#### Grasses:

|                          |                                                                                     |
|--------------------------|-------------------------------------------------------------------------------------|
| Bluebunch wheatgrass     | <i>Agropyron spicatum</i> (Pursh) Scribn. & Sm.                                     |
| Bottlebrush squirreltail | <i>Sitanion hystrix</i> (Nutt.) J. G. Sm.                                           |
| California oatgrass      | <i>Danthonia californica</i> Boland.                                                |
| Columbia needlegrass     | <i>Stipa occidentalis</i> Thurb. ex Wats.<br>var. <i>minor</i> (Vasey) C.L. Hitchc. |

<sup>1</sup> Nomenclature for plants, forbs, shrubs, and trees follows Garrison and others (1976).

Green fescue  
Kentucky bluegrass  
Mountain brome  
Mountain oatgrass  
Pinegrass  
Red fescue  
Thin bentgrass  
Thin grass  
Timothy  
Tufted hairgrass  
Western needlegrass  
Western fescue

*Festuca viridula* Vasey  
*Poa pratensis* spp.  
*Bromus marginatus* Desf.  
*Danthonia intermedia* Vasey  
*Calamagrostis rubescens* Buckl.  
*Festuca rubra* L.  
*Agrostis variabilis* Rydb.  
*Agrostis diegoensis* Vasey  
*Phelum pratense* spp.  
*Deschampsia caespitosa* (L.) Beauv.  
*Stipa occidentalis* Thurb. ex Wats.  
*Festuca occidentalis* Walt.

Grasslike:

Baltic rush  
Beaked sedge  
Elk sedge  
Hood sedge  
Nebraska sedge  
Parry's rush  
Rush  
Sedge  
Water sedge  
Wire rush

*Juncus balticus* Willd.  
*Carex rostrata* Boott.  
*Carex Geyeri* Boott.  
*Carex Hoodii* Boott.  
*Carex nebraskensis* Dewey  
*Juncus Parryi* Engelm.  
*Juncus* spp.  
*Carex* spp.  
*Carex aquatilis* Wahl.  
*Juncus filiformis* L.

Forbs:

Biscuitroot  
Buckwheat  
False horsemint  
Gland cinquefoil  
Goldenrod  
Gooseberry  
Indian paintbrush  
Owl's clover  
Penstemon  
Pokeweed fleecflower  
Pussytoes  
Strawberry  
Tailcup lupine  
Tarweed, cluster  
Twin flower  
Umber (brown) pussytoes  
Western coneflower  
Yarrow

*Lomatium dissectum* var. *multifidum* (Nutt.) Math. & Const.  
*Eriogonum* spp.  
*Prunella* spp.  
*Potentilla glandulosa* Lindl.  
*Solidago missouriensis* Nutt.  
*Ribes* spp.  
*Castilleja* spp.  
*Orthocarpus* spp.  
*Penstemon* spp. Mitch.  
*Polygonum phytolaccaefolium* Meisn. ex Small  
*Antennaria* spp.  
*Frageria* spp.  
*Lupinus caudatus* Kell.  
*Madia glomerata* Hook.  
*Linnaea borealis* L. spp. *Longiflora* (Torr.) Hulten  
*Antennaria umbrinella* Rydb.  
*Rudbeckia occidentalis* Nutt.  
*Achillea Millefolium* var. *lanulosa* Piper



## Animals

### Mammals:<sup>2</sup>

|                          |                                                                  |
|--------------------------|------------------------------------------------------------------|
| American marten          | <i>Martes americana</i> (Rhoads) (Turton)                        |
| Beaver                   | <i>Castor canadensis</i> var. <i>pacificus</i> Rhoads (Schreber) |
| Black bear               | <i>Ursus americanus</i> Pallas Kuhl                              |
| Bobcat                   | <i>Lynx rufus</i> Rafinesque                                     |
| Cougar (mountain lion)   | <i>Felis concolor</i> (L.)                                       |
| Coyote                   | <i>Canis latrans</i> Say                                         |
| Elk                      | <i>Cervus elaphus</i> (L.)                                       |
| Fisher                   | <i>Mustela pennanti</i> (Rhoads) (Erxleben)                      |
| Grey wolf                | <i>Canis lupus</i> (L.)                                          |
| Grizzly bear             | <i>Ursus arctos</i> (L.)                                         |
| Lynx                     | <i>Lynx lynx</i> Kerr                                            |
| Mink                     | <i>Mustela vison</i> Schreber                                    |
| Mountain (bighorn) sheep | <i>Ovis canadensis canadensis</i> Shaw                           |
| Mule deer                | <i>Odocoileus hemionus</i> (Rafinesque)                          |
| Pronghorn                | <i>Antilocarpa americana</i> (Ord)                               |
| Squirrel                 | <i>Tamiasciurus</i> spp.                                         |
| White-tailed deer        | <i>Odocoileus virginianus ochrourus</i> (Zimmermann)             |
| Wolverine                | <i>Gulo gulo</i> (L.)                                            |

### Birds:<sup>3</sup>

|                    |                                       |
|--------------------|---------------------------------------|
| Clark's nutcracker | <i>Nucifraga columbiana</i> (Wilson.) |
| Stellar's jay      | <i>Cyanocitta stelleri</i> (Gmelin)   |

### Fish:<sup>4</sup>

|                              |                                           |
|------------------------------|-------------------------------------------|
| Salmon                       | <i>Salmonids</i>                          |
| Chinook                      | <i>Oncorhynchus tshawytscha</i> (Walbaum) |
| Steelhead trout (summer run) | <i>Salmo gairdneri</i> (Richardson)       |

### Insects:<sup>5</sup>

|                           |                                            |
|---------------------------|--------------------------------------------|
| Douglas-fir bark beetle   | <i>Dendroctonus pseudotsugae</i> (Hopkins) |
| Mountain-pine bark beetle | <i>Dendroctonus ponderosae</i> (Hopkins)   |
| Western pine bark beetle  | <i>Dendroctonus brevicomis</i> (LeConte)   |

### Diseases:<sup>6</sup>

|              |                                          |
|--------------|------------------------------------------|
| Blister rust | <i>Cronartium ribicola</i> Fisch ex Rabh |
|--------------|------------------------------------------|

<sup>2</sup> Nomenclature for mammals follows Hall (1981) and Jones and others (1992).

<sup>3</sup> Nomenclature for birds follows that of the American Ornithologists Union (1983).

<sup>4</sup> Nomenclature for fish follows that of the American Fisheries Society (1970).

<sup>5</sup> Nomenclature for insects follows Furniss and Carolin (1977).

<sup>6</sup> Nomenclature for diseases follows Hedwigia (1872), and Torrey Botanical Club Bulletin (1895), respectively.

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