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Interpreting Long-Term Trends in Blue Mountain Ecosystems from Repeat Photography

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H.W. Harris, 1908

1992

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Cover Photos

1908 (top). Early researcher, James T. Jardine, and Wallowa National Forest Supervisor, Harvey W. Harris (photographer), rest their horses while riding out of Swamp Creek to Starvation Ridge. They are traveling the newly constructed Chico Trail connecting Sled Springs Guard Station, 30 kilometers north of Enterprise, with Billy Meadows Ranger Station where forest grazing experiments were underway.

1992 (bottom). Landscape changes after 84 years include timber harvest of old-growth ponderosa pine on the distant skyline (left). Selection of only yellow pine during the 1920s along with grazing and fire suppression have converted the parklike canyon (right) to a thick stand of second-growth Douglas-fir and grand fir. In 1986 all three side canyons (left center) sustained disastrous crown fires Several light colored patches on the far open slopes have been colonized by cheatgrass brome which invaded about 1920. In the foreground, vegetative cover may be slightly less in 1992 than in 1908. This could be caused by natural variation in spring growth since plant composition has remained the same. A climax bluebunch wheatgrass-balsamroot community occupies this harsh rocky site. Since about midcentury, cattle have made moderate use of this intermingled forest range. Rocky Mountain elk have made conservative but increasingly heavier use, and modest deer use decreased.

Abstract

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Photographs taken before 1925 were compared with photos taken as recently as 1992 to interpret changes within ecosystems in the Blue Mountains of Oregon. For discussion purposes, 10 ecosystems were aggregated into seven broad landscape systems. Nearly all systems exhibited some degree of conversion from herbaceous to woody forms of vegetation. Nonforested ecosystems improved markedly except in the riparian-aquatic habitats. Forested ecosystems were stressed from stand stagnation, conversion from pine to fir, serious insect infestations, and crown fires. This project shows how these ecosystems have changed since the advent of settlement by nonendemic people. It was carried out to assist land managers and researchers to develop strategies to improve ecosystem stability and thereby provide for resource sustainability.

Keywords: Blue Mountains, Oregon, photography (repeat), photo history, long-term change, landscape ecology, ecosystem stability.

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Introduction

The forest ecosystems of the Blue Mountains in Oregon and Washington are unhealthy This is the diagnosis of those who find the forest no longer producing the raw materials and other amenities that communities have grown to expect (Quigley 1992) Timber sales have been halted. Grazing allotments have been curtailed or eliminated. Salmon runs continue to diminish. The forests are deemed unhealthy because resource production alleged to be on a sustained yield has proven unsustainable at former levels of extraction.

Recognition of this reality has been slow in coming, although the symptoms have become increasingly evident in destructive forest fires and insect and disease depredations that have left entire landscapes of standing dead trees (Wickman 1992). Concern about the declining quality of water, wildlife habitat, and recreation was increasingly expressed, but not until the economic ramifications of reduced timber production became apparent did people really take notice.

Much research and management effort is now going into developing strategies to turn this situation around and put the forests back into a healthy condition; that is, one where production from the forest resources is truly sustainable (Everett and others 1994). The starting point for this restoration effort is to learn as much as possible about what the forests were like before they were altered by settlement, farming, logging, ranching, forest management, and associated activities. From this information, appropriate restoration strategies can be developed (Mutch and others 1993).

One of the techniques useful in analyzing long-term trends in the physical and biological world is repeat photography (Rogers 1984) Repeat photography is the art of finding the site of a previous photograph, reoccupying the original camera position, and making a repeat photograph of the same scene.

Whenever such photographs are repeated, they become elements of a continuous record and provide a quantitative basis for understanding and predicting the natural forces that give a particular landscape its character. Time-lapse photography is also an excellent tool for monitoring the results of management activities.

Because early pictures of the Blue Mountains are available, it is possible to use this technique to achieve a historical perspective on the changes that have occurred in this area. Most of the original photographs were taken to survey the boundaries of the Forest Reserves or to record U.S. (now USDA) Forest Service research efforts or the activities of the first range reconnaissance crew.[1] Other pictures were taken to show prospective buyers the potential of the timber resources of the area.[2]

Many of the photo sites have been relocated and photographed periodically. The earliest pictures were taken in 1901; the most recent retakes were done in 1992. Some repeats illustrate over 90 years of change.

The objectives of this study were to rephotograph a representative group of picture points throughout the Blue Mountains in Oregon, describe the history of use, and analyze the long-term trends based on landscape ecology (Urban and others 1987). The purpose of this visualization of change since the early 1900s was to assist land managers in developing strategies to improve long-term sustainable productivity. ■

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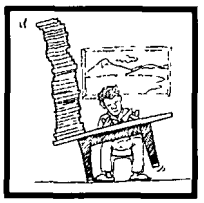
[1] Photographs taken before 1920 are on file with the National Archives, Washington DC Photos taken after 1920 are on file with the USDA-Forest Service Photo Collection, National Agricultural Library, Beltsville, MD.

[2] Lacey Co 1919 Report on lumbering potential in northeastern Oregon Pictorial report commissioned by August Stange On file with Boise Cascade Corp , Forestry Department, La Grande Division, La Grande, OR 97850.

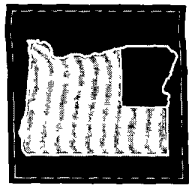


Review of Literature

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

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

Published time-lapse photography in the Blue Mountains has been confined mainly to the subalpine grassland ecosystem in the Wallowa Mountains. These studies (Reid and others 1980,1991; Strickler 1961; Strickler and Hall 1980) analyzed 70 years of the change on the Standley Sheep Allotment and 50 years of change on the Tenderfoot Allotment. ■



Study Area

The Blue Mountains of northeastern Oregon and southeastern Washington present a highly diverse physical and biological province. Topography includes the rolling Palouse Hills near Walla Walla, WA, and the rugged 1.5-kilometer-deep Hells Canyon of the Snake River on the Idaho-Oregon border.[3] Elevations range from over 3000 meters in the lofty Wallowa Mountains to less than 300 meters along the Snake River where the three States meet.

Although most of the Blue Mountains are derived from basalt flows, the Wallowas, Greenhorns, and Elkhorn Ridge Mountains are granite (granodiorite) showing various degrees of glaciation. The Strawberry, Aldrich, and Murray Mountains are uplifted domes of faulted basalt surrounded by seas of forest and woodlands.

This physiographic province (Fenneman 1931) receives most of its precipitation from Pacific maritime air masses but is strongly influenced by continental weather systems from the Great Basin and northern Great Plains. Precipitation ranges from 2000 millimeters near Tollgate to less than 200 millimeters near Burns. This entire mountain uplift is drained around its perimeter by the Malheur, Silvies, Ochoco, Umatilla, Walla Walla, Tucannon, and Imnaha Rivers; the John Day and the Grande Ronde and its tributaries, the Wallowa, Minam, and Wenaha, drain the interior.

About 6,500 years ago the whole of the area had its brown forest soils overlain in places by up to a meter of grey ash dust from the eruption of Mount Mazama (Crater Lake). This provided for much greater diversity in vegetation than otherwise would have been possible (Geist and Strickler 1978).

Biological aspects of the Blue Mountains are as diverse as the physical attributes (Omernik and Gallant 1986). In one sense, the Blues are an ecological island with a complex mixture of plants and animals representing both Rocky Mountain and Cascade Range fauna and flora.[4] Given the isle theory, the Blue Mountains have many plant species endemic to the province (Hitchcock and Cronquist 1973), but in a holistic sense these mountains are a complex mixture of both regions, which are in turn influenced by closer systems.

The Blue Mountains can be divided ecologically into forested and nonforested ecosystems. Kuchler (1964) describes eight true ecosystems based strictly on climax characteristics. Garrison and others (1977) added a mountain meadow ecosystem not recognized by Kuchler and divided the mixed-conifer coined by Thomas (1979) into separate Douglas-fir and larch ecosystems. Others have variously subdivided these 8 or 10 major systems into cover types, associations, or plant communities (Eyre 1980, Ganskopp 1978, Hall 1973, Johnson 1959, Johnson and Simon 1987).

The whole province is bounded by a grassland steppe, a shrub steppe, and a woodland zone (Franklin and Dyrness 1973), which are mostly below the mountain forest ecosystems. These zones must be considered, though, for a complete understanding of the functioning of the higher elevation regions. These zones also occur within the mountain forests as do islands of forest within the steppe, shrub steppe, and woodland zones.

The Columbia Basin grassland steppe (foothill type) to the northwest (Sheehy 1987) merges with the high desert western juniper woodland in central Oregon (Driscoll 1962), which in turn joins the Great Basin big sagebrush shrub steppe to the southeast into Idaho (Tisdale and Hironaka 1981). To the east of the Blue Mountains across the Snake River are extensions of the vast Idaho batholith not unlike the Wallowa Mountains.

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[3] English equivalents are given at the end of the text.

[4] Scientific names for all species mentioned are given in Appendix I.

The open ponderosa pine (pine-bunchgrass) and Douglas-fir ecosystems are the lower forest edge associations; above them is the mixed-conifer ecosystem made up of western larch, grand fir, and lodgepole pine ecosystems (Seidel and Cochran 1981). Spruce-fir of the "upper slope type" lies below the subalpine fir ecosystem. The subalpine fir ecosystem is open grassland surrounding islands of mixed-fir forests (Pickford and Reid 1942a).

The photographs selected for this publication will not be of true ecosystems because the original photographs were not taken to depict ecosystems as such. In some cases, the photographers were illustrating problem areas, in others promoting a prolific resource. It would be difficult to take these random photos and classify them into discrete categories In fact, Hall (1973) introduces his key to the Blue Mountain plant communities by saying that nearly one-third (30 percent) of any random point will fall into the gray transition zone where two or more communities merge. The real world of nature is not black or white, but shades of gray.

For this paper, references to ecological landscape systems will use the Australian classification approach outlined by Christian (1958) and enlarged by Christian and others (1960). In this method, principal emphasis is on a two-level classification: land systems and land units "Land systems" are areas with a recurring pattern of topography, soils, and vegetation, "land units" are subdivisions of land systems and display homogeneity but differences in use potential. ■

Methods and Materials

Techniques for this study were quite simple. As nearly as possible, the exact camera position was found and a black and white large-format picture was repeated at the same time of day and year as the original photograph. Field notes were made on changes that were apparent when the view was compared with copies of the original print- Notes were made on species composition, cover, production, and use. A 35-mm color slide was taken for future use in reconstructing details such as variations in plant development. To gain an understanding of the history of use and recent events that might have a bearing on landscape changes, local users and resource managers were interviewed.

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 or disease, rodents, or other agents, singly and in combination. For this paper, the obvious changes were analyzed based on personal knowledge of the sites. Readers are encouraged to scrutinize the photographs and make interpretations based on their own knowledge.

All original photos chosen for this report were taken before 1925. This date was selected so that conditions prior to settlement by nonendemic people would be best illustrated. With the exception of early livestock grazing, not too much settlement activity had come about during the late 19th century that would influence the upland Blue Mountain forest and rangeland setting on a landscape scale.

A word on plant succession and trend interpretation is appropriate because changes in concepts and terminology are being proposed and have been partly accepted in some scientific quarters. For example, forested and nonforested rangeland in poor, fair, good or excellent condition may now be expressed, respectively, as "early," "mid," or "late" seral stages and "climax" (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" (Kuchter 1964). For the purpose of this paper, however, generic or vernacular terms will be used.

The equipment used was press-type camera bodies of either the Crown Graphic or Speed Graphic series by Graflex.' Lenses were usually a standard 135 mm. Filters were seldom used except to block haze. Exposure meters were either General Electric PR-l or Grossen Luna Pro; film was either Kodak PlusX or TriX Pan. The original and repeat photos were processed in the same format, preferably 12.7 by 17.8 centimeters to assist in analyzing change.

Photos repeated in the mid 1960s and in 1982 had a survey stake in the foreground at 7.6 meters. Those in 1992 had the stake at 15.2 meters. Intervals of black and white along the slake were 0.3 meter to give the viewer some appreciation of scale- The camera lens height was kept at about 1.5 meters, and a tripod mount was used consistently. •

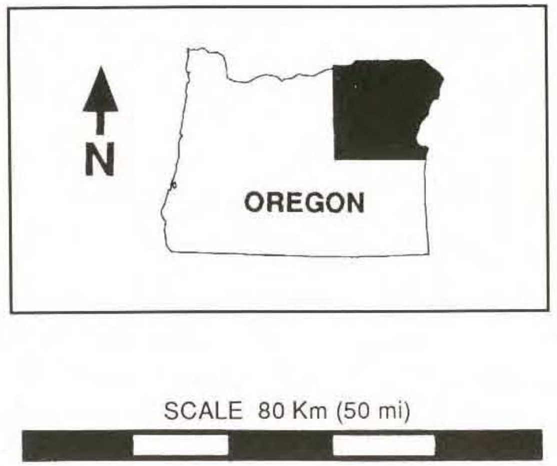
[5] The use of trade, firm, or corporation names is for the information and convenience of the reader Such use does not constitute an official endorsement by the U.S. Department of Agriculture of any product or service to the exclusion of others that may be suitable.

Results and Discussion-

THE PHOTOGRAPHIC RECORD

The photographs used in this report of long-term trends were selected as representative of the Blue Mountain province (fig. 1). They have been grouped into landscape systems. The landscapes are divided into nonforested and forested.[6] The nonforested landscapes are broken roughly into (a) sagebrush steppe and juniper woodlands, (b) canyon lowlands and associated foothills, and (c) valley grasslands and associated foothills. The forested landscapes include (a) mountain forest, (b) mountain grassland, (c) mountain meadow and riparian habitat, and (d) subalpine grasslands.

[6] Forested ecosystems are those lands producing more than 1.4 cubic meters of wood growth per hectare per year,



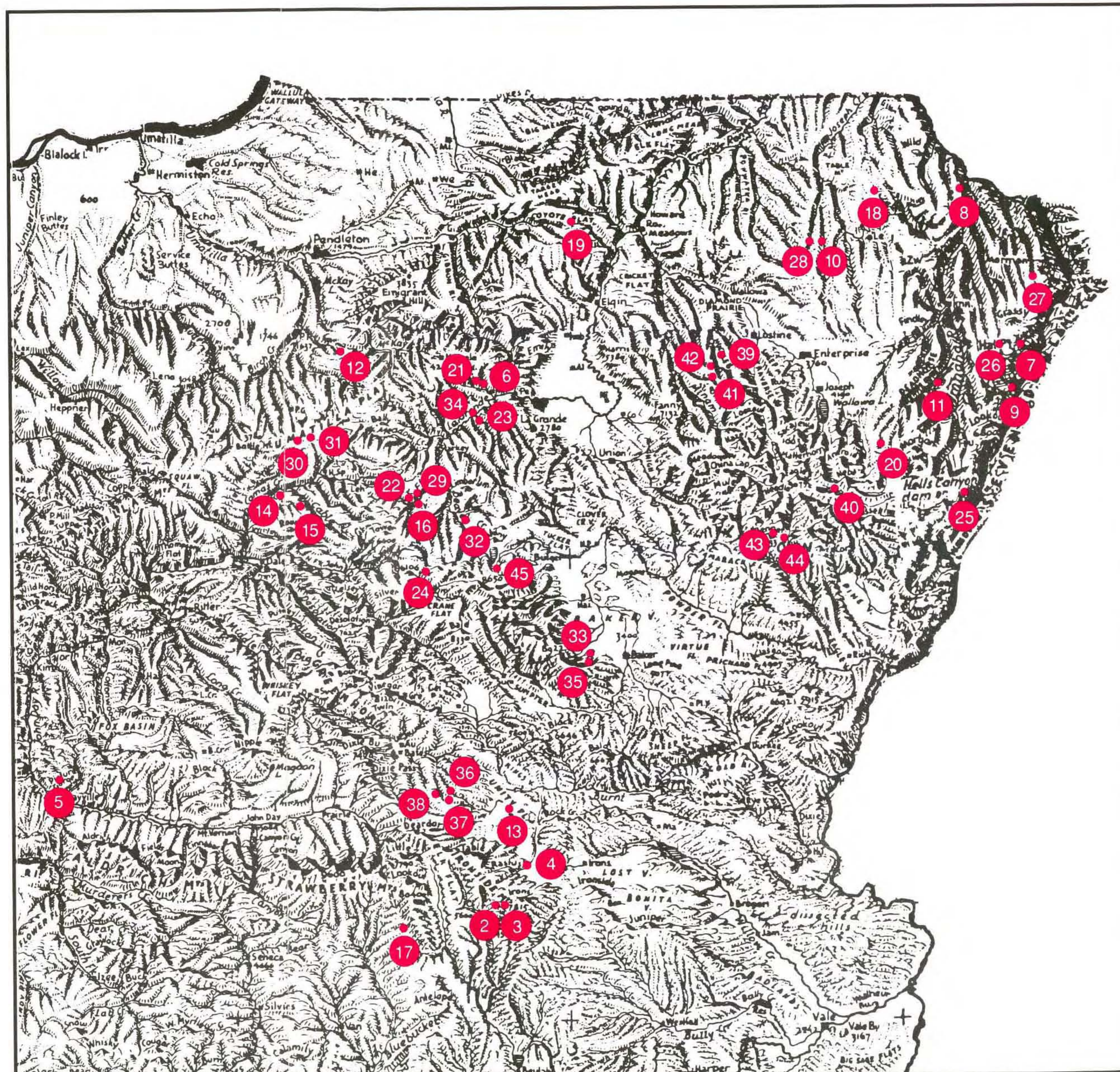


Figure 1—The Blue Mountain province showing land features, towns, and the location of repeat photographs. Numbers on the map correspond to figure numbers in the text. Photo descriptions, with legal locations, are shown in Appendix II. (Maps copyrighted by Erwin Raisz [1941]; reprinted with permission by Raisz Landform Maps, Melrose, MA 02176.)

NONFORESTED LANDSCAPES

Sagebrush steppe and juniper woodlands

Because these ecosystems are not homogeneous and are influenced by soils, aspect, topography, drainage, and local climate, they will for our purposes be considered as one landscape; that is, the sagebrush steppe and juniper woodland. These types are mostly absent from Umatilla, Union, and Wallowa Counties in the northern Blue Mountains. They occur, however, in Grant and Malheur Counties and in the drier parts of Baker County.

Common trees are western juniper and ponderosa pine; shrubs are big sagebrush, antelope bitterbrush, rubber rabbitbrush, and mountain-mahogany. Forbs include western yarrow and Wyeth buckwheat. Grasses on shallow south slopes are scattered bunchgrasses like Sandberg bluegrass or bluebunch wheatgrass. Cheatgrass brome is an ever-present introduced annual.

The first grazing pressure in these arid zones of the southern Blue Mountains was concentrated around the Canyon City and Eldorado mines. Later these areas were taken over by stockmen who left the northern Blue Mountains after settlers began growing crops on the more fertile valley lowlands and foothills. The shrub steppe and woodlands were not being fully grazed until the mid- to late-1880s and early 1890s.

Figure 2—Little Malheur River Panorama, Malheur County, OR.
This panorama was taken from a butte on private land, part of the present Phil Kuhl ranch. The picture point is between Bridge Creek and the Little Malheur River, 40 kilometers due south of Unity, OR. The photos show the headwaters of Camp Creek and the Little Malheur River as the viewer looks northwest toward Monument Rock Wilderness Area.

Early spring and late fall cattle use was heavy until the middle of the 20th century and has been moderate since. Sheep grazed these areas for several decades after the start of the 20th century. These slopes have received heavy winter use by Rocky Mountain mule deer and, in recent years, Rocky Mountain elk.

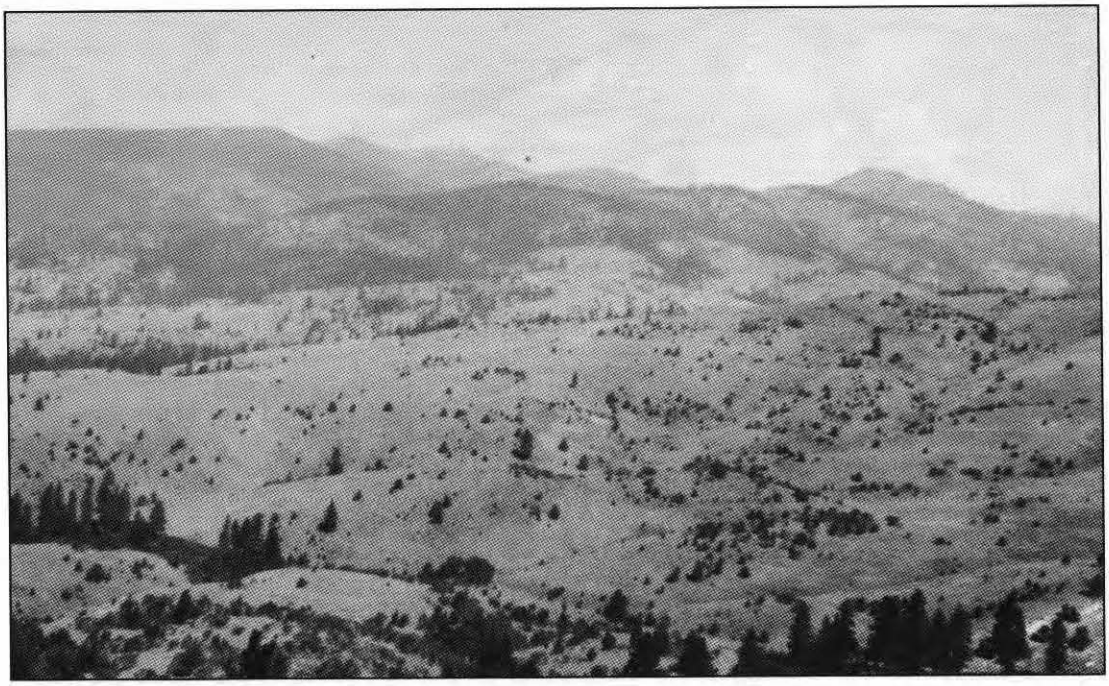


Photo by W.L. Dutton

Figure 2a—1922. Western juniper consisted of older single trees and groups confined to pockets on the benchland across the valley below.

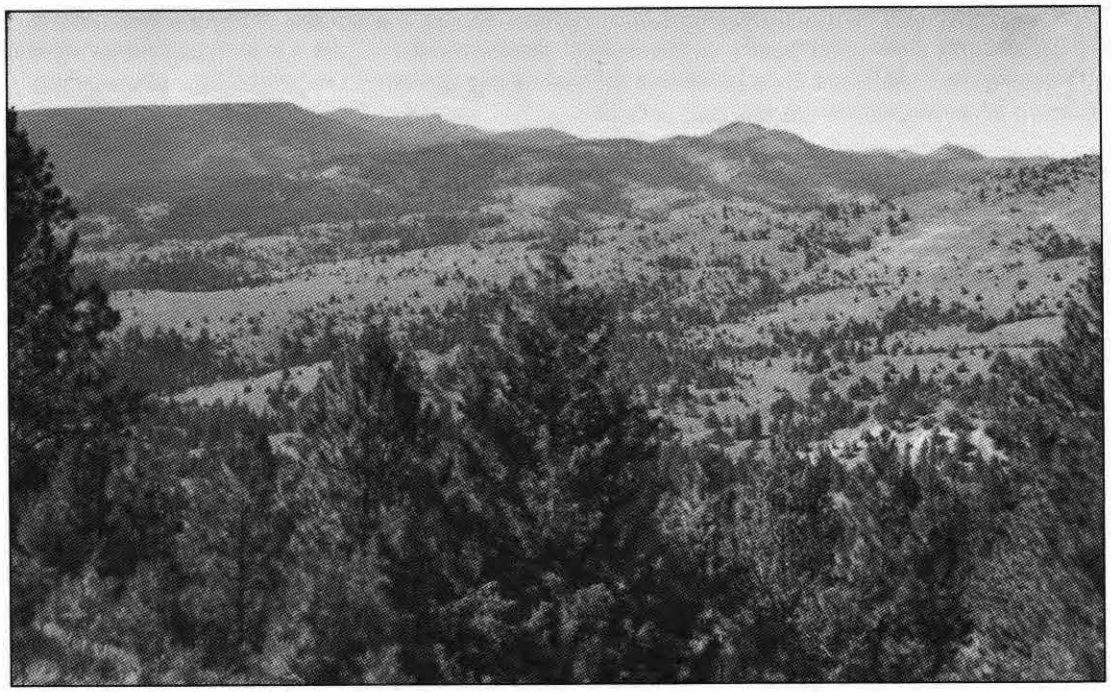


Figure 2b—1992. There has been considerable encroachment of western juniper on the benchland in the exact center of the photo. The entire foreground has been masked by sapling and pole-sized ponderosa pine and western juniper.

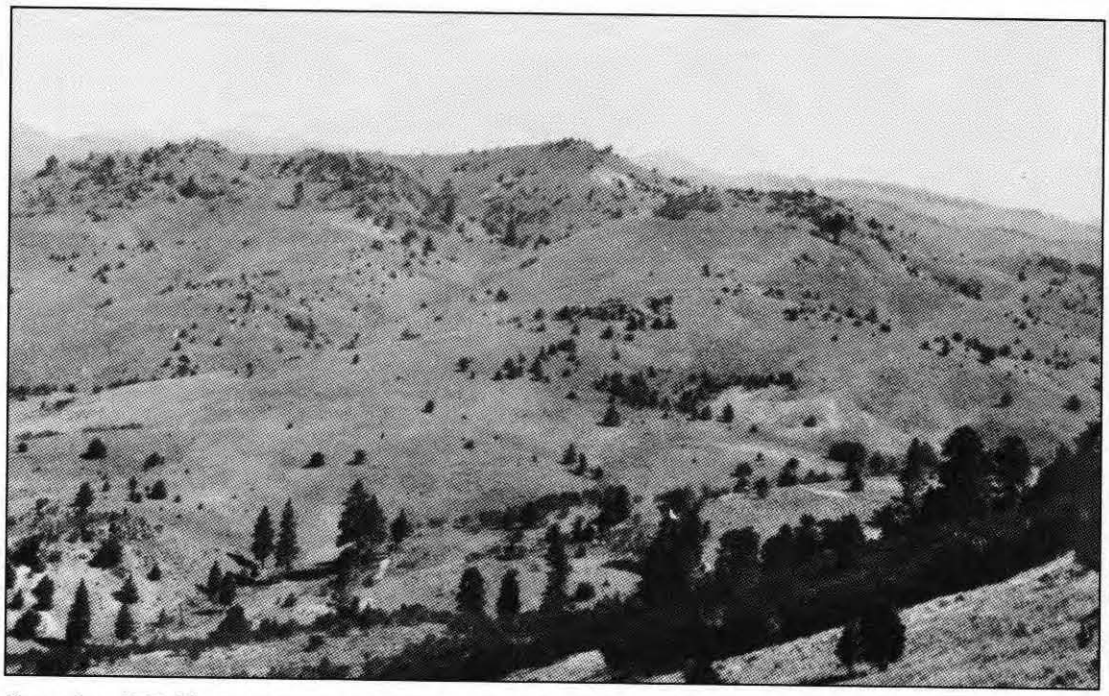


Photo by W.L. Dutton

Figure 2c—1922. The lower right slope has an open bunchgrass aspect with scattered western juniper.

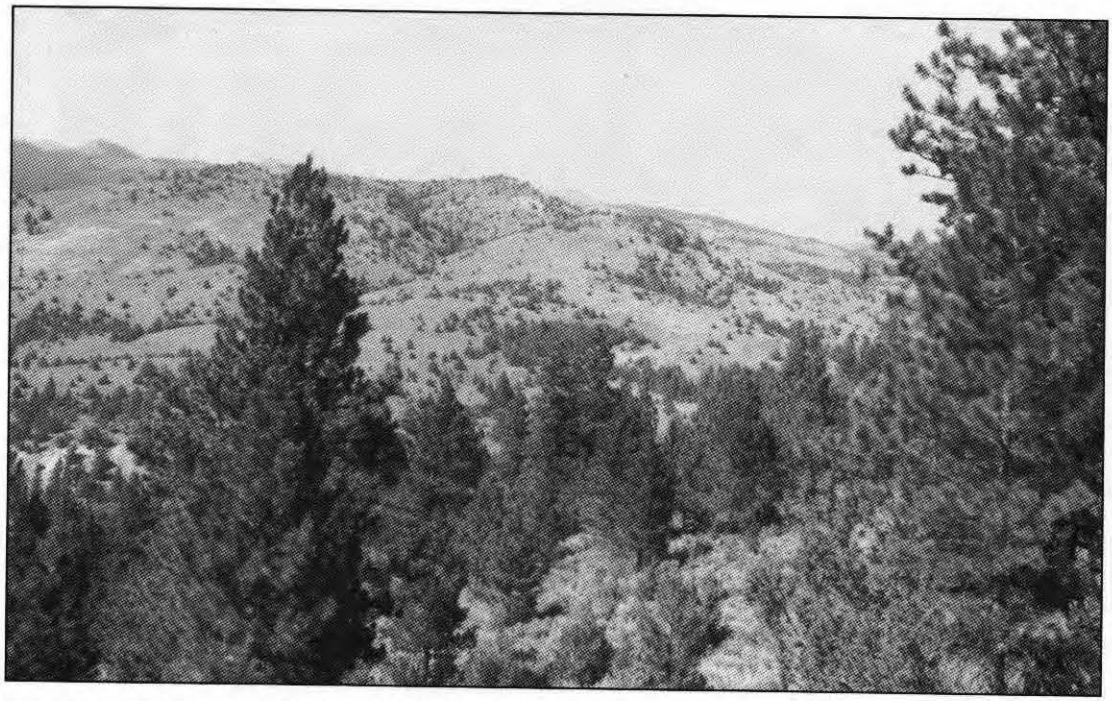


Figure 2d—1992. The pockets of western juniper on the far butte (Twin Butte) are now well established. Ponderosa pine, western juniper, and big sagebrush have encroached on the former bunchgrass slope in the foreground.

Figure 3—Ironside Mountain, Malheur County, OR.
This photo series was taken about 1 kilometer northeast of the Little Malheur River panorama (fig. 2). The photo point is on a small parcel of Bureau of Land Management (BLM) land surrounded by private land. The view is looking northeast into the southwest-facing slopes of Ironside Mountain, which is mainly BLM land. Bridge Creek valley is seasonally grazed by cattle of the Holdout Division of the Castle Rock Ranch in Juntura, OR.

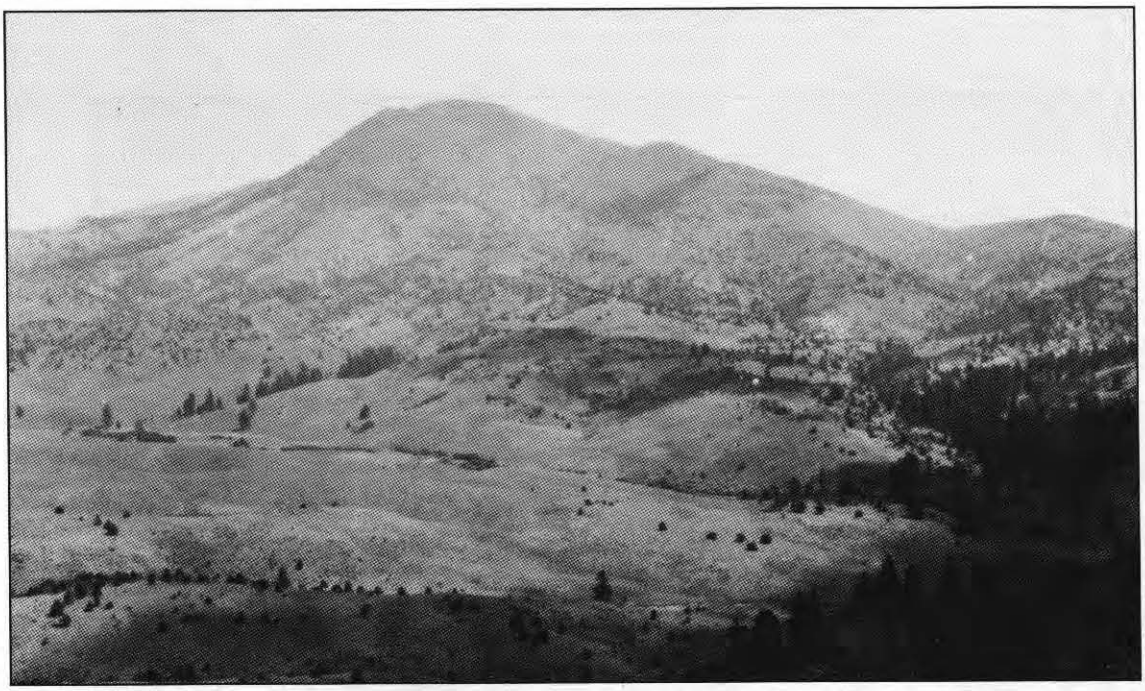


Photo by W.L. Dutton

Figure 3a—1924. The lower ridges (left) are quite bare of woody vegetation. Clumps of sagebrush can be seen here and there on the south slopes below the ridge tops.

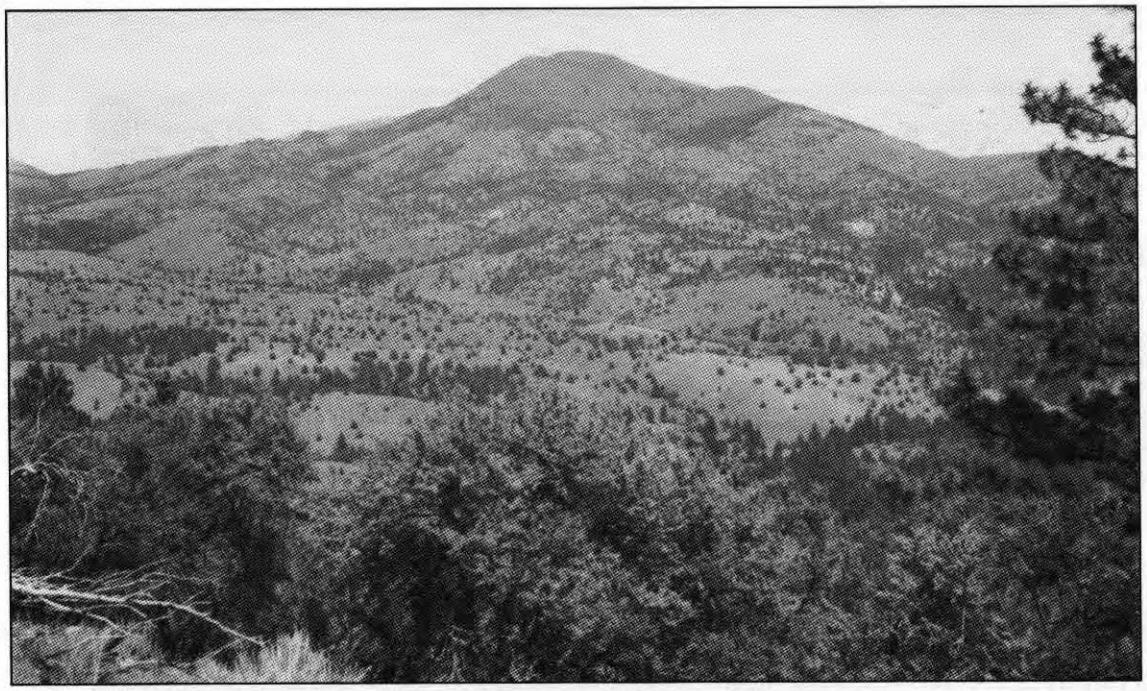


Figure 3b—1992. The gently sloping ridges that parallel Bridge Creek have been invaded by juniper. Though not readily apparent, big sagebrush also has spread to the ridge tops. Only a patchy and fine line of willows remains along Bridge Creek. Mountain-mahogany has become visible in the immediate foreground.

Figure 4—Ironside Holding Pasture, Malheur County, OR.
The holding pasture for the Ironside Cattle and Horse (C&H) Allotment is about 13 kilometers southeast of Unity and 2 kilometers west of Eldorado Pass on State highway 26 to Vale, OR. It is private land currently belonging to M. Farley.

Photo by J.L. Peterson

Figure 4a—1915. The photo shows cattle trailing along the old county road about 1 kilometer from the National Forest boundary. A sparse stand of juniper with a moderate stand of big sagebrush is evident. A patch of bare eroding soil is visible between the two trees at left. The two lines across the photo are a barbed-wire fence.

Figure 4b—1992. Sagebrush has occupied most of the barren patches and bunchgrass slope on the left. The erosion is apparently stabilized. Juniper regeneration has increased perhaps fourfold but is not yet a dominating feature. The herbaceous layer contains desirable species such as Idaho fescue and bluebunch wheatgrass.

Figure 5—Sheep Creek, Grant County, OR.
This photo series was taken on the Al Brown ranch about 5 kilometers west of Dayville, OR. Sheep Creek, which runs through this property, was named for the California bighorn sheep once abundant here. Throughout the mining and development period (1862-1900) this range was heavily used as year-round pasture for the stock of freighters and drovers and as a holding ground for beef cattle. It is now a well-managed spring–fall cattle range with a stable mule deer population and an increasing number of resident elk.

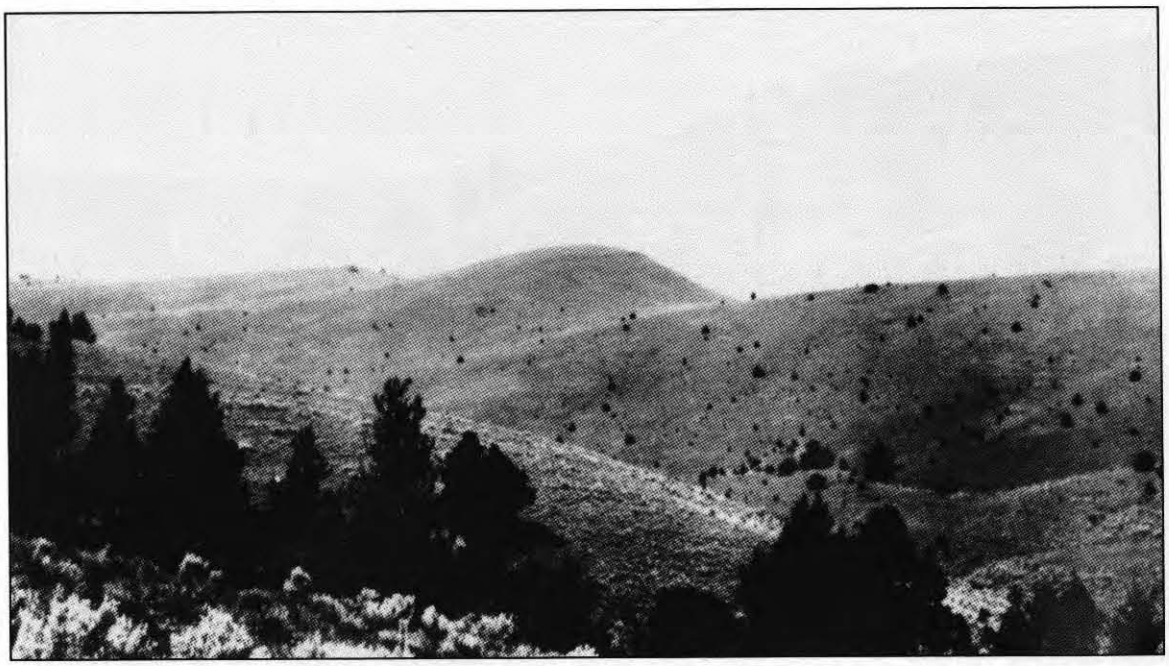


Photo by M.K. Kennedy

Figure 5a—1920. A few scattered mature western juniper dot the distant landscape with some interspersed clumps of big sagebrush.

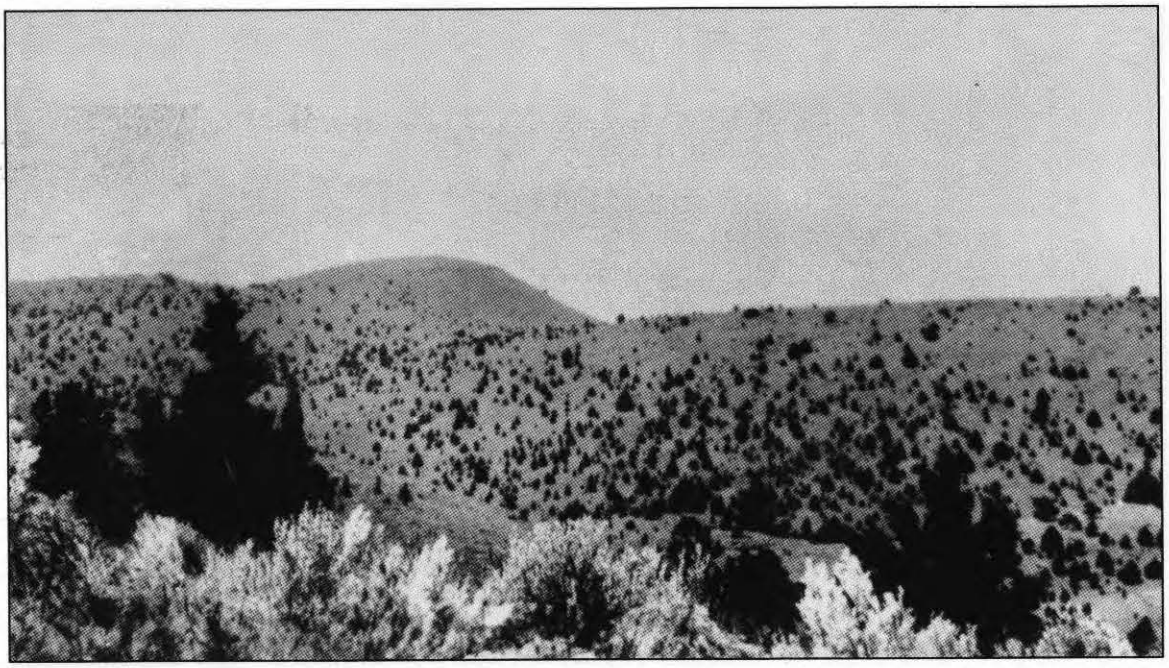


Photo by Ollie Cliff

Figure 5b—1945. Encroaching juniper fill the interspace among the scattered older trees. Big sagebrush in the foreground make a solid shrub layer.

Photo by W.K. Farrell

Figure 5c—1956. The juniper stand occupies about 40 percent of the distant slope; rubber rabbitbrush is apparent in the foreground.

Figure 5d—1992. Between 1969 and 1971 the entire landscape was cleared of juniper. Now, 20 years later, the stand of seedlings and saplings has a higher stem density than in 1945. The sagebrush in the foreground of earlier photos has given way to rabbitbrush.

Figure 6—Bally Ridge, Union County, OR.
This photo point is on Bally Ridge, on the former Rugg Sheep Allotment, about 9 kilometers northeast of the village of Hilgard, OR, on Five Points Creek. The allotment has been grazed by cattle for several decades. This photo point is in a mountain forest setting, but it is used here to illustrate the invasion of sagebrush into grassland.

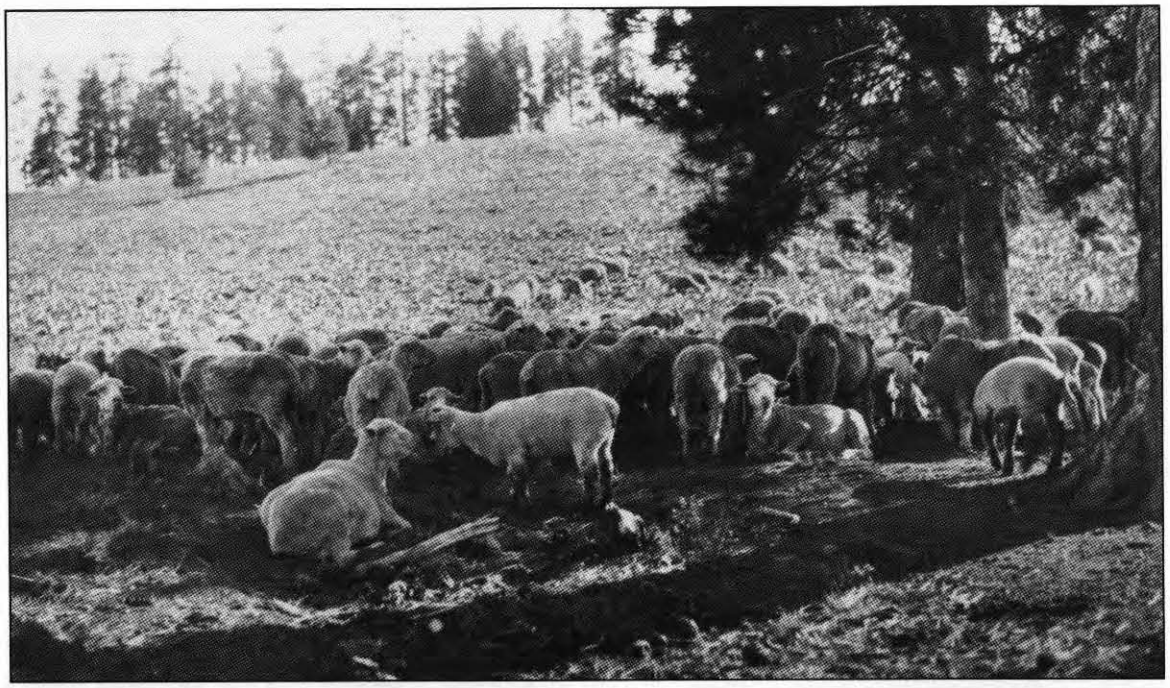


Photo by D. Lacey

Figure 6a—1919. That the ewe and her fat lamb appear to be in good condition in early August attest that they have been on ample, high-quality forage. Beyond the resting ewe is the remnant of a burned pine stump, which was still visible in 1992, 73 years later (fig. 6b).

Figure 6b—1992. The dominant shrub in the background is stiff sagebrush, which was not apparent in 1919. The weed, probably mules ears wyethia, abundant in 1919, is now absent, replaced by desirable bluebunch wheatgrass. The open ponderosa pine forest has been harvested of old growth and replaced by a rather dense stand of Douglas-fir.

Much of the former semi-arid grassland steppe in Baker and Grant Counties are today in the sagebrush steppe and juniper woodland types. The Sheep Creek series (fig. 5) illustrates invading sagebrush and encroaching juniper that began following heavy livestock grazing in the late 1800s (Burkhart and Tisdale 1976).

Grazing eliminated the fuels that carried periodic fires, which formerly kept the sage and juniper in check (Shinn 1980). More recently, efforts at Federal, State, and local levels to suppress fires has reinforced the effects of grazing, and the composition and structure of these ecosystems has been altered

The general sequence of woody plant encroachment was interrupted occasionally when sagebrush and juniper control programs were undertaken in the mid-1960s. These programs included reseeding crested wheatgrass and other species. This seeding, which was also practiced after wildfire, has tended to duplicate the grassland steppe Watershed and forage conditions benefit from this practice, but extensive monoculture does not provide high-quality wildlife habitat

On arid south-facing slopes of the "northside range" (north of John Day River), much of the former bunch-grass types have given way to cheatgrass, which is able to endure the hot summer drought in the form of seed

Deer concentrated on the south-facing slopes in winter and spring, which further depleted the remaining stands of bitterbrush This condition was aggravated by several eruptions in mule deer numbers before the middle of the 20th century (Cliff 1939, Einarson 1947) Since mid-century, grasshopper outbreaks have occurred on these and northern foothill rangelands in the Blue Mountains. The insects have migrated on occasion to nearby forested areas and damaged trees by eating foliage and tender shoots (Furniss and Carolin 1977). ■

Canyon lowlands

Canyon lowlands and foothills constitute the dissected landscapes along the Snake River between Oregon and Idaho (Tisdale 1986) and its major tributaries, such as the Imnaha and lower Grand Ronde Rivers. Deep canyons, often with sharp intervening ridges and steep slopes, make up much of the north and east rim of the Blue Mountains uplands.

Depending on their orientation, side canyons and draws often will have north slopes of woody vegetation and south slopes of grasses and forbs. Scattered woody vegetation at elevations above 500 meters usually is ponderosa pine and Douglas-fir. Shrubs can be ninebark with occasional common snowberry or rose. Grasses are usually Idaho fescue and perhaps Sandberg bluegrass.

South-slope grasslands are usually bluebunch wheatgrass, Sandberg bluegrass, cheatgrass brome, and rattle brome. Forbs often are western yarrow, balsamroot, and Wyeth buckwheat. On very steep or rocky south slopes, one might find Lewis mockorange (syringa), chokecherry, or serviceberry and perhaps some of the other above-mentioned shrubs.

The introduction of cheatgrass brome to this region probably occurred between 1905 and 1910. In 1914, in the first range survey of the Imnaha National Forest, cheatgrass was mapped in parts of only 12 sections.[7] Within 25 years it had spread throughout the lowlands, occupying depleted areas once sparsely covered with native rattle brome. Today cheatgrass brome is very common on all areas below 1000 meters. In recent years, two warm-season perennials common to the southwest (red threeawn and sand dropseed) have effectively occupied many sites below about 500 meters.

These deep valleys were once the winter quarters of the Nez Perce Indians. The first grazing of domestic ungulates in the canyon lowlands began with horses of the Wallowa band of Nez Perce Indians, probably in about 1750. By the time Young Chief Joseph was forced from the Wallowas in 1877, his band was running between four and five thousand head of cattle and horses.[8]

Much of the friction between Indians and settlers centered on grazing trespass on winter range in this landscape system. Settlers were grazing cattle and horses along the Snake River and lower Imnaha River as early as 1875. Sheep use began here in about 1890 and peaked in about 1920. At one time, Leonard Johnson wintered 200,000 sheep in these canyons (Wentworth 1948). Homesteading activity included farming the benches and flats along the river.

Since creation of the Hells Canyon National Recreation Area (NRA) in 1975 and the purchase of isolated deeded ranch land enterprises, sheep and cattle grazing have diminished. Presently no domestic sheep graze these lowlands and only three cattle companies are active. A number of private cattle operations still use these lowlands in fall, winter, and spring, however. This is also winter and spring range for many thousands of elk in the Snake, Chesnimnus, Sled Springs, and Wenaha wildlife units managed by the Oregon Department of Fish and Wildlife (ODF&W).

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[7] Burke, M H 1937 Memorandum dated November 19 to the Forest Supervisor In-Tucker, Gerald J 1963. History of the Wallowa National Forest Unpublished document On file with' Wallowa-Whitman National Forest, PO Box 907, Baker City, OR 97814.

[8] Reid, Kenneth C 1985. Horses "as fat as seals" the ecology and economy of Nez Perce herding in the nineteenth century. Paper presented at the 38th annual Northwest Anthropological conference, April 18-20, Ellensberg, WA 13 p.

Figure 7—Homestead Ridge, Wallowa County, OR.
The ridge lies between Rush Creek and Sand Creek. It is 6.5 kilometers northeast of Hat Point. This remote section has a history of winter sheep grazing that began about the start of the 20th century. Since the early 1930s, it also has been used regularly during fall and spring by herded sheep.

Beginning in about 1945, it was grazed in fall and winter by unherded sheep (herderless system). This country has been winter and spring–fall sheep range for the Temperance Creek Sheep Company that, because of labor shortages during World War II, began putting ewes on the range during lambing. This practice was very helpful in range restoration but was possible only because of an intensive predator control program. This operation was effectively ended by the proclamation against poisons and pesticides on public lands in the early 1970s.

Photo by A.W. Sampson

Figure 7a—1909. Nearly all of Homestead Ridge is visible because foreground trees and foliage were destroyed by fire a few years earlier. Only scattered timber occupied the north slopes on the Idaho side.

Figure 7b—1992. The Pumpkin Creek and Horse Creek fires of 1986 allowed a clearer repeat photo, even though regeneration prevented use of the original photo point. Today, considerable clearcutting can be seen on the ridge lines in Idaho.

Figure 8—Cemetery Ridge Panorama, Wallowa County, OR.
This overlook of the Snake River canyon is about 85 kilometers northeast of Enterprise, OR. Nearly all these views are in the Hells Canyon NRA and the land in the distance is designated wilderness.

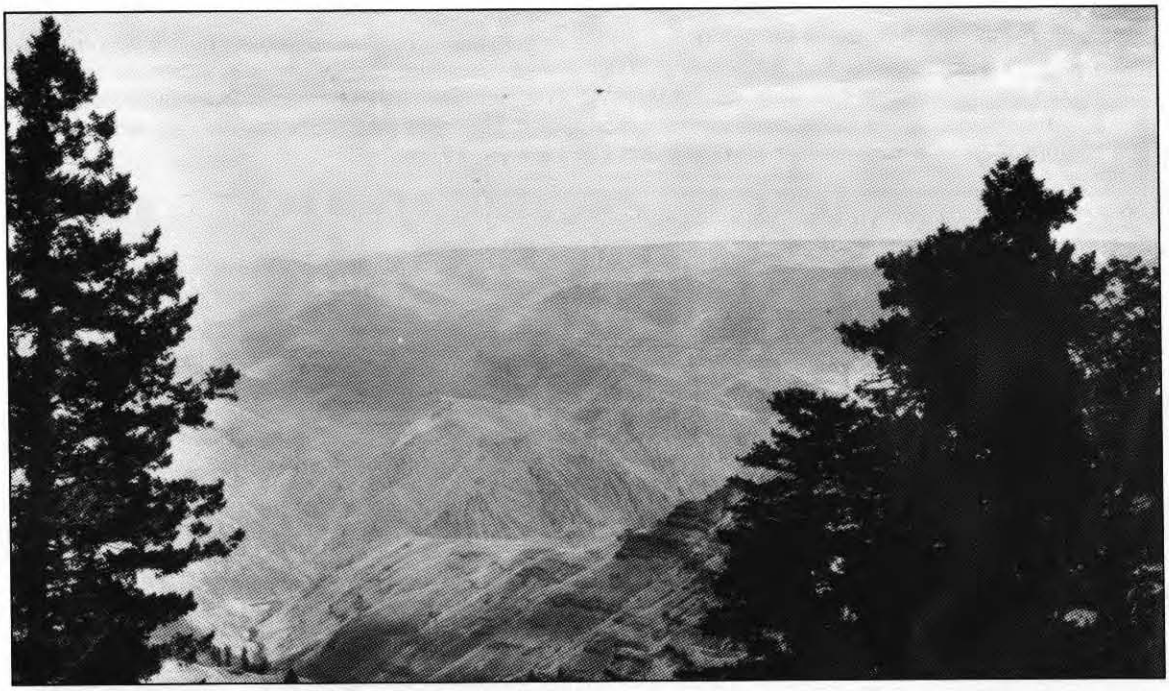

Photo by W.L. Dutton

Figure 8a—1924. A thread of Snake River shows at the mouth of Eureka Creek. The lambing camp of the Cherry Creek Sheep Company was in the bottom of this canyon where the creek disappears behind the second ridge. The Imnaha River enters the Snake about 1 kilometer upriver (right) at the head of Eureka Bar.

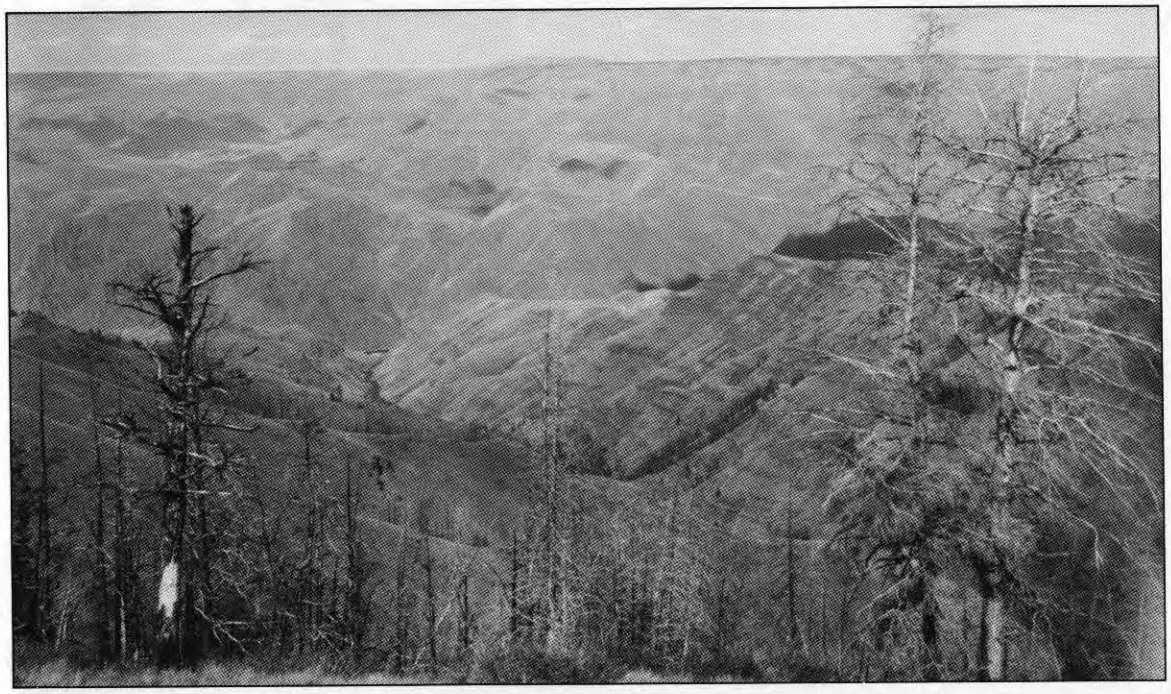

Figure 8b—1992. Old pines on the left side of Eureka Creek have been consumed by the 1988 Tepee Butte fire as have the Douglas-fir trees in the foreground. Timber in the draw to the right, halfway up Eureka Creek, has come into existence since 1924. Across from the mouth of Eureka Creek is Divide Creek in Idaho where Chief Joseph and his Wallowa band of Nez Perce Indians made their retreat in 1877. To the left of Divide Creek is the Salmon River about 10 kilometers above its confluence with the Snake River.

Photo by W.L. Dutton

Figure 8c—1924. This center frame looks through Spain Saddle on the closest ridge into the Spain Fork of Tulley Creek. In about 1875, Jim and Erasmus Tulley were among the first Europeans to graze cattle in these canyons. Jay Dobbin ran sheep in the head of Eureka Creek and Spain Fork of Tulley Creek after 1894. In 1922, most of Tulley Creek was fenced and made into spring (April to May 15) and fall (November) cattle range. The wagon road was from Buckhorn Springs to the Eureka Mines, which, although active at the start of the 20th century, turned out to be an investment hoax.

Figure 8d—1992. Three of the heavily timbered draws between the two tabletop rims on the near ridge were mostly burned out in the 1988 fire. The distant sharp ridge across the Imnaha River is the beginning of Summit Ridge, which extends south some 75 kilometers and terminates near Hells Canyon Creek in Baker County, OR. Cactus Mountain (where the shadow crosses the ridge) is named for an uncommon species of barrel cactus endemic here.

Photo by W.L. Dutton

Figure 8e—1924. This view across the Imnaha is up Cow Creek and a part of Lightning Creek. The broad benches on the north side of each creek are several thousand hectares in extent. This area historically has been winter cattle range, except from 1926 to 1946 when Joe McClaran ran sheep along Lightning Creek.

Figure 8f—1992. The headwaters of Eureka Creek were nearly cleared of forest by the 1988 fire. This basin is now spring-fall elk range, sheep having vacated this territory in the 1970s. These north slopes have a thick understory of ninebark, which will be very prominent for the next 30 or 40 years.

Figure 9—Sluice Creek, Wallowa County, OR.
This photo position is 2 kilometers east of Hat Point and 730 meters below it. The view is from Smooth Hollow Bench looking into the headwaters of Sluice Creek, the next canyon upriver from Rush Creek (shown in figure 7).

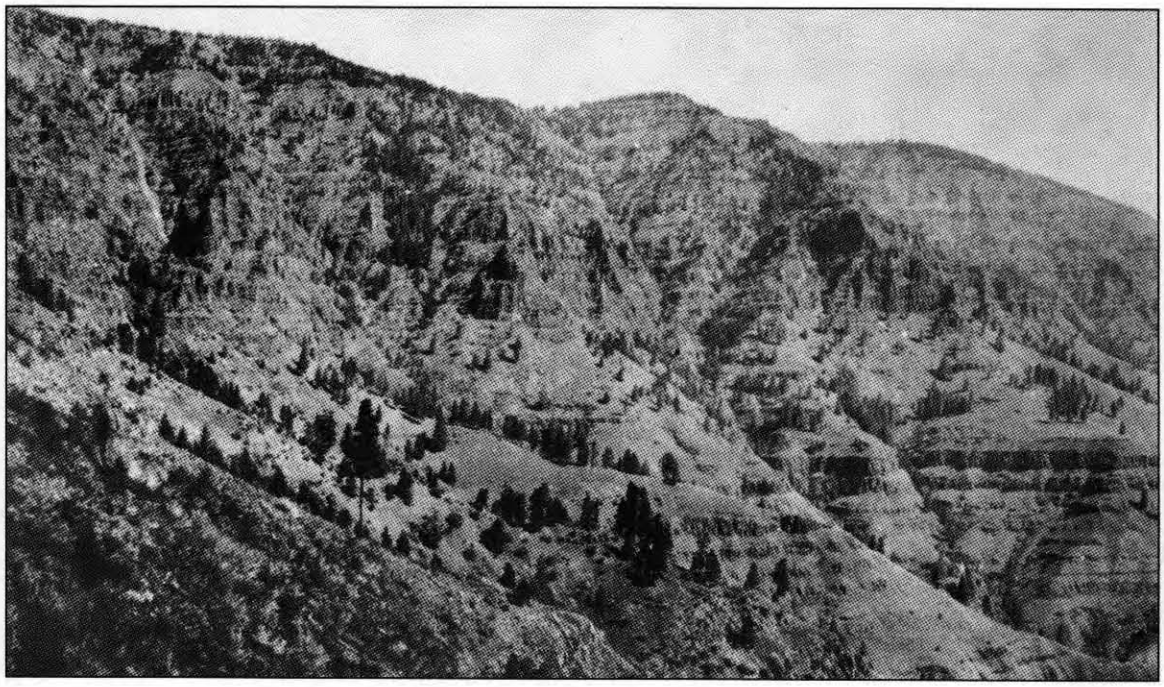

Photo by J.L. Peterson

Figure 9a—1914. These layers of eroded basalt rimrock are quite sparse in tree cover. Except in the side canyons, there are only widely spaced individual ponderosa pine and Douglas-fir.

Photo by W.B. Hall

Figure 9b—1974. Minor changes in aspect over the years include a general growth and thickening of the forest except in one stand (left center) where fires of 1949 destroyed the mature stand. Cover and composition of perennial grasses have improved since about 1930. The expanded white-appearing patches of cheatgrass were aggravated by a disastrous mouse infestation that peaked in 1960.

Figure 10—Chico Trail Closeup, Wallowa County, OR.
This photo point is on Starvation Ridge along the trail between Swamp Creek and Davis Creek about 32 kilometers north of Enterprise, OR. The area was used as summer cattle range by settlers in the Wallowa Valley.

Photo by J.L. Peterson

Figure 10a—1914. This slope has a heavy stand of large bluebunch wheatgrass plants. Because the ridge had very little developed stock water, use by cattle was only occasional.

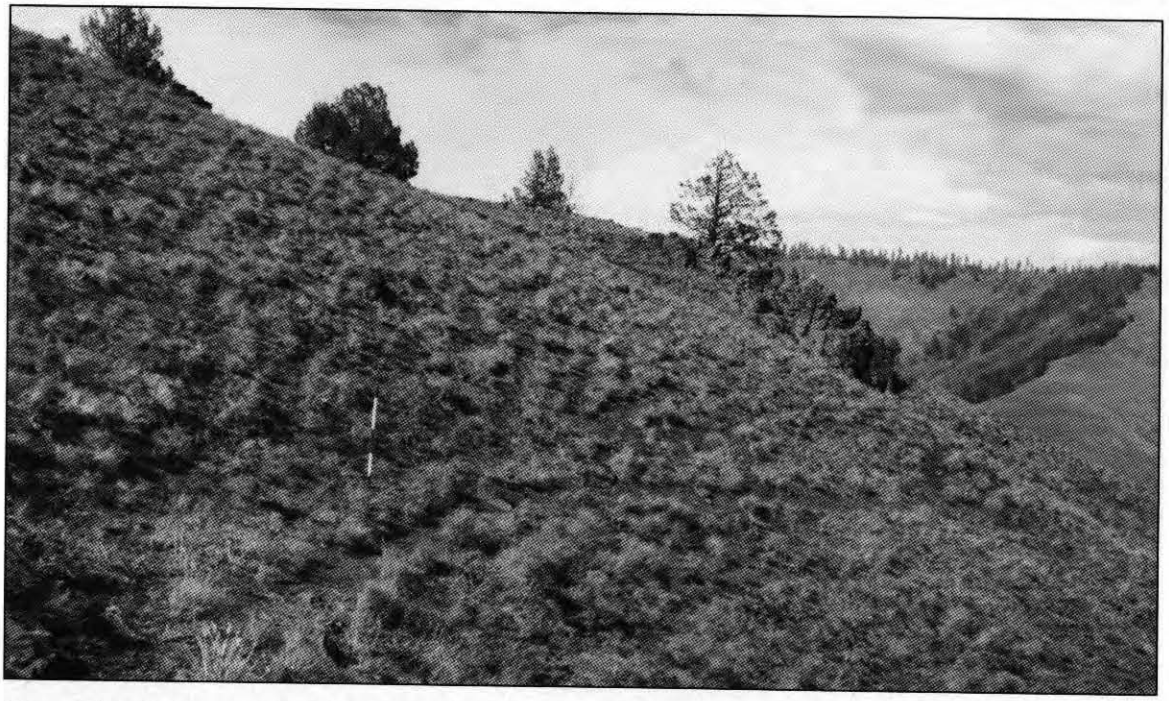

Figure 10b—1992. The number of plants is probably greater today but cover may be less because grazing often creates more but smaller plants. Fences and nearby water developments have allowed considerable cattle grazing on this particular ridgetop, which lies between spring and summer range. Current use is conservative to moderate. This slope does not appear unstable, and the ecological condition remains good.

Figure 11—Branson Creek, Wallowa County, OR.
This small flat on private land at the confluence of Branson (formerly Squaw) Creek and Big Sheep Creek is about 32 kilometers southwest of Imnaha, OR. The surrounding canyons have been traditional spring–fall cattle range. During the early days of homesteading, this flat was irrigated and farmed for hay.

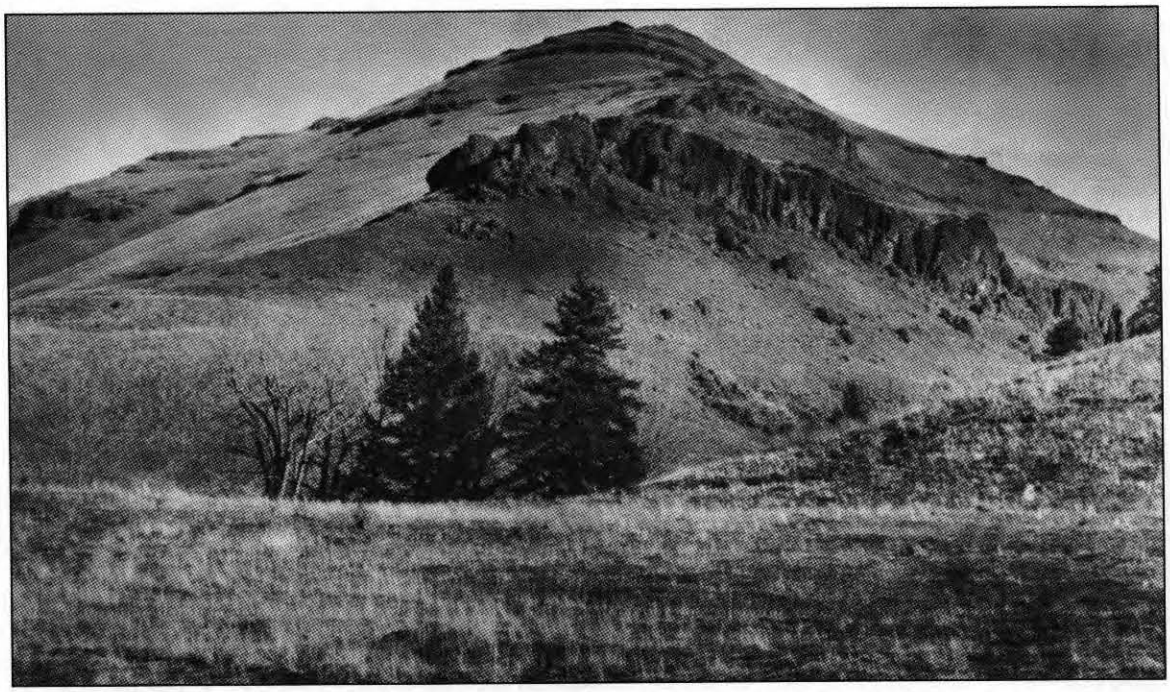

Photo by J.L. Peterson

Figure 11a—1914. The bottom land and lower canyon slopes appear to be heavily grazed. The slope below the rimrock shows little remaining grass from the spring growing season, and the foreground has a sparse cover.

Photo by W.B. Hall

Figure 11b—1974. Noxious and ephemeral weeds scattered among the heavy cheatgrass attest to continued disturbance. Dark patches on the far slope show bluebunch wheatgrass fully occupying the sites between heavy stands of cheatgrass. Note the increase in shrubs on the mid-ground slope (right). The more northerly aspect has been taken over by ninebark. Riparian cottonwood trees and the Douglas-fir tree (left; see fig. 11a) are now dead or decadent. Use appears light and appropriate for maintaining site stability.

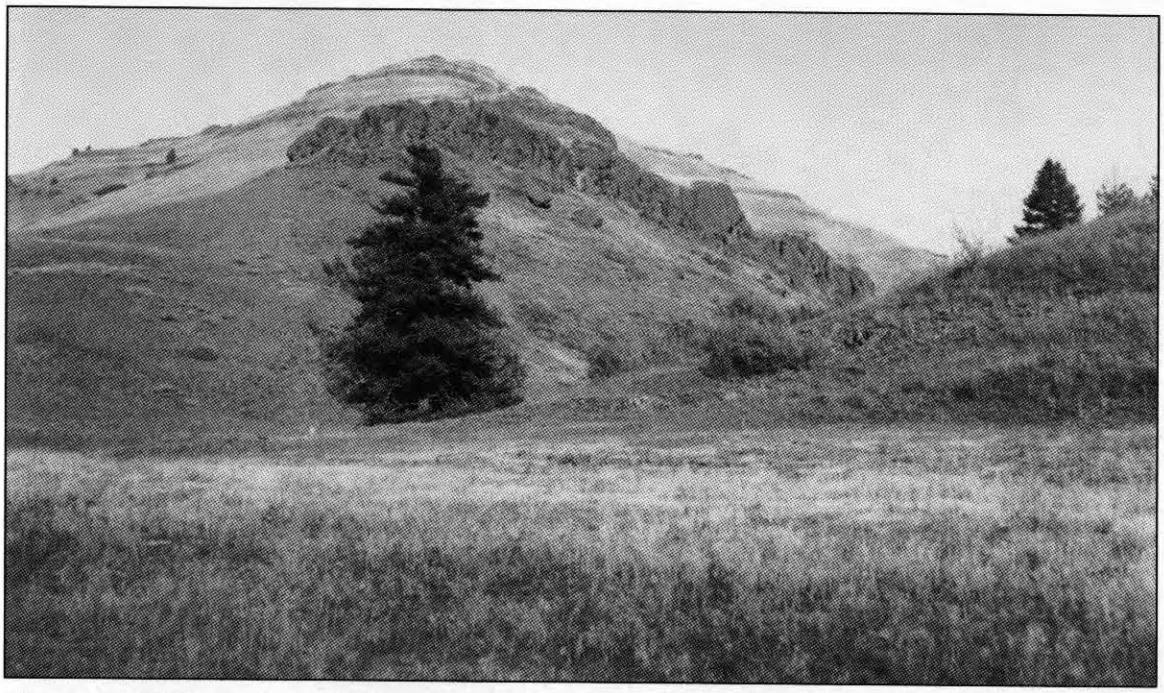

Figure 11c—1992. Shrubs have subsided over 1974 levels; cottonwood has disappeared and weeds and cheatgrass brome in the foreground have nearly disappeared from the flat. The far slope, however, has been invaded with pioneer weeds and low shrubs. Current grazing use on perennials, such as bluebunch wheatgrass, is very heavy. Cheatgrass brome production in 1992 was probably less than 10 percent of that produced in the wet spring of 1974.

Figure 12—McKay Creek, Umatilla County, OR.
This creek drains a large watershed of the western Blue Mountains, including the south part of the Umatilla Indian Reservation. This photo point is on the reservation opposite the mouth of Sumac Creek about 19 kilometers southeast of Pendleton and 9 kilometers northeast of Pilot Rock, OR.

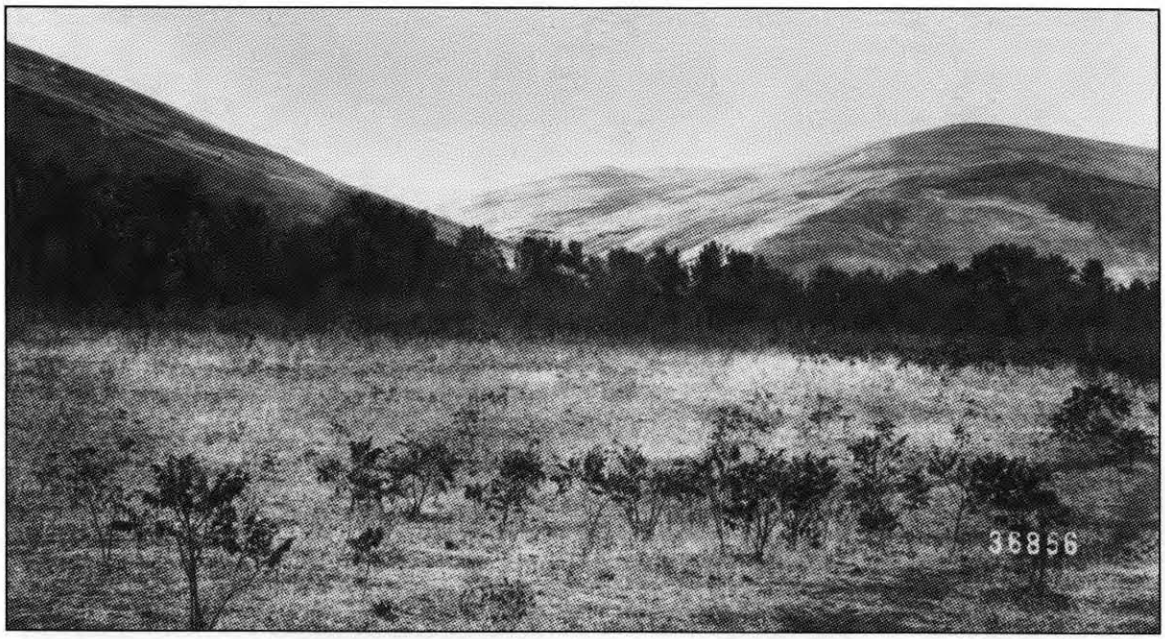

Photo by G.B. Sudworth

Figure 12a—1902. This flat had been open range spring and fall pasture for cattle and horses. Sumac seedlings and annual grasses constitute the bulk of the foreground cover. A thick stand of black cottonwood lines McKay Creek. A photo in the late 1960s (not included) shows the site in precisely the same ecological state with the exception of a loss in cottonwood riparian cover.

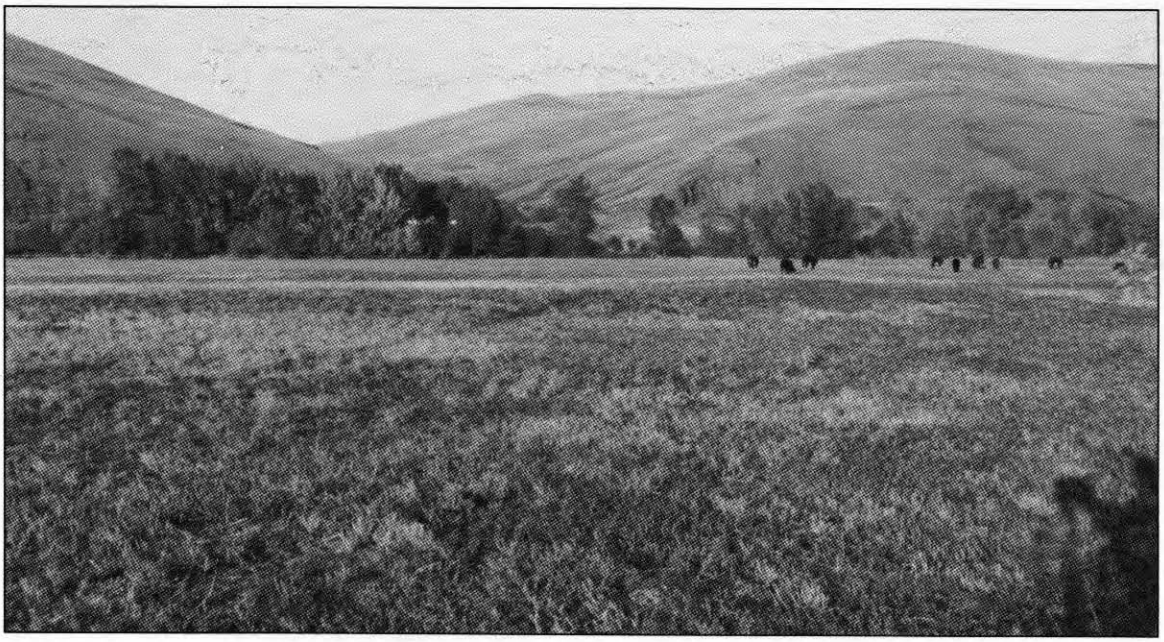

Figure 12b—1992. This bottom was leased for farmland in about 1980. It is now an intensive farming enterprise with sprinkler irrigation of hay followed by fall pasturage of beef cattle. The surrounding foothills were the first invasion site of St. Johnswort or goat weed in the late 1940s. This aggressive weed, poisonous to many ungulates, spread throughout the entire canyonlands below about 1000 meters elevation. The goat weed beetle introduced from Australia reduced densities of plants, and by the late 1960s goat weed was held in check.

By and large, the bottoms of the canyon lowlands, which were mostly private land, suffered the most from early, uncontrolled, season-long livestock grazing. Today, because of stocking reductions, fencing, and other management practices, private bottomlands are probably not degenerating but have improved or remain static. Federally managed canyonlands have improved in the past 30 years but still show some effects of early grazing, logging, and reading abuses.

Based on aquatic or wetland habitat standards, many riparian zones in the canyons are in poor condition, a problem that has begun to be addressed only since the 1970s. White-tailed deer, which were nearly extirpated in these habitats, have now recolonized their old ranges. •

Valley grasslands

where valley grassland bottoms have been undisturbed, they have a rich mixture of grasses and forbs. Because water tables normally are high, vegetation stays green well into midsummer. In meadow bottomland, grasses include prairie Junegrass, California oatgrass, many sedges, and perhaps some rushes. Common forbs are cinquefoils, clovers, biscuitroot, and groundsels. Alluvial outwashes were originally thick stands of giant wildrye grass.

On well-drained adjacent foothills, bluebunch wheatgrass and Idaho fescue are interspersed with forbs of sulphur lupine and arrowleaf balsamroot. Shrubs are uncommon in these communities. The associated foothills often are partially forested with scattered stands of ponderosa pine and Douglas-fir on north slopes.

Valley grasslands were the areas first occupied by nonendemic settlers in the Blue Mountains. Examples of these larger valleys are the Grande Ronde, Powder, Indian, and Wallowa. Because they contain deep alluvial soil, most larger valleys are now in permanent crop production. The smaller, slightly higher valleys, as shown in this photo series, usually are left for native hay production or spring-fall grazing by livestock. Within these valleys, weather conditions, except for short periods of extreme cold or deep snow, often are mild enough to provide winter range for wild ungulates and livestock.

These grasslands have undergone drastic alterations, mostly the result of agricultural development. One example in this photo series is near the town of Unity, OR, in the Burnt River Valley where a semiarid valley bottom of sagebrush was converted to hay and permanent pasture.

Some prime ponderosa (yellow) pine was cut from the surrounding foothills before the start of the 20th century for the needs of settlers. The lesser quality second-growth pine often was harvested just before or after ranch property was sold. The prescribed harvest method was to take every tree over a 28-centimeter diameter.

Figure 13—Burnt River Valley, Baker County, OR.
This view is from the Forest Service ranger station compound in the village of Unity, OR, looking toward the Monument Rock Wilderness Area. Unity reservoir is 5 kilometers north of here at the confluence of the north, west, middle, and south forks of Burnt River.

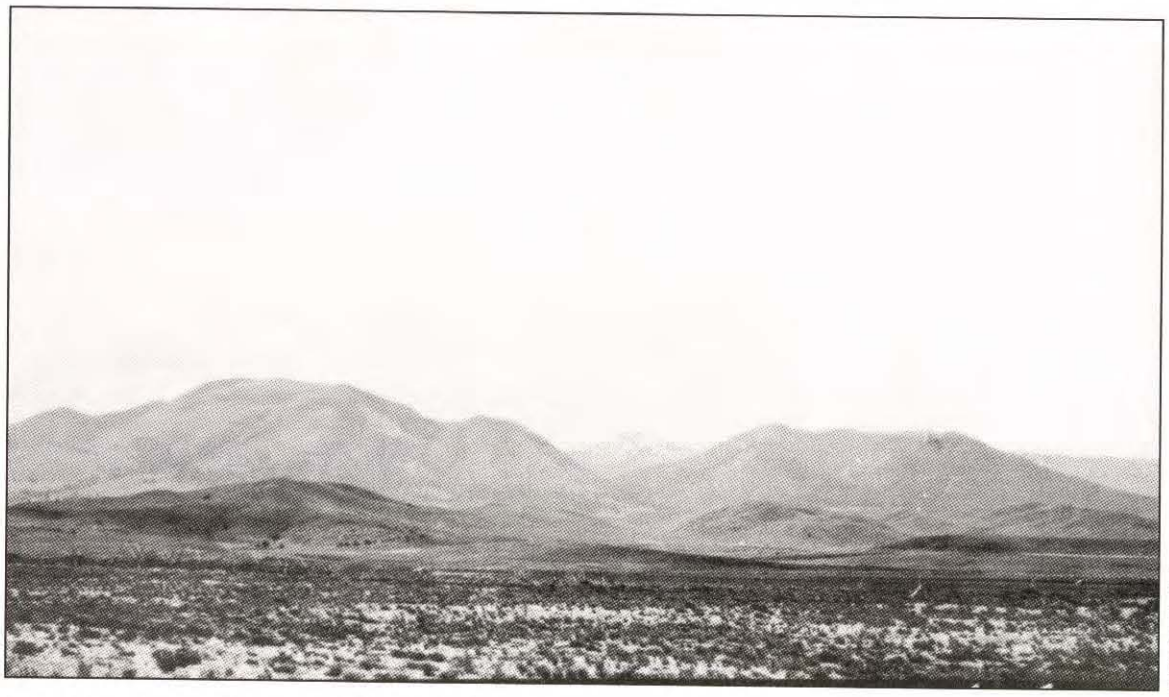

Photo by J.L. Peterson

Figure 13a—1920. The barren flat in the foreground shows bare soil, scrubby sagebrush, and weeds. It had been used as the village common grazing ground since about 1900.

Figure 13b—1992. The flats in the foreground are now productive pasture and hay land. Private land extends to the base of the mountains. The mountains, especially Mine Ridge (right), have burned several times since the middle of the 20th century. The most recent fires were in 1989, but perhaps the worst fire was during the mid-1960s. Salvage logging and some patch clearcutting have left these front range forest resources in disarray.

Figure 14—Mosie Pasture, Umatilla County, OR.
This pasture in Camas Valley, 4 kilometers east of the hamlet of Ukiah, OR, never has been cultivated. It has sustained heavy grazing since about 1880 but without depletion. From about 1890 to 1920, these fertile grasslands supported large herds of dairy as well as beef cattle. After 1920 when dairying activities waned, beef cattle were grazed here during spring and fall.

Photo by D.C. Ingram

Figure 14a—1919. The Mosie Pasture as it appeared in October when fall grazing began. Spring use in 1919 had been early enough to allow ample regrowth during summer deferment. Common species were annual grasses and weedy species, such as mules ears wyethia, red besseya, western yarrow, and thistle.

Figure 14b—1967. This fall photograph was taken after light summer grazing. Principal grasses on deeper soils were Idaho fescue, prairie Junegrass, and bluebunch wheatgrass. Onespike danthonia (oatgrass) and Sandberg bluegrass were common in rocky swales. Deep-rooted forbs included two species of cinquefoil and two of lupine plus clovers and hawkweed.

Figure 14c—1992. The new fence has introduced an element of heavy cattle use to a stand that has improved through secondary succession to good ecological condition. Beyond the fence, the composition has gained Idaho fescue and lost forbs since 1967. Cover also has improved. The cluster of three ponderosa pines (center) has been removed, probably as a result of mountain pine beetle attack. The snag to the left probably was dead too long to salvage.

Photo by D.C. Ingram

Figure 14d—1920. This is a spring retake of the fall 1919 photo point (fig. 14a). A moderate amount of grass was carried over from fall, thereby indicating a conservative level of fall stocking.

Figure 14e—1992. After 15 years of altered use due to the new fence and cattle concentration at the handling facilities, plant cover has thinned and the unpalatable broadleaf forbs have been left to prosper. The black cottonwood trees are 85 to 90 years old and seem to be thriving.

Photo by D.C. Ingram

Figure 14f—1920. This closeup of a square meter of the Mosie Pasture shows new bluebunch wheatgrass and Idaho fescue stalks mixed with old growth. Forbs include Browns peony, hawkweed, Douglas blue-eyed grass, geranium, camas, and Oregon checkermallow.

Figure 14g—1966. The most striking change is the removal of old-growth ponderosa pine from the background along Pine Creek. The foreground reveals fewer long-lived forbs and perhaps a higher composition of grasses. The dominant grass continued to be bluebunch wheatgrass.

Figure 14h—1992. This photo shows ecological retrogression since the construction of the fence. Tall weedy species such as yarrow and thistle have increased, and plant cover seems to be more broken. The cattle trail to the left has become a prominent feature.

Figure 15—Hidaway Prairie, Umatilla County, OR.
These flats about 12 kilometers east of Ukiah, OR, in upper Camas Valley are extensive grasslands on rather shallow soil compared to those of the Mosie Pasture. These flats were grazed year-round from about 1885 until 1925, after which they received only spring–fall and winter use.

Photo by G.B. Sudworth

Figure 15a—1902. The choppy soil surface resulted when cattle grazed shallow saturated soils during early spring and caused puddling, which impeded lateral drainage. During spring and fall, the pedestaled plants of Sandberg bluegrass are subjected to destructive frost heaving, which separates the plant crown from much of its root system.

Figure 15b—1967. About 40 years of the proper season of grazing restored this former Sandberg bluegrass-dominated site to bluebunch wheatgrass. Note the leveling of the choppy soil surface.

Figure 15c—1982. Fifteen more years of moderate grazing has not appreciably improved the cover, composition, or choppy soil surface. Stones are less evident and moss more evident, thereby indicating that the site is slowly improving. Notice that a rock jack and figure-four type fence has replaced the old post and rider fence.

Figure 15d—1992. During the preceding 10 years, the rough soil surface continued to level out. Although current grazing use is slightly heavier, ground cover has improved. Idaho fescue and balsamroot are increasing in the composition.

Figure 16—Fly Valley, Union County, OR.
Fly Meadow is about 6 kilometers northwest of the Sheep Ranch on Vey Meadows. It is drained by Fly Creek, an upper tributary of the Grande Ronde River. The meadow is deeded land inside the Wallowa-Whitman National Forest. This moist meadow has been grazed alternately by cattle and sheep since about 1870. It has been fenced where it borders the Umatilla stock driveway, formerly used by sheep trailing from winter quarters in southern and western Umatilla County to summer pastures in the central Blue Mountains.

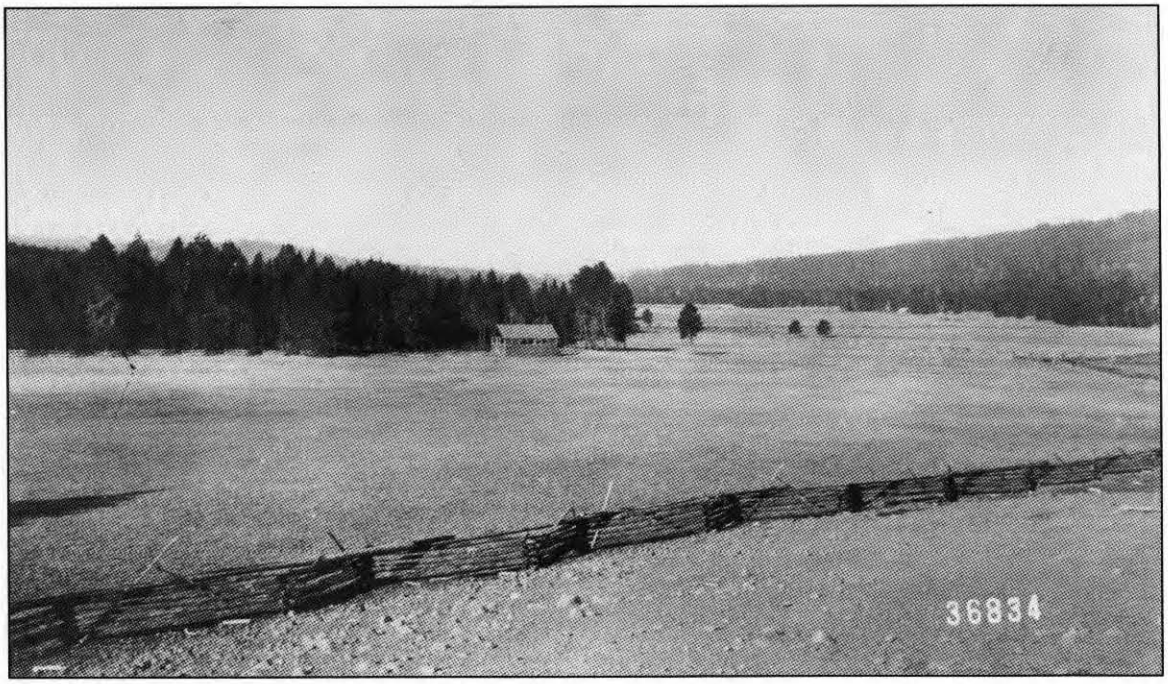

Photo by G.B. Sudworth

Figure 16a—1902. The hay barn attests to the productivity of the meadow protected by the split rail fence. The rocks and bare soil in the immediate foreground reflect the condition of the Umatilla stock driveway.

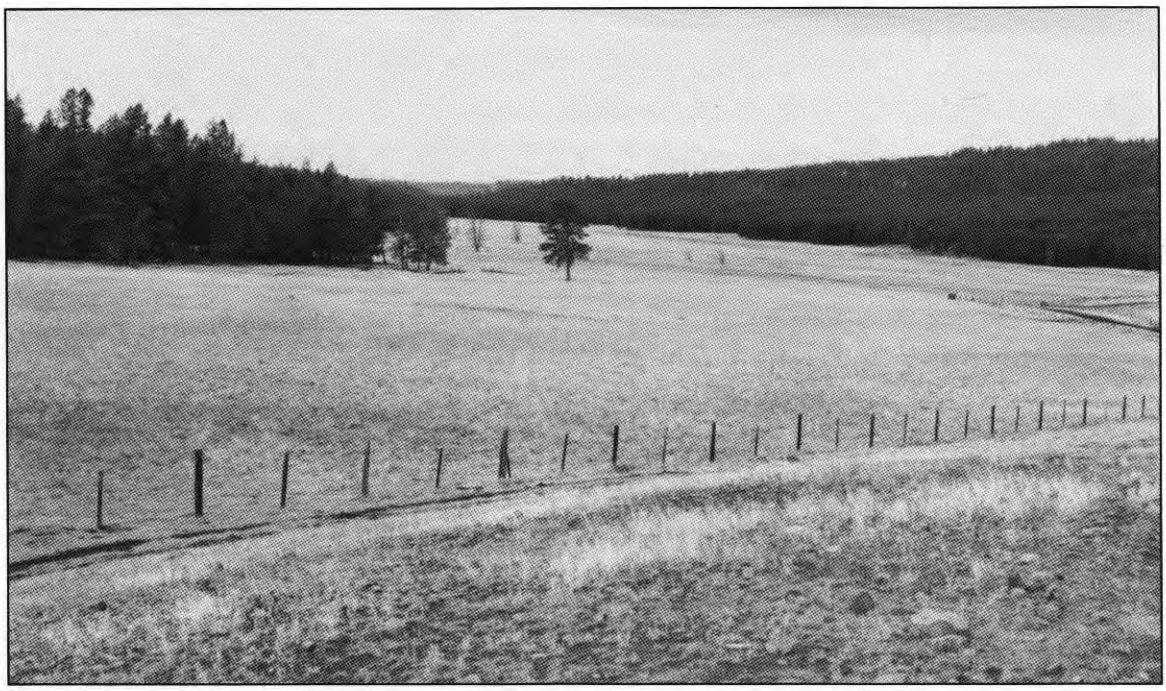

Photo by R.W. Harris

Figure 16b—1956. Dominant ponderosa pine extend above the lodgepole pine canopy (left of center) and appear healthy. There has been only occasional use of the driveway in recent years.

Figure 16c—1982. Pine beetles heavily damaged these stands in the mid-1970s, and salvage operations have removed most merchantable trees. Lodgepole pine that made a distinct edge across the meadow in 1956 has retreated. Considerable chipping salvage was accomplished on lodgepole to the left of the far meadow.

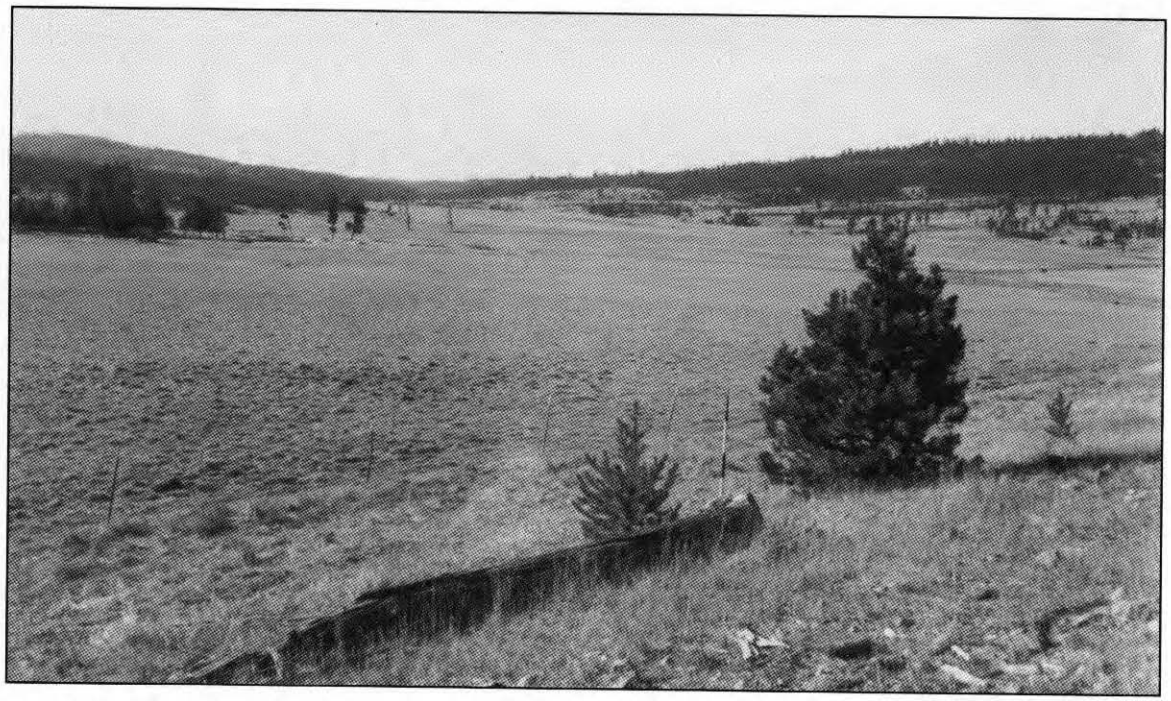

Figure 16d—1992. The driveway has fallen into complete disuse in the last decade and shows good recovery from former poor condition. The meadow, being private and fenced against open range, continues to be in good condition. Insect infestation has converted the forest (right) to a grassland with scattered pine overstory.

Figure 17—Crane Prairie, Grant County, OR.
This has been the site of an early-day Forest Service guard station and now is a work center for field activities. It is about 40 kilometers southeast of Prairie City, OR. Only the near north end of this valley is public land. The meadow pasture traditionally has been grazed in summer by cattle.

Photo by W.L. Dutton

Figure 17a—1924. From the foreground to the fence was Forest Service horse pasture, and the remainder of the valley was a late summer gathering unit for cattle from surrounding mountain forest range.

Figure 17b—1992. Sagebrush has encroached at the edge of the valley. Although the older lodgepole pine on the right have been cut, there is ample regeneration. A recent patch clearcut is visible on the hill across the meadow valley. To the left is a shelterwood cut.

All photo points in this landscape system are in private ownership. Although these holdings are on more productive land, they probably were mismanaged for a longer period than either the upper mountain forest range or the grassland inclusions. All the sites have shown improvement in watershed quality and forage production. Much of this is due to intensive agricultural practices.

The productivity of the surrounding forest resource has declined, possibly reflecting lack of interest or information to manage for timber production. There is little evidence of any effort to rehabilitate these nonindustrial private forests after the selective cutting practices of the past 80 years.

This landscape with its surrounding foothills is traditional spring-fall cattle range and winter deer and elk range. Some private landowners are allowing fee hunting to diversify their economic opportunities. •

FORESTED LANDSCAPES

Mountain forests

Mountain forest exists wherever soils are deep enough to hold sufficient moisture for tree growth. Included within this mountain forest zone are islands of mountain grassland and stringers of mountain meadows. At lower elevations, the forests consist of ponderosa pine and Douglas-fir grading into mixed-conifer forests, which also support western larch and grand fir. Upper slope spruce-fir forests may be interpersed with monotonous stands of lodgepole pine.

The dense stands, with 70 to 80 percent crown cover, support few understory grasses but may have low shrubs and forbs. Vegetation of the understory ranges from the pine-bunchgrass type to the shrubby huckleberry under a lodgepole canopy. Certain closed forest communities, like grand fir, contain little or no understory vegetation.

A large part of the mountain forest zone came under USDA Forest Service jurisdiction in 1906 after being designated part of the Blue Mountain Forest Reserve. Effective fire suppression started about 1910[9] just as livestock grazing was being reduced after the destructive days at the start of the 20th century. Wildlife numbers were at an all-time low about this time.

Lumbering had begun but was not on an industrial basis on public lands until midcentury. Although Blue Mountain saw-log production remained about the same between 1955 and 1970, that from private lands fell off by over half and that from National Forests increased by over 40 percent (Bolsinger and Berger 1975).

[9] Tucker, G.J 1968 History of the Wallowa-Whitman National Forest. 3 vol. Unpublished document On file with Wallowa-Whitman National Forest, P.O Box 907, Baker, OR 97814 [Not paged]

Figure 18—Billy Meadows Ranger Station, Wallowa County, OR.
This was the center for the Chesnimnus District of the old Imnaha National Forest (now part of the Wallowa-Whitman National Forest). It is about 60 kilometers northeast of Enterprise, OR. The station was used during research projects such as the 1912 program for transplanting elk from Jackson Hole, WY (Coffman 1984). The stocking rate for both domestic and wild ungulates on this limited summer range with abundant winter range is perhaps the highest of all government forested ranges in the Blue Mountains.

Photo by J.T. Jardine

Figure 18a—1908. The photographer described the background as a "heavy lodgepole pine" stand. It has not invaded the adjacent opening, as is often the case. The site within the fence was used for a grass-seed nursery by early researchers.

Figure 18b—1992. Today this stand consists of Engelmann spruce, grand fir, subalpine fir, lodgepole pine, and western larch. The reseeding has reverted mostly to native plants. Wheatgrass and timothy create a dense stand on this side of the road.

Figure 19—Lookinglass Creek, Union County, OR.
This overlook is about 1.5 kilometers northeast of Spout Springs and 5 kilometers southeast of Tollgate. The Forest Service has managed this area as commercial forest. Remnant herds of Rocky Mountain elk have been increasing in this area since the start of the 20th century. There are active cattle allotments between here and the Wenaha River and several bands of sheep graze nearby clearcuts.

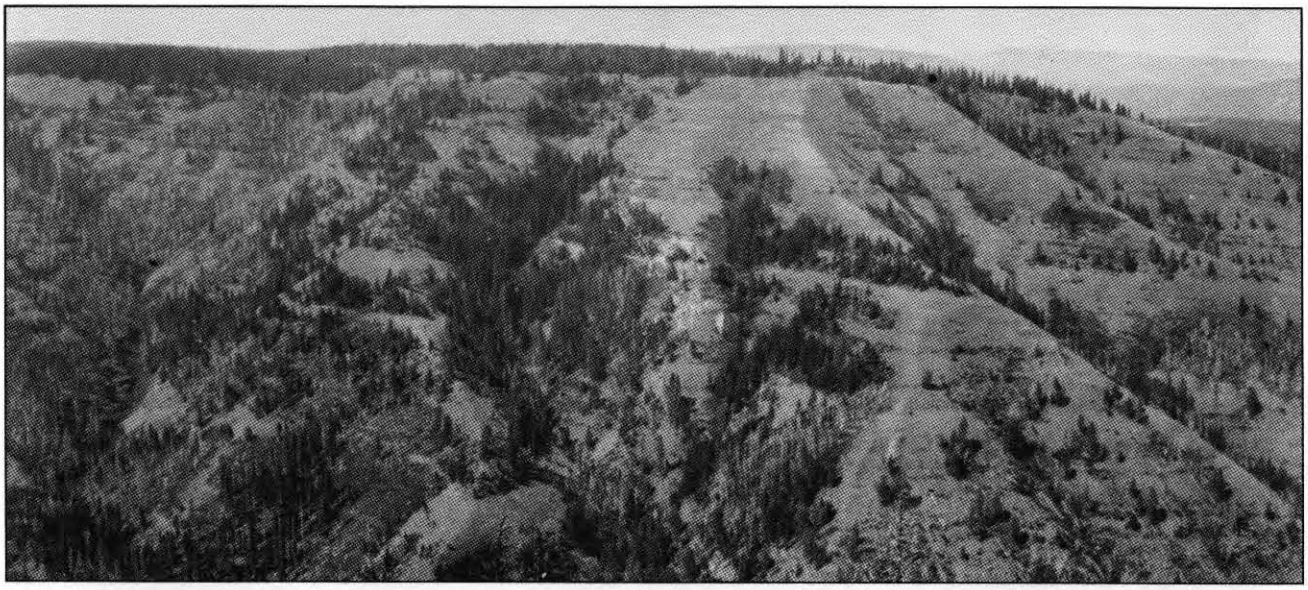

Photo by W.L. Dutton

Figure 19a—1924. The left part of the panorama shows fires have burned from the canyon bottom toward the top; one, probably in 1910, burned the entire headwaters of the far left-side canyon. Old-growth timber, which was missed by the recent fire, remains in the small side canyon to the right (center of photo).

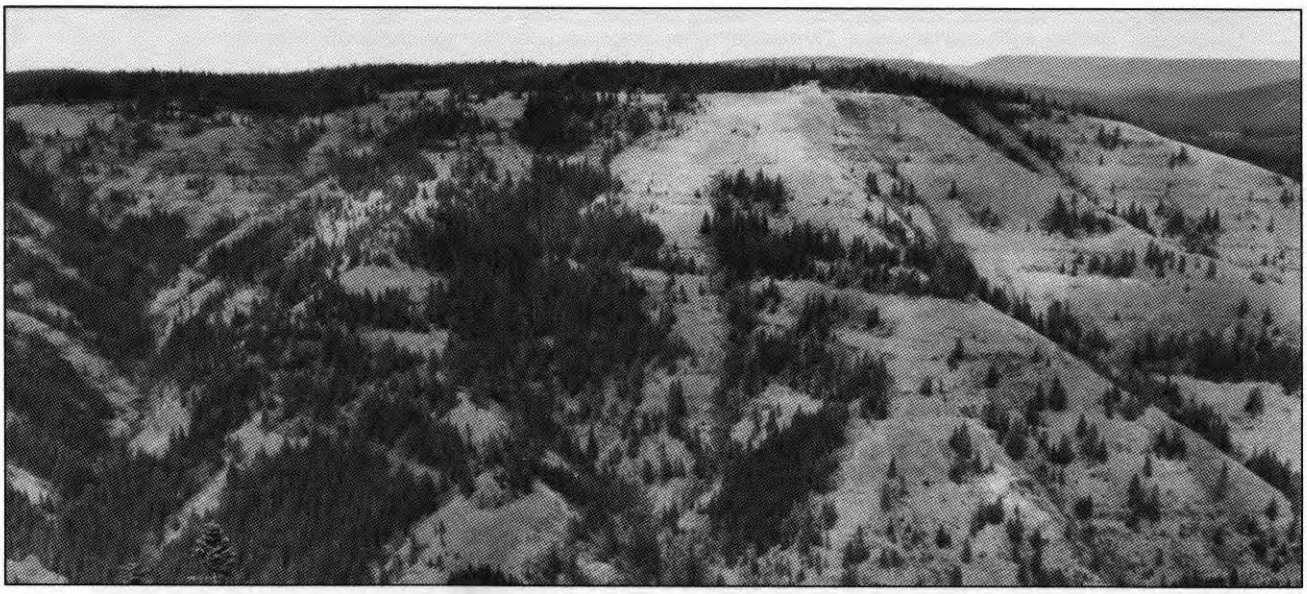

Figure 19b—1992. This photo shows a marked improvement in appearance of the timber stand conditions. The pocket of old growth can barely be discerned from the surrounding postfire-recovered stands.

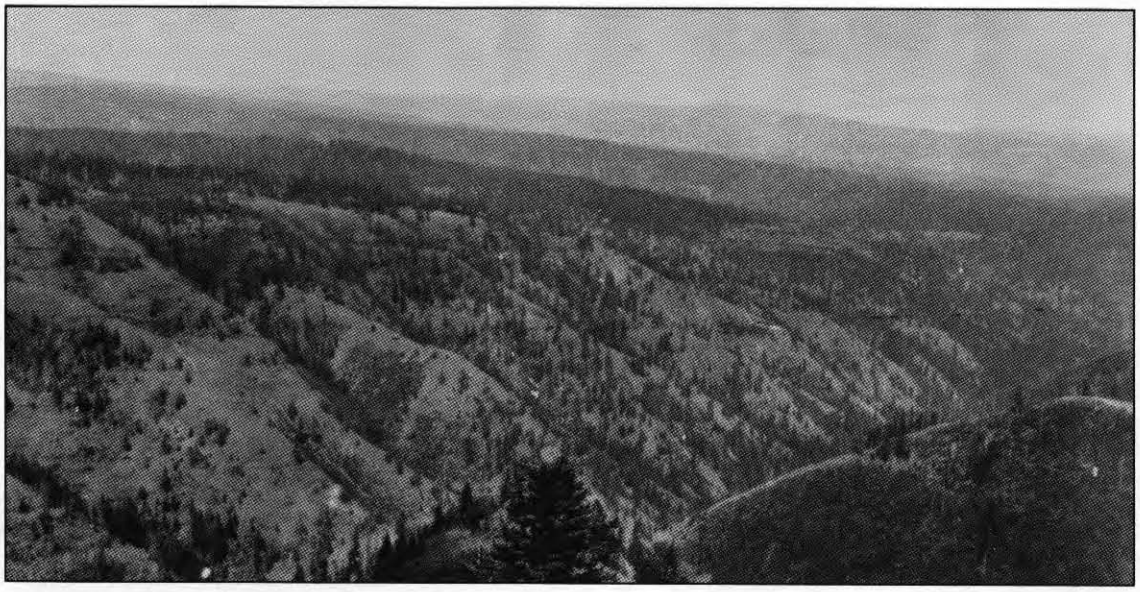

Photo by W.L. Dutton

Figure 19c—1924. The right-hand photo of the pair shows snags and irregular old growth on the timbered flat across the canyon. Note the pole-sized patch of regeneration just above the canyon breaks (upper left). Also, note the burned hillside at the lower right.

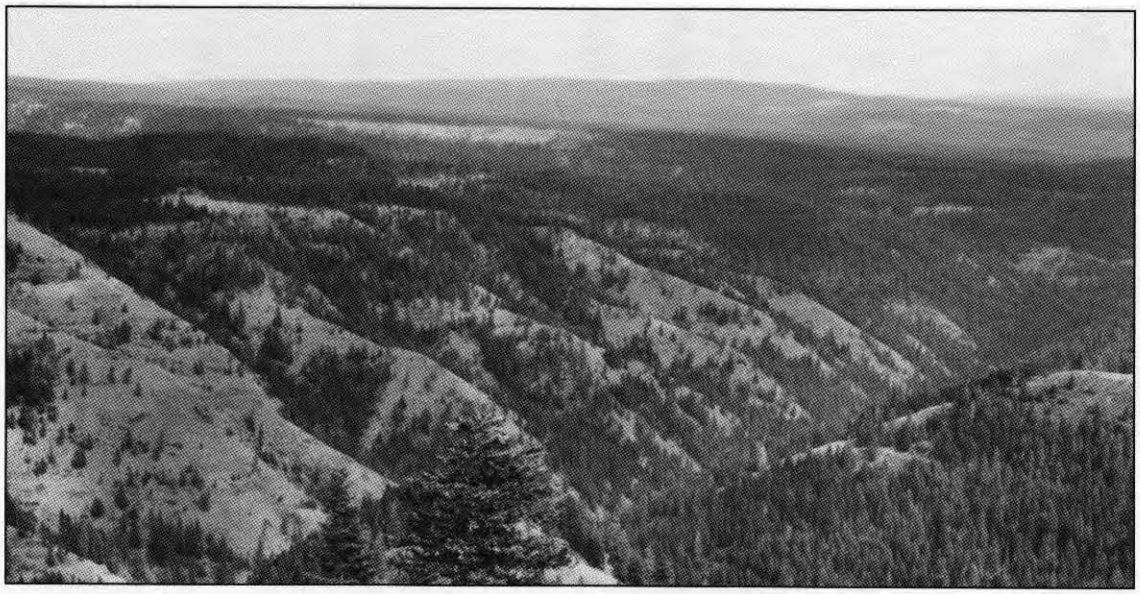

Figure 19d—1992. Logging has replaced the uneven-aged stands with even, well-stocked stands that are uniform and healthy in appearance. The burned hillside at the lower right has completely regenerated. Several clearcuts were visible from this overlook in 1982 (photo not shown). Eighteen are seen now; one appears to be in excess of 30 hectares.

Figure 20—Target Springs, Wallowa County, OR.
This spring is about 16 kilometers southeast of Joseph, OR. The site was a favorite camp for hunting parties of Chief Joseph's band of Nez Perce Indians.

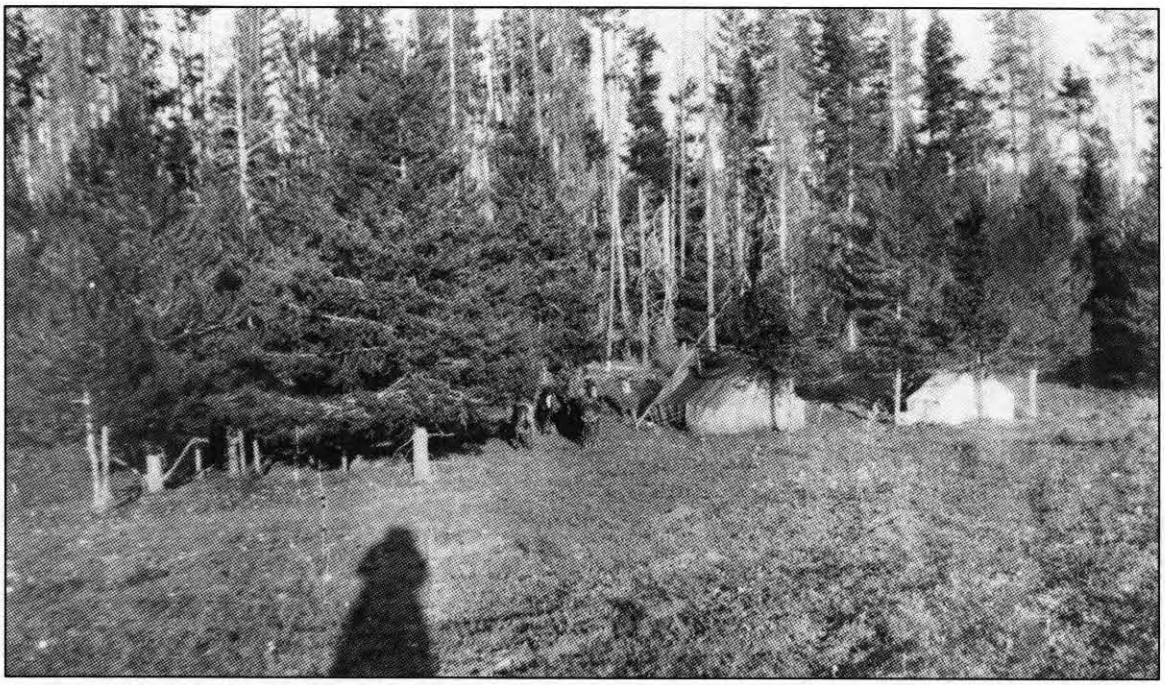

Photo by J.L. Peterson

Figure 20a—1914. This photo depicts a camp site of one of the earliest range reconnaissance survey crews in the Pacific Northwest.

Figure 20b—1992. The stake is positioned below the stump of the tree that was just above the photographer's shadow in the 1914 photo (fig. 20a). Much of the timber has been removed for such site improvements as corrals, pole fence, and firewood. Douglas-fir trees make up the edge of this stand, but beyond are lodgepole pine. Only a few scraggly fir and lodgepole remain. In the distance is a dead standing lodgepole forest ravaged by the 1989 Canal fire.

Figure 21—Pelican Creek Tree Cluster, Union County, OR.
This scene on the old wagon road 5 kilometers northwest of Hilgard, OR, looks across Pelican Creek into the canyon of the Grande Ronde River near the mouth of Spring Creek. It is a part of the Rugg Sheep Allotment, which was converted to cattle use in about 1960.

Photo by J.D. Lacey

Figure 21a—1919. The far slope consists mostly of old-growth ponderosa pine in rather open stands. The foreground is a dense stand of mules ears wyethia.

Figure 21b—1992. The mules ears wyethia have contracted to a 100-square-meter area in front of the pine grove. Constant use by elk in early spring has nearly eliminated mules ears from certain landscapes of Blue Mountain rangelands. The forest across Pelican Creek has been logged twice and has closed in a dense growth of regeneration, with Douglas-fir predominating.

Figure 22—Fly Ridge Afforestation, Union County, OR.
This site is located along the old wagon road between Pilot Rock and Sumpter about 7 kilometers from the Sheep Ranch or about 1 kilometer north of the Fly Valley photo series (fig. 16). This photo location is along the old Umatilla stock driveway. Heavy grazing before the start of the 20th century converted this site from natural grassland to forest (afforestation).

Figure 22a—1902. A lone ponderosa pine seedling has been badly hedged by sheep. Note the absence of vegetation and the bare soil of the driveway.

Photo by G.B. Sudworth

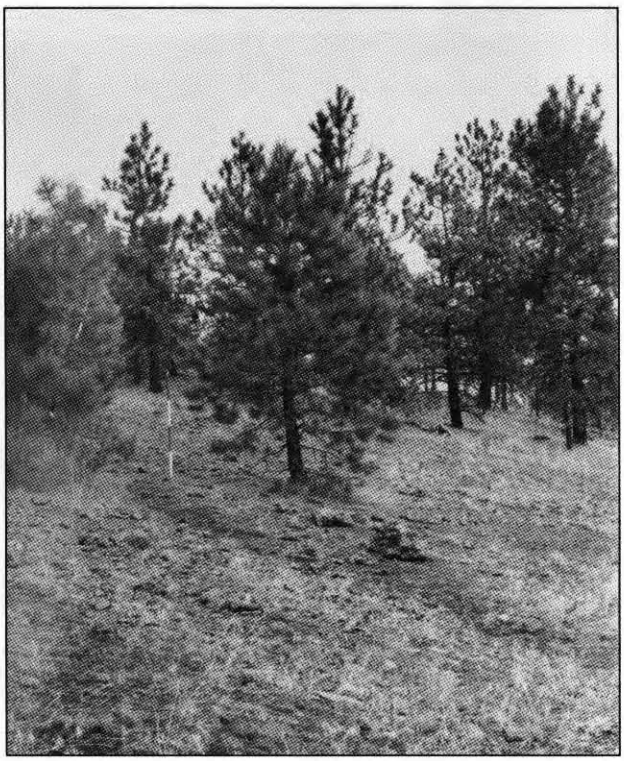

Figure 22b—1967. Scattered perennial grasses colonized the site, and annual grasses and forbs contributed litter cover. Before this site had begun to recover, however, sheet and rill erosion had progressed to a wide gully formation coming from near the bushy pine (left center).

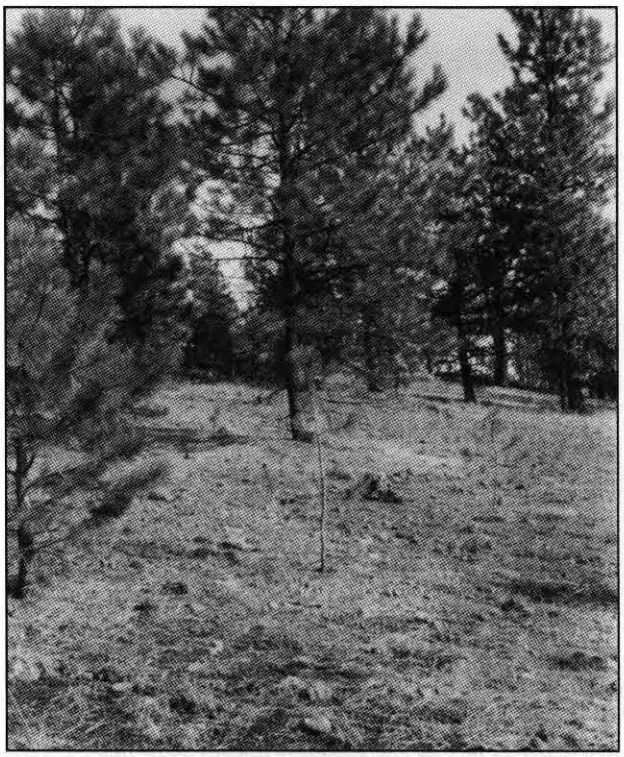

Figure 22c—1982. The gully process was in remission and pine needles and other litter have helped protect the site. Young pine seedlings continue to prosper where heavy grazing destroyed the cover and prepared the seedbed shown in the 1902 photo. Ample moisture after a good cone crop and seed scattered on mineral soil provided good seedling survival.

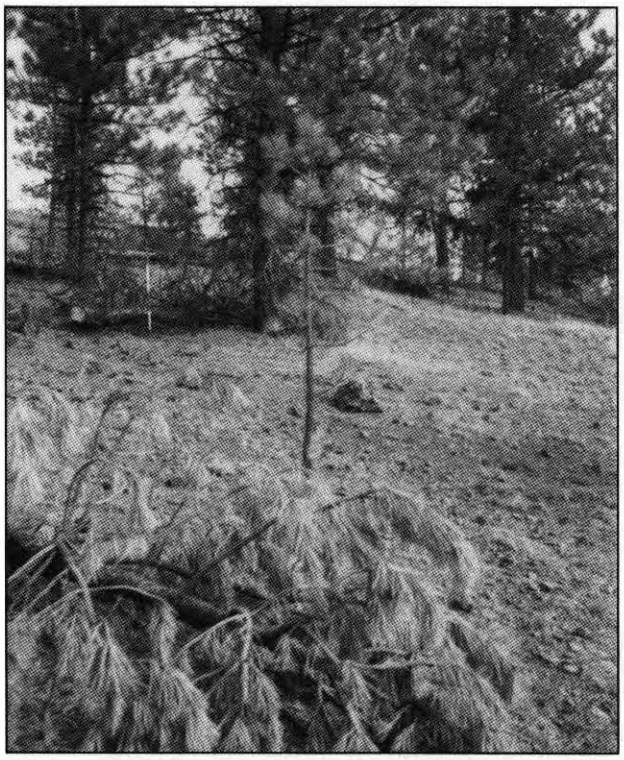

Figure 22d—1992. In 1990 this grove of pine was chosen for timber stand improvement (TSI) and thinned to a 4.5 to 6-meter spacing. The old juniper tree on the horizon in 1902 is again visible behind the stake. The site was thinned to a slightly wider spacing in 1991 as evidenced by the slash in the foreground still bearing needles.

Figure 23—Richardson Hill, Union County, OR.
This homestead site is on the west side of the Grande Ronde River, halfway between La Grande and Starkey via State highway 244. The first sawmill on the upper Grande Ronde River was built on this site in the late 1880s. This is a companion picture to figure 34.

Photo by J.D. Lacey

Figure 23a—1919. Timber in the draw behind the homestead has been heavily cut. Alder and willows along the spring branch are thick and continuous.

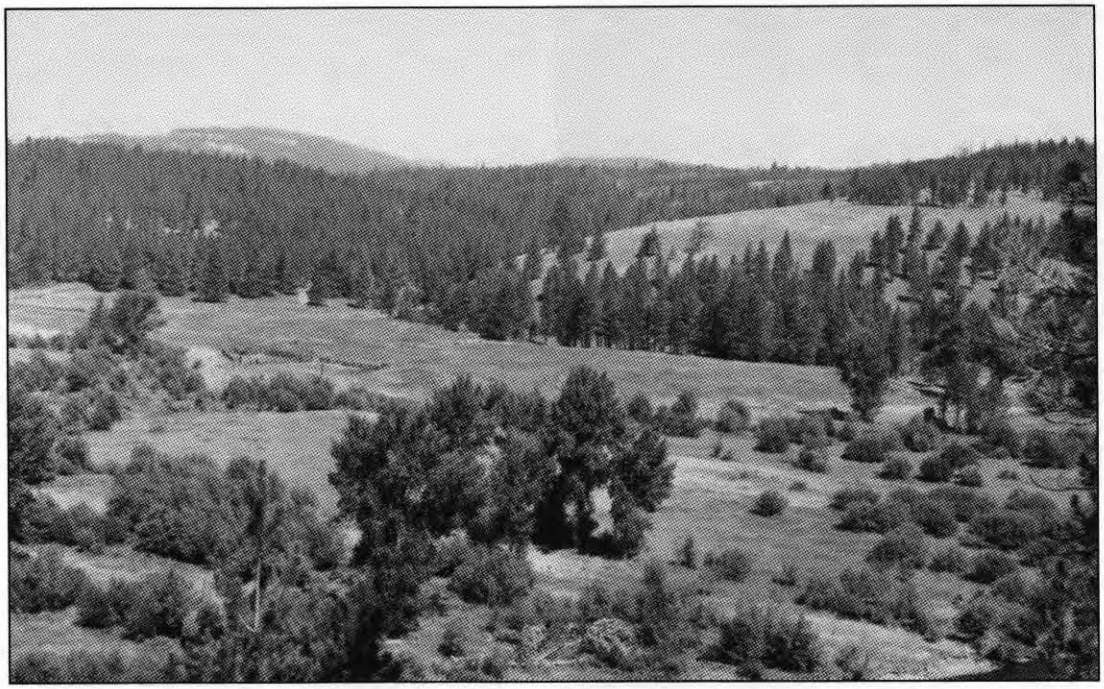

Figure 23b—1967. The standing dead snags on the right horizon are the aftermath of the 1965 Spring Creek Fire. This fire burned part way into the basin, which had been heavily logged at the start of the 20th century (fig. 23a). Evidence of the homestead has disappeared, thereby illustrating the population shift to urban areas during the 1930s and 1940s.

Figure 23c—1982. Fire snags on the right horizon have fallen. The mixed-conifer cutover stand of 1919 on the left is now uniform and dense in appearance. Highway 244 has been realigned, which has altered the river course along this stretch.

Figure 23d—1992. Fewer alder and willow occupy the riparian bottom land. There is now a preponderance of hawthorn and a few older cottonwood trees. This may reflect attempts to drain the fields to improve farming capability. Note the instream rock structures installed for fish habitat enhancement. Note also the disappearance since 1967 (fig. 23b) of the cutbank across the river.

Figure 24—Trail Creek, Grant County, OR.
This view looks due east toward Lakes Lookout on Elkhorn Ridge. It is opposite Chicken Creek on the watershed divide between the Grande Ronde and John Day River basins. There were large mining camps near here in the late 1870s and 1880s, which created a demand for lumber for mine timbers, railroad ties, firewood, and other construction activities.

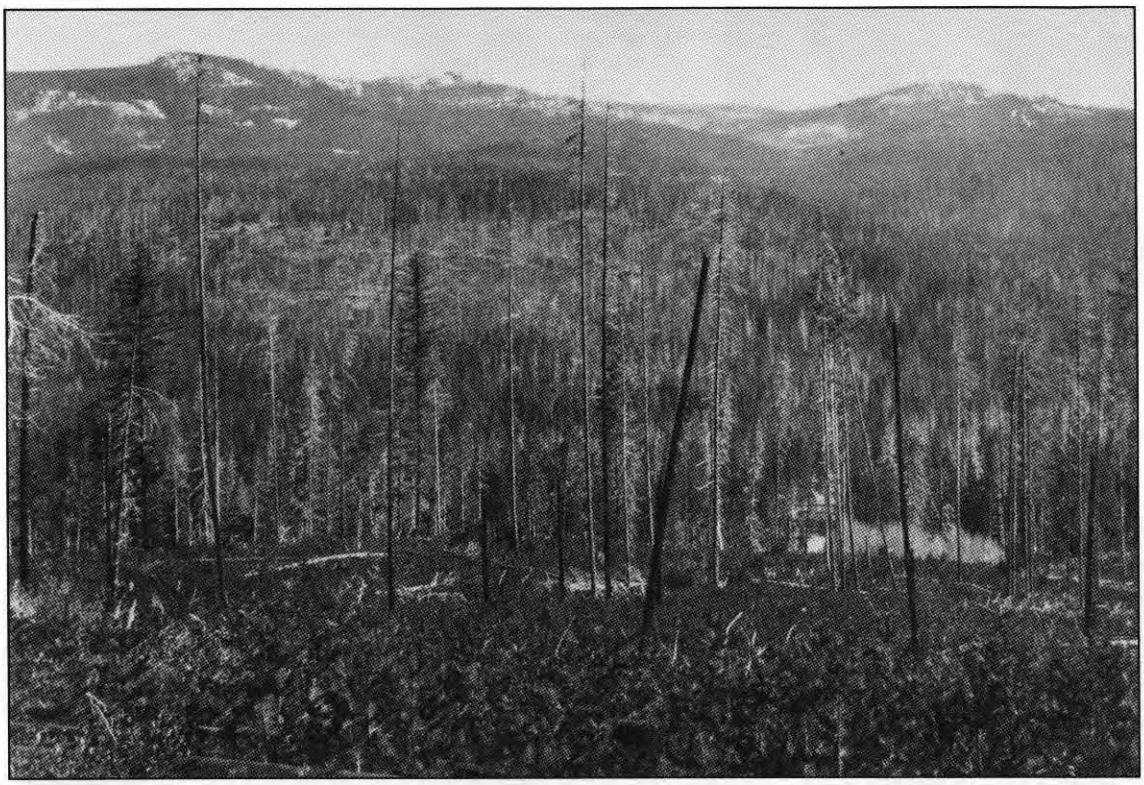

Figure 24a—1902. Ravages of the 1889 burn are obvious. Note lodgepole pine seedlings in foreground and a cluster of larch saplings (right). The ridge tops on the distant horizon are quite open.

Figure 24b—1967. The new lodgepole stand is about 75 years old and the canopy has closed. Older larch that survived the fire of 1889 are prominent above the continuous canopy. Ridge-top openings have become overgrown with conifers.

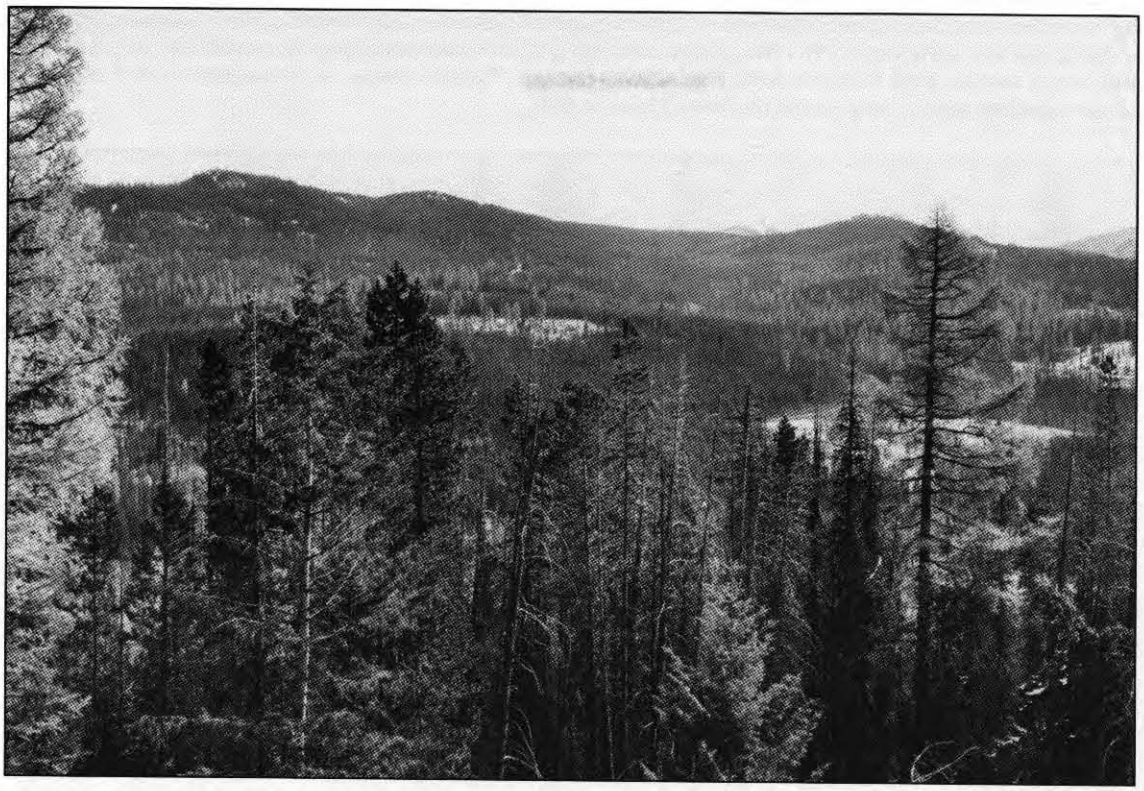

Figure 24c—1982. Evidence of western and mountain pine beetle infestation of the late 1970s is highlighted in three patch-cut openings created after salvage logging. Old-growth larch is still prominent.

Figure 24d—1992. The Clear fire, 1986, and the Tanner Gulch fire, 1989, destroyed much of the remaining timber below the high buttes on the left horizon. The whole of the right horizon, Black Butte, also has burned, thereby exposing the cleft rock outcropping. Most of the old larch has been taken in fire salvage operations. The photo point is in the center of a beetle-killed salvage sale of the early 1980s. Saplings in foreground were cut to take this picture. They were part of the natural regeneration that followed the salvage disturbance and overstory removal. Sharp-crowned subalpine fir are emerging in the middle ground.

Figure 25—McGraw Springs, Wallowa County, OR.
This spring is on the west rim of the Snake River Canyon about 7 kilometers southwest of Hells Canyon Dam. It has been used as a camp site since the time of the Nez Perce Indians. It was a stopover along the stock driveway between the tri-State winter range and the high Wallowa Mountain summer range. The first range reconnaissance crew also used this camp. The surrounding area is now within the Hells Canyon NRA.

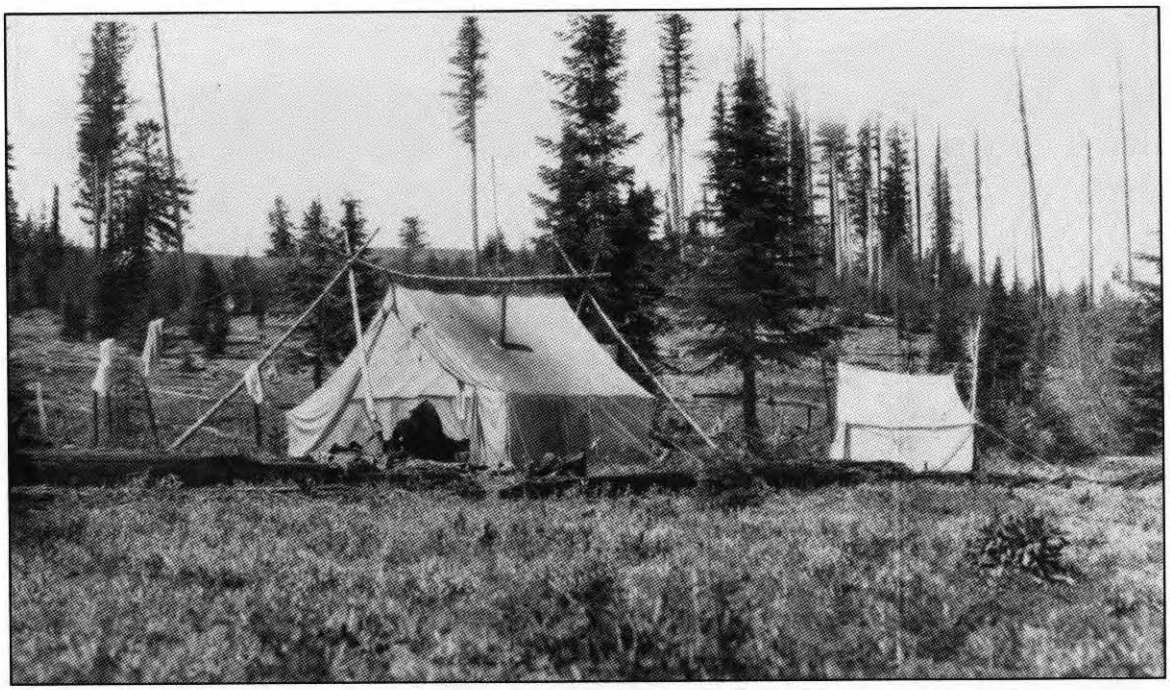

Photo by J.L. Peterson

Figure 25a—1914. Many fire-scarred snags attest to a hot crown fire in recent times, perhaps during the severe 1910 season. Judging by the variety of species remaining, this was a mixed-conifer stand.

Figure 25b—1992. The stake (left center) has been placed at the location of the near corner of the large crew tent (fig. 25a). Trees were removed in a 0.5-hectare clearcut within the past 2 years. Grand fir, Engelmann spruce, and lodgepole pine contributed most of the volume. Other less common species were western larch and Douglas-fir. Tree growth is good considering the high elevation (1800 meters). A 10-hectare area about the spring has been heavily roaded.

The mountain forests have undergone drastic changes since the arrival of nonindigenous settlers. Most striking has been the tremendous increase in regeneration of understory trees, which old timers refer to as "brushing up." The understory of current forests is heavily stocked with saplings and poles of the shade-tolerant species, Douglas-fir and grand fir. This thickening of young forests (Weaver 1949) has been caused by a combination of factors (Pearson 1949).

Overgrazing by cattle and sheep removed fine fuel, destroyed ground cover competition, and created bare soil seedbeds (Rummell 1951). Widespread tree establishment was intensified when horses were replaced by tractors for logging, which scarified the forest floor thereby exposing mineral soils and creating ideal seedbeds (Garrison 1964). Efficient fire suppression especially after midcentury further contributed to heavy fuel accumulation (Arno 1976). Without fires, shade-tolerant firs replaced fire-resistant pines.

Another apparent change shown in photo comparisons is that the old-growth ponderosa pine and Douglas-fir are gone. Also, snags that are necessary for cavity-nesting birds and eventually large woody debris for insects have been eliminated through fire protection policies. Snags once were common, but are now found mostly in areas of recent fires.

The practice of selecting only prime ponderosa pine and western larch has left inferior trees to regenerate. Other radical changes in species composition have occurred besides the conversion from pine to fir. Several lodgepole stands, such as the one at Billy Meadows (fig. 18), have changed to mixed-conifer stands, which illustrates the serai nature of lodgepole pine (Trappe and Harris 1958) Some tree stands on semiarid marginal sites (for example, Target Springs, fig 20) have not and probably will not regenerate naturally.

Several series in the mountain forest landscape show insect infestations The most common was the mountain pine beetle outbreak of the mid-1970s. In the Upper Grande Ronde River area, the mountain pine beetle affected mature lodgepole pine in Fly Valley (fig. 16) and Trail Creek (fig. 24). Douglas-fir tussock moth outbreaks occurred in the Tollgate area (fig. 19). Much of the western spruce budworm and Douglas-fir bark beetle infestation has recently occurred in the thick, shade-tolerant stands (Wickman 1992).

Early attempts to control insects began in mid-century when the chemical DDT was tested and applied to local forest lands infected by western spruce budworm (Eaton and others 1949). Millions of acres of Blue Mountains forest were sprayed with this long-lived pesticide during the next 25 years, until it was confirmed that tissues from lambs grazing sprayed range near Tollgate (fig. 19) showed concentrations of DOT far exceeding limits for agricultural commodities (Strickler 1975). This finding had serious marketing implication for ranchers, and it implied that the meat from deer and elk taken by hunters also would be contaminated (USDA Forest Service 1981)

Clearcutting and road building are two development activities that have accelerated over the past 25 years. Studies show that when properly executed, small unit Clearcutting (<10 hectare) tends not to degrade the environment but can be used to mimic small fires (Skovlin and others 1989, Tiedemann and others 1988).

As a result of the build-up of understory fuels, standing dead trees, and ladder fuels accumulating in brushed-up stands, large and destructive crown fires have occurred over the past 10 years. The photo series in the mountain forest landscape shows evidence of six large fires averaging over 10 000 hectares each since 1986. The total area burned was about 59115 hectares.

There were large and destructive fires in former times also; for example, Lookinglass in 1889 (fig. 19) and the Sleepy Burn in 1910 (fig. 7). By midcentury these forested areas had largely regenerated through natural succession. •

Mountain grasslands

Mountain grasslands occur interspersed within the mountain forest. Grasslands usually occur on sites with soils too shallow to support trees, such as the rockier ridge types or steeper south-facing slopes. They are normally small (2.5 to 25 hectares) nonforested openings surrounded by more-or-less continuous forest. They often represent only one-fourth or less of the upland forested area but are very important to grazing ungulates (Skovlin and others 1976).

These grasslands are characterized by prairie Junegrass, bluebunch wheatgrass, and Idaho fescue. Forbs are mostly palatable to all ungulates and include lupines, balsamroot, and various early succulent lilylike plants, such as camas root. Scattered pines often invade the mountain grasslands but usually succumb to drought before maturing.

These areas are choice summer range for all forms of livestock and big game if higher elevation range is not available. Because these areas provide diversity and contain desirable grass and forb species, deer and elk prefer them in spring and early summer, and livestock prefer them over the forested grasslands except in late summer. Because of this, they historically have sustained heavier use than has the surrounding forest understory.

These grasslands supported the livestock of the early ranchers and homesteaders beginning in the early 1880s. Cattle and extra horses were turned out to mountain pasture in the spring. There was a community beef gather in August and a fall roundup in October. Herded sheep often grazed throughout traditional cattle range until creation of the Forest Reserves, which divided these mountain pastures by class of stock. Except for the occasional drift fence, fencing was not customary until the 1930s and 1940s. Systems of management did not come into being until after 1950.

Figure 26—Monument Ridge, Wallowa County, OR.
This photo point is about 6 kilometers northwest of Hat Point and about 2 kilometers past the Horse Creek cabin. The site is within the Hells Canyon NRA on the headwaters of Haas Creek (left). From the late 1940s to the early 1960s, this pasture held government horses. During this time, there was some cattle trespass from the nearby Cayuse allotment and some late fall sheep use. This general area stabilized about 1950 and continues to improve slowly. Today pocket gopher activity is moderate to heavy on elevated hummocks.

Photo by J.L. Peterson

Figure 26a—1914. The pack string is moving the range reconnaissance survey team. The lodgepole pine trees appear to have died as a result of the 1910 mountain pine beetle epidemic (Burke 1990).

Figure 26b—1992. The mixed-conifer forest edge has remained quite stable over the years. Isolated Douglas-fir trees remain in the grassland, and although lodgepole pine has died back, it remains a component of the stand. The interior of the stand also contains Engelmann spruce, subalpine fir, and a few old ponderosa pine. Dead windfalls still can be seen after 75 years. The immediate foreground has recovered considerably and improved from a broken sod with raw exposed soil interspace to a good stand of mixed fescues that constitute a nearly unbroken sod.

Figure 27—Mormon Flat, Wallowa County, OR.
This area is about 24 kilometers north of Hat Point and within the Hells Canyon NRA. It was traditional summer cattle range for the Dorrance Ranch that had winter range on the Snake River. Cattle use stopped about three decades ago. Until about 1980, sheep migrated through here to and from Wallowa Mountains summer range and Snake River winter range. Today this area receives moderate summer use by elk; before the 1950s, however, elk were not common in these Snake River canyon breaks.

Photo by D.C. Ingram

Figure 27a—1919. Cattle have grazed most of the available dry forage. Even so, cover appears to be continuous except along the main ridge trail in the foreground.

Figure 27b—1992. Much improvement can be seen in the cover characteristics. The current composition places this mountain grassland in a good ecological condition with an upward trend.

Figure 28—Chico Trail, Wallowa County, OR.
This trail connected the Sled Springs Guard Station, 30 kilometers north of Enterprise, OR, with the Billy Meadows Ranger Station via Chico Guard Station. In 1916 this Forest Service allotment was designated cattle range for the Swamp Creek C&H Association. In 1934 a drift fence was built to separate spring and summer use. Boundary fences now help manage cattle use on this allotment. Cattle are put on the lower Swamp Creek unit (left of photo center) in late April and enter the upper Miller Springs unit (right) in late June.

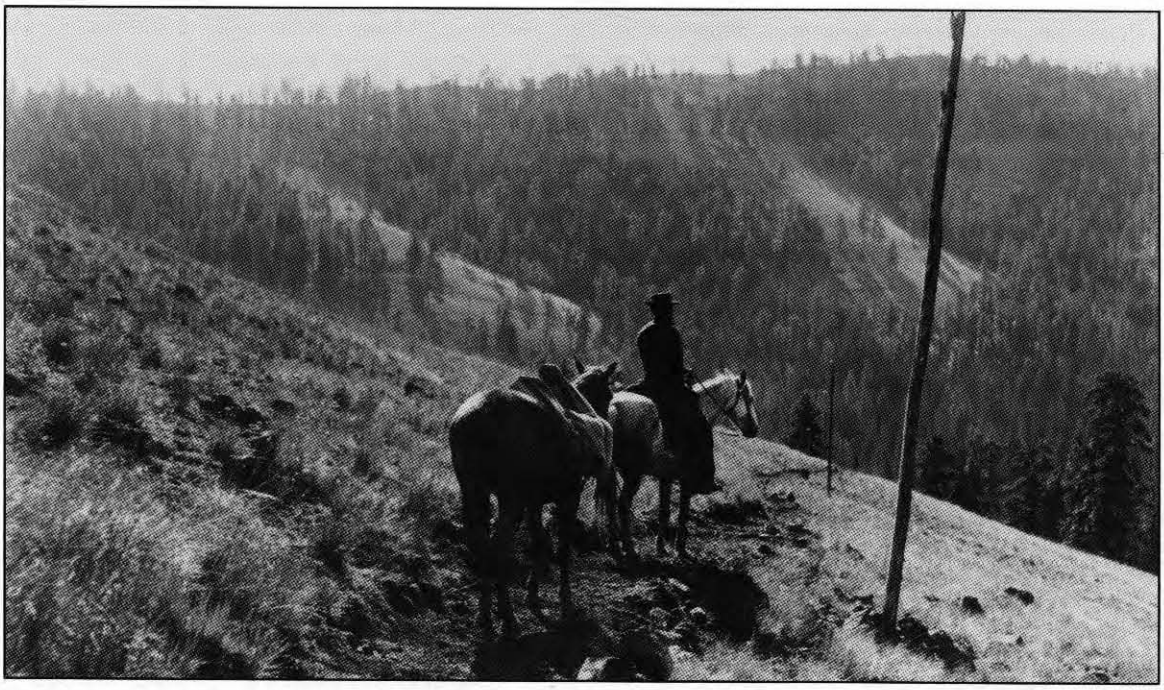

Photo by H.W. Harris

Figure 28a—1908. A heavy stand of climax bluebunch wheatgrass occupied the moderately steep, south-facing slope into Davis Creek. Note the open ponderosa pine forest across the canyon. Early range researcher, James T. Jardine, is shown.

Figure 28b—1992. The stand of bluebunch wheatgrass in the foreground is still in good condition, but increaser forbs, such as western yarrow, and half-shrubs, like Wyeth buckwheat, are now in evidence. Cover for watershed protection seems not to have diminished appreciably, however. The background forest has been converted from ponderosa pine to overstocked grand fir and Douglas-fir.

Figure 29—Fly Ridge, Union County, OR.
This photo point is near the Umatilla stock driveway, 9 kilometers northwest of the Sheep Ranch. The ridgetop (foreground) was in a severely depleted state at the start of the 20th century. Relief from the heavy grazing stress began with creation of the Forest Service in 1906. Management started by designating its use for sheep from the McCarty Allotment and denying use by transient herds.

Photo by G.B. Sudworth

Figure 29a—1902. The description on this picture said, "Foreground shows excessive sheep grazing, and some effects are seen in the middle foreground."

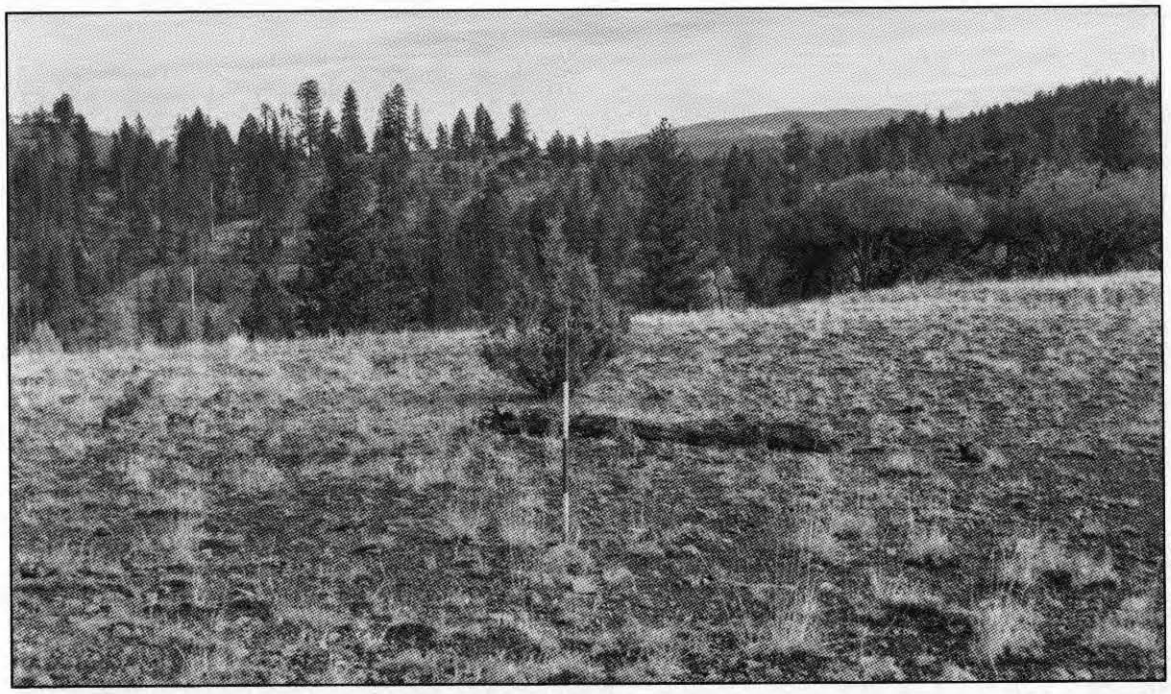

Photo by R.W. Harris

Figure 29b—1957. Sandberg bluegrass and bluebunch wheatgrass now account for most of the cover. Old-growth ponderosa pine on the far ridge was logged in the middle 1950s. The western juniper sapling is between 25 and 30 years old.

Figure 29c—1992. One-time bare erosion pavement now has a good cover of moss; lichen covers the larger boulders. The juniper snag laying in the middle ground has not deteriorated much in nearly 90 years. The mountain-mahogany shrubs (right background) appear more decadent and have a high browse line—the result of elk feeding activity. Perennial cover has more than doubled in the past 35 years; additional recovery will be quite slow on this harsh site.

Figure 30—Bear Wallow Driveway, Umatilla County, OR.
This site is on the main stock driveway, 30 kilometers west of the previous Fly Ridge photo (fig. 29). At the peak of use, this trail was crossed annually by thousands of cattle and perhaps a hundred thousand head of sheep trailing from the Columbia basin to the high mountains in the spring and back in the fall. Because nearly all the topsoil was removed, the site will never achieve its original condition. Attempts to rehabilitate these sites have not succeeded (Klomp 1968).

Photo by F.B. Kellogg

Figure 30a—1915. This picture was taken near Bear Wallow Guard Station during a range inspection of the Umatilla National Forest.

Photo by R.M. Filloon

Figure 30b—1939. There has been little if any change after 24 years of somewhat reduced stock trailing pressure. The bare soil area seems to have diminished slightly. Chokecherry is becoming decadent on the hummock below the distant spreading ponderosa pine tree. An automobile road has replaced the original wagon trail.

Figure 30c—1964. Twenty-five years later, the site shows substantial improvement in ground cover on both hummocks and swales. Native species reoccupying the swale site were mostly cluster tarweed and annual hairgrass. On the hummocks were scattered plants of western yarrow, low gumweed, bottlebrush squirreltail, and western needlegrass. Through frost heaving and settling and the action of wetting and drying of the heavy clay subsoil, the erosion pavement (cobblestones) has subsided.

Figure 30d—1992. Twenty-eight years later, additional recovery is apparent. Swales were producing Sandberg bluegrass and rush pussytoes, and hummocks were covered with many different forbs. Secondary succession was proceeding quite rapidly. Deer, elk, and considerable cattle use was in evidence.

Figure 31—Bear Wallow, Umatilla County, OR.
This sequence is about 1 kilometer east of the previous series (fig. 30) along the Umatilla stock driveway. It is within the old Camas-Hidaway Allotment about 3 kilometers north of Granite Meadows. This former sheep range is presently an active cattle allotment. Historically, it has been elk summer range. Scattered bands of elk occurred here even at their lowest population ebb at the end of the 19th century.

Photo by F.B. Kellogg

Figure 31a—1915. This juniper stump is on a hummock elevated above the eroded ground. Note the prominent willow and serviceberry shrubs along the forest edge.

Photo by R.M. Filloon

Figure 31b—1939. After 24 years, the hummock seems to have been reduced in size by about half. Old-growth timber along the forest edge remains unchanged, and willow and the tall shrubs of serviceberry also remain.

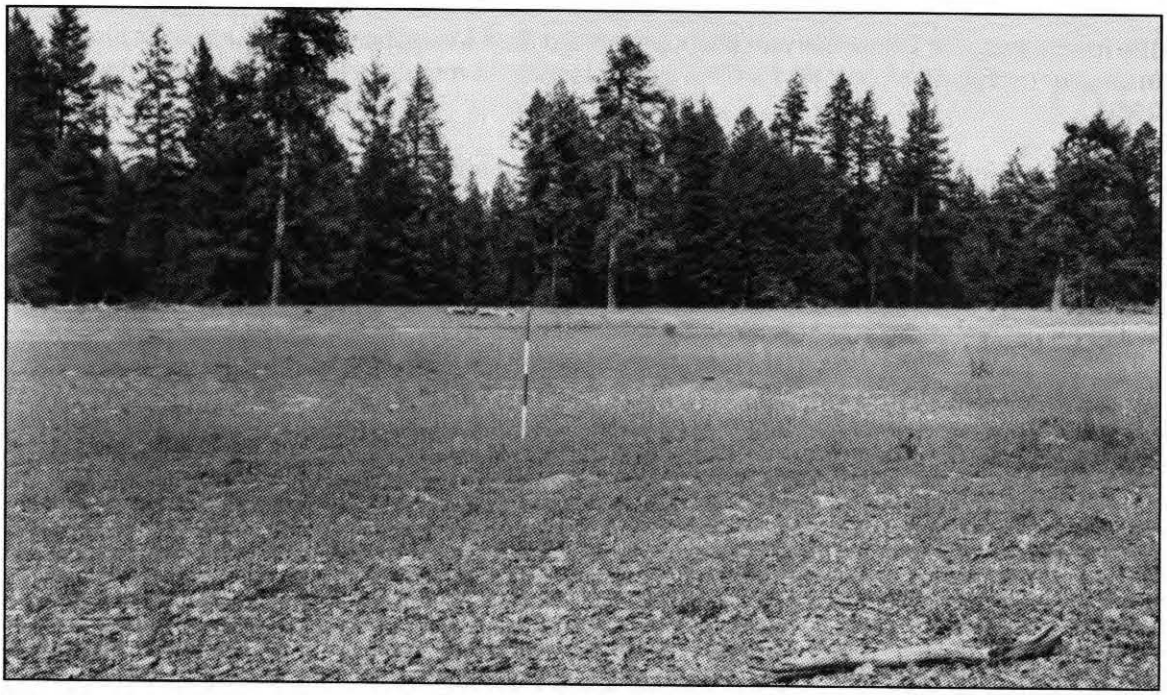

Figure 31c—1964. After 25 more years, the hummock has disappeared. All the shrubs and some of the old-growth pines are gone. The trees were harvested but the shrubs disappeared because of decadence and failure to regenerate due to heavy ungulate browsing. Ground cover, though mostly annual grasses and weeds, is much improved.

Figure 31d—1992. After 28 more years, the only old-growth ponderosa pine remaining are the two scraggly leaning trees in the background (right). Considerable pole-sized ponderosa pine regeneration has established itself along the edge of the stand where shrubs were prominent in 1915. Perennial grasses also have become established in the foreground. The erosion pavement seems to have subsided, and the process of accumulating humus and building soil has begun.

On the whole, mountain grasslands have improved one full ecological condition class, from poor to fair at the start of the 20th century to fair to good at present. Of the five photo pairs comprising this landscape type, only the first three represent the true mountain grassland situation. The remaining two were selected by range examiners soon after the turn of the century to illustrate recognizable problem areas; in this case, stock driveway condition and trespass through abuse of crossing permits.

Much of the forage base for Forest Service allotments in the Blue Mountains is derived from mountain grasslands with smaller contributions coming from the understory of the mountain forest zones (Sanderson and others 1990).

Management has brought about improvement because stocking numbers have remained relatively static in spite of factors that tend to diminish the forage supply, such as logging slash and soil disturbance, brushing-up of thickets, or crown canopy closure. Early management focused on better distribution of stock through fencing, water development, and salting After midcentury, systems of grazing management for improving the forage supply were introduced (Skovlin and others 1976). Seeding for range improvement also was attempted (Rummell and Holscher 1955).

Elk that once were migratory through this zone during spring and fall now have become resident and appear to thrive throughout the summer Deer long have been resident in this zone •

Mountain meadows and riparian habitats

Mountain meadow and riparian habitat are two companion types and often occur together within the mountain forest landscapes. One is a wet meadow consisting of heavy clay and alluvial-type soils usually waterlogged during spring months (Hall 1973). The other is a dry meadow on well-drained loamy upland soils. Both types of meadow are sought by all ungulate forms.

In the Blue Mountains, meadows occupy only 1 or 2 percent of the forested area but can account for upwards of 10 to 20 percent of the summer-range ungulate forage One hectare of mountain meadow can provide as much forage as 10 to 15 hectares of surrounding forest range (Reid and Pickford 1946). Meadow plants are very palatable and remain succulent long after plants in the nearby forest uplands have dried. One-half hectare of meadow in fair condition should support several elk or a cow for a month.

In meadows of good condition, perennial grasses, such as tufted hairgrass, and grasslike plants, such as Nebraska sedge, cover half the ground surface. Indicators of degraded meadows include Kentucky bluegrass, western yarrow, false hellebore (more commonly called skunk cabbage), cinquefoils, and common dandelions.

Figure 32—Upper Grande Ronde River, Union County, OR.
This series is taken about 32 kilometers southwest of La Grande, OR. First- and second-order watersheds above here drain perhaps 175 square kilometers (60 sections) of the Grande Ronde River headwaters, which are important to salmon. Tony Vey's sheep grazed the uplands until about 1950 after which cattle grazed both uplands and mountain meadows bottoms.

Photo by J.D. Lacey

Figure 32a—1919. This wet stringer meadow is fringed with willow. The rather open stand of ponderosa pine has some advanced regeneration along the edge.

Figure 32b—1992. Modern road construction has altered the surface and subsurface drainage patterns and eliminated the woody riparian shrubs. Heavy logging on this arid south-facing slope has modified the microclimate to further depress tree regeneration. This timber site is being converted into an open pine savanna grassland.

Figure 33—Rock Creek Meadows, Baker County, OR.
Rock Creek is a major drainage flowing from the Elkhorn Ridge Mountains into the Powder Valley about 20 kilometers northwest of Baker City. Rock Creek Meadows was grazed by sheep until the area was closed in the 1920s to protect the Baker City watershed.

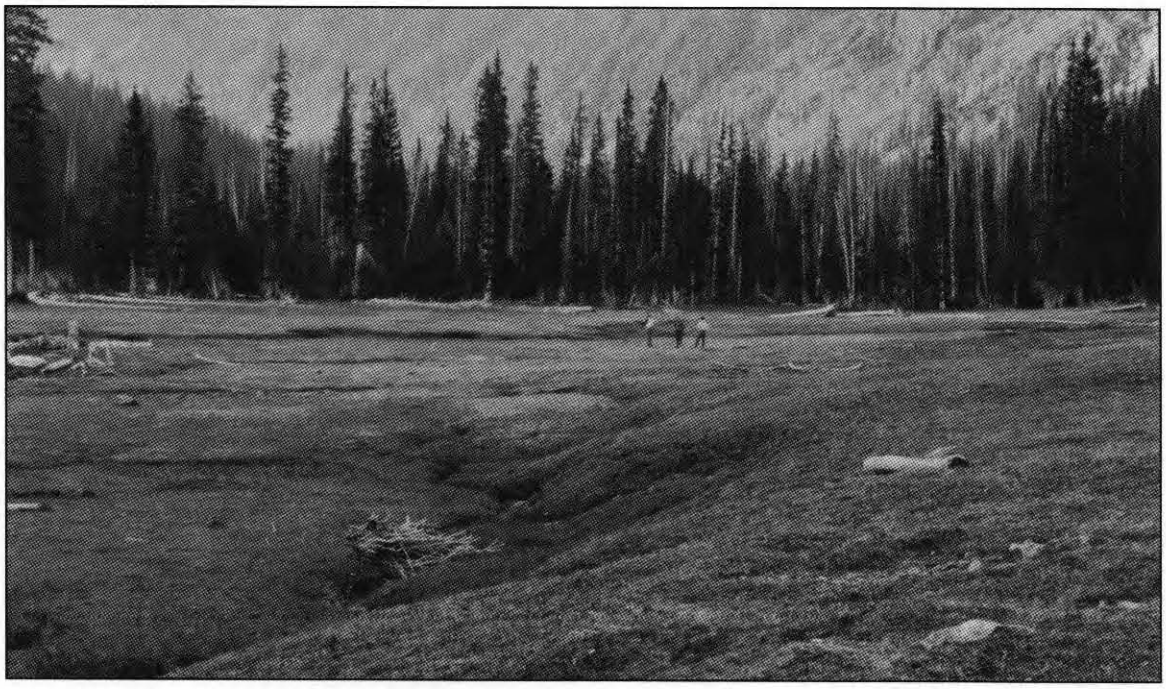

Photo by Gifford Pinchot

Figure 33a—1901. Although the vegetative cover is still intact, close cropping is evident by the stark appearance of objects in the foreground. There were many dead standing subalpine fir trees scattered throughout the stand as well as fallen snags of fir and spruce along the meadow edge.

Figure 33b—1992. The spruce-fir stand of trees appears young and healthy and is perhaps slowly encroaching on the meadow. Note the saplings at the far left where only large boulders were evident in 1901. Elk make substantial use of the meadow as evidenced by recent bedding areas and other fresh signs.

Figure 34—Longley Meadows, Union County, OR.
These meadows are along the Grande Ronde River, halfway between La Grande, OR, and Starkey, OR, on State highway 244. They are a part of the present day River Ranch and historically have been cut for hay and then grazed by cattle in late summer and fall. This photo point forms a panorama with figure 23, Richardson Hill.

Photo by J.D. Lacey

Figure 34a—1919. The black cottonwood trees lining the river were only saplings early in the 20th century. The rail fence (lower left) marks the line between government land (foreground) and private (background). The higher distant hills are National Forest lands drained by Spring Creek, a small tributary of the Grande Ronde River.

Figure 34b—1967. The old railroad grade was built in 1927 for the train that at one time carried over 20 carloads of logs per day to Mt. Emily Lumber Company mills in La Grande. The railroad was not used after the mid-1950s.

Figure 34c—1982. The river is encroaching on the railroad grade. The drainage pattern of Bear Creek that meandered through Longley Meadows in 1919 is very apparent (fig. 34a). Though rerouted, it still enters the river from the left just beyond the gravel bar in the foreground. Much of the meadow was cultivated and seeded to pasture grass in the early 1960s. Riparian shrubs that were to the left of the black cottonwood grove (center) have disappeared since 1967.

Figure 34d—1992. The river channel continues to cut through the railroad grade. The forest is a mixture of second-growth ponderosa pine, Douglas-fir, and larch.

Figure 35—Rock Creek Bed Ground, Baker County, OR.
This pair of photos was taken about 100 meters off the meadow to the right of the three men standing near the center of figure 33a, Rock Creek Meadows.

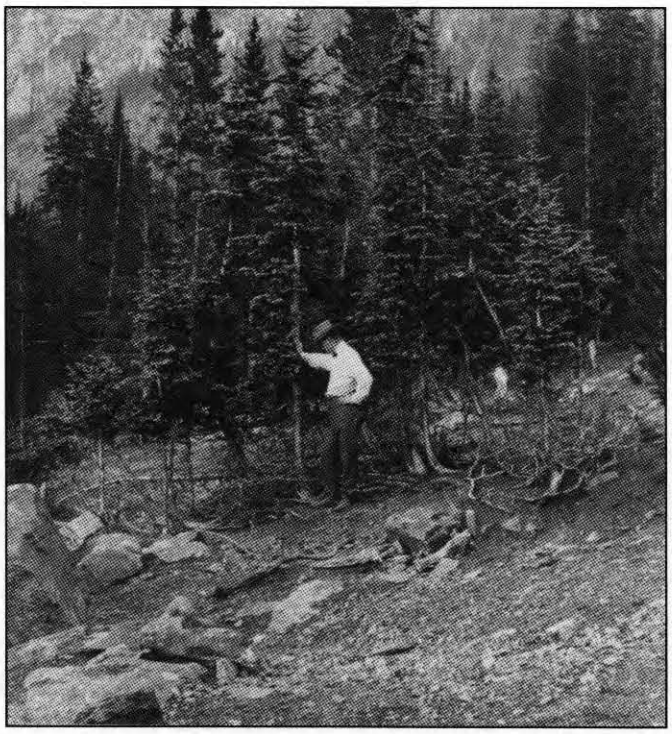

Photo by Gifford Pinchot

Figure 35a—1901. The photographer noted this was a sheep bedding ground where both bark and tree needles had been eaten. The waist-high browse line is quite distinct. The person shown is probably W.O. Dayton, then a senior botanist of the Bureau of Plant Industry.

Figure 35b—1992. Little remains of the clump of trees, and the site has been reoccupied by herbaceous species. The opening between the camera point and the tree line is in a snow avalanche chute where invading woody vegetation is periodically destroyed. Many nearby root wads were torn from the granite soil perhaps 3 or 4 years before this photo was taken.

Figure 36—Lyman Meadows (east), Baker County, OR.
This long, narrow stringer meadow is about 20 kilometers southwest of Unity, OR, and about 2.5 kilometers due south of the Blue Mountain summit on State highway 26 (and 1 kilometer east of the Baker County-Grant County line). The watershed divide between Burnt River (east) and the John Day main stem (west) became the early division between cattle range (east) and sheep range (west) in 1906.

Photo by W.L. Dutton

Figure 36a—1924. Some standing dead lodgepole pine surrounding the meadow appear to have been killed by bark beetle. The meadow vegetation seems to be robust and not yet over used. Trailing in heavy grass to left indicates cattle have just been turned into this part of Lyman Meadow. One stand of willow trees appears to the right of the boulder in center of photo.

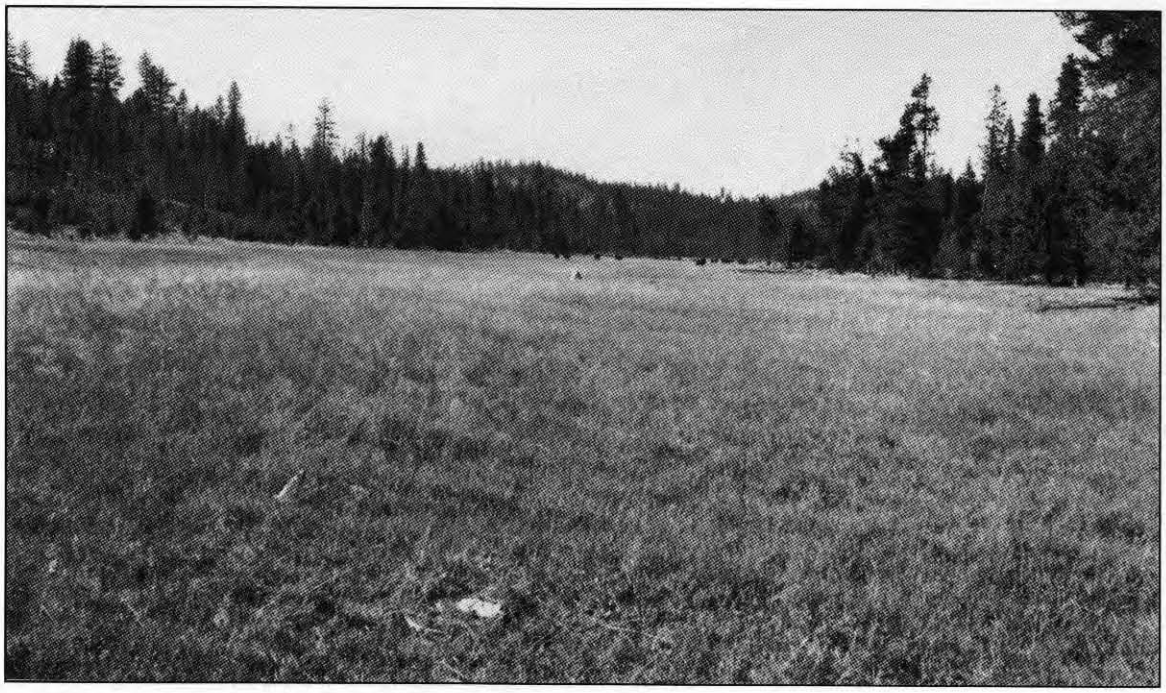

Figure 36b—1992. All vestiges of shrubs have disappeared. The meadow forage, however, contains highly desirable species, such as tufted hairgrass. The skunk cabbage has disappeared. The timber on the forested hill at the far end of the meadow has been cut with a shelterwood treatment in the past several years. To the left, several hectares of lodgepole pine were salvaged about a decade previously.

Figure 37—Lyman Meadows (west), Baker County, OR.
This photo point is 1 kilometer up the meadow looking east toward figure 36. This upper end of Lyman Meadows is a rather dry site compared to the preceding photo, which is a wet meadow at the head of open water in the middle fork of Burnt River. Fencing once separated use of these meadows from that of the upland forested range.

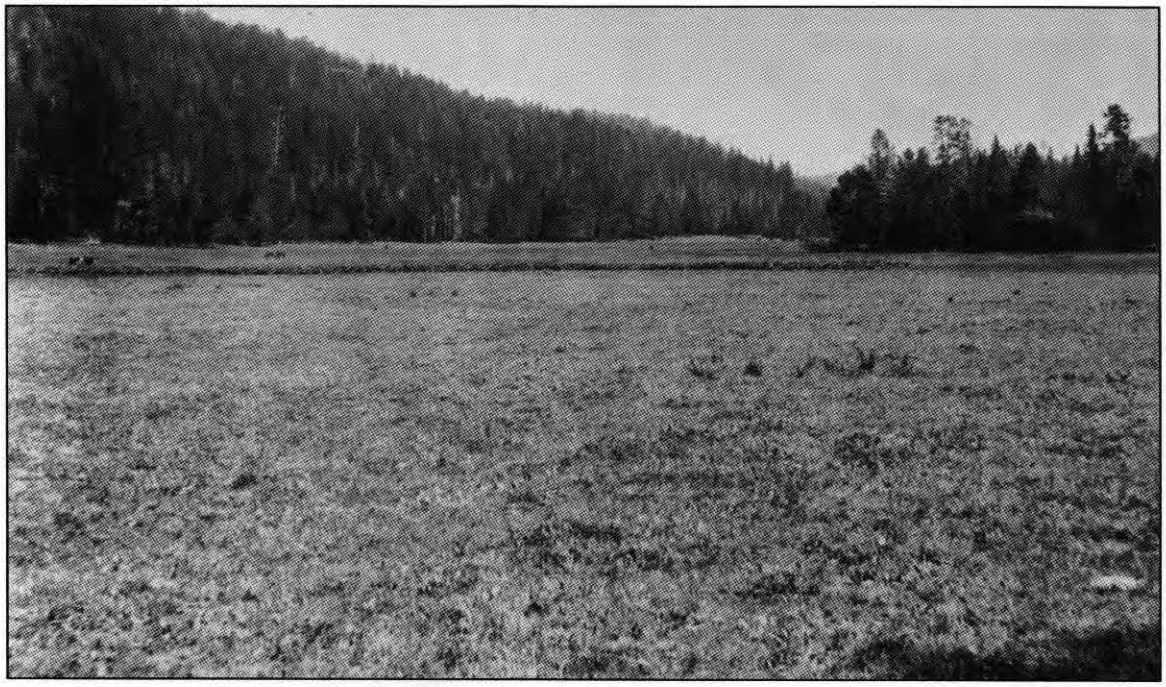

Photo by W.L. Dutton

Figure 37a—1924. The meadow vegetation in the foreground shows a weedy composition. The line across the meadow in front of the two cows (left center) is skunk cabbage. More lodgepole pine snags are visible from this end than from the east photo point (fig. 36).

Figure 37b—1992. This end of the meadow has been degraded by logging slash left where it is slow to rot. It also has been abused by loafing cattle left unattended throughout the grazing season. The fences are down and no longer control grazing use by forage type or protect the riparian habitat. There is perhaps more perennial grass and fewer weeds now, but the cover is more patchy and broken. Current grazing use is heavier.

Figure 38—Olmstead Meadows, Grant County, OR.
One and one-half kilometers west of Lyman Meadows and across the stock division line, this meadow drains into the Middle Fork of the John Day River above Bates, OR. This was traditional sheep range, but the photo description said this meadow suffered badly from trespass cattle and horses. No sheep graze on the Malheur National Forest today.

Photo by W.L. Dutton

Figure 38a—1924. Very little forage remains, and gopher mounds and cattle and horse dung can be seen for great distances. Cover for watershed protection is sparse, and bare areas account for much of the soil surface.

Figure 38b—1992. A remarkable recovery has been made through trespass control and range management. Although only in fair to good ecological condition today, the site has 100-percent vegetative cover and the marks of continuing improvement.

Figure 39—Bear Creek Guard Station, Wallowa County, OR.
This early outpost has been and continues to be a center for forest activities at the west end of the Wallowa Mountains. It is 18 kilometers south of the town of Wallowa, which at one time was headquarters of the Wallowa National Forest.

Figure 39a—1911. This group, under the direction of W.O. Dayton, Chief Forest Service botanist from the Washington office, was inspecting A.W. Sampson's research activities at the Standley Sheep Allotment. The valley bottom had been ravaged by fire, probably in 1889, and is shown in early seral stages of recovery. In the foreground are new seedings of smooth brome grass and timothy. The tall weed is western coneflower. Behind the cabin is pole-sized regeneration of Engelmann spruce and grand fir. (Photographer unknown)

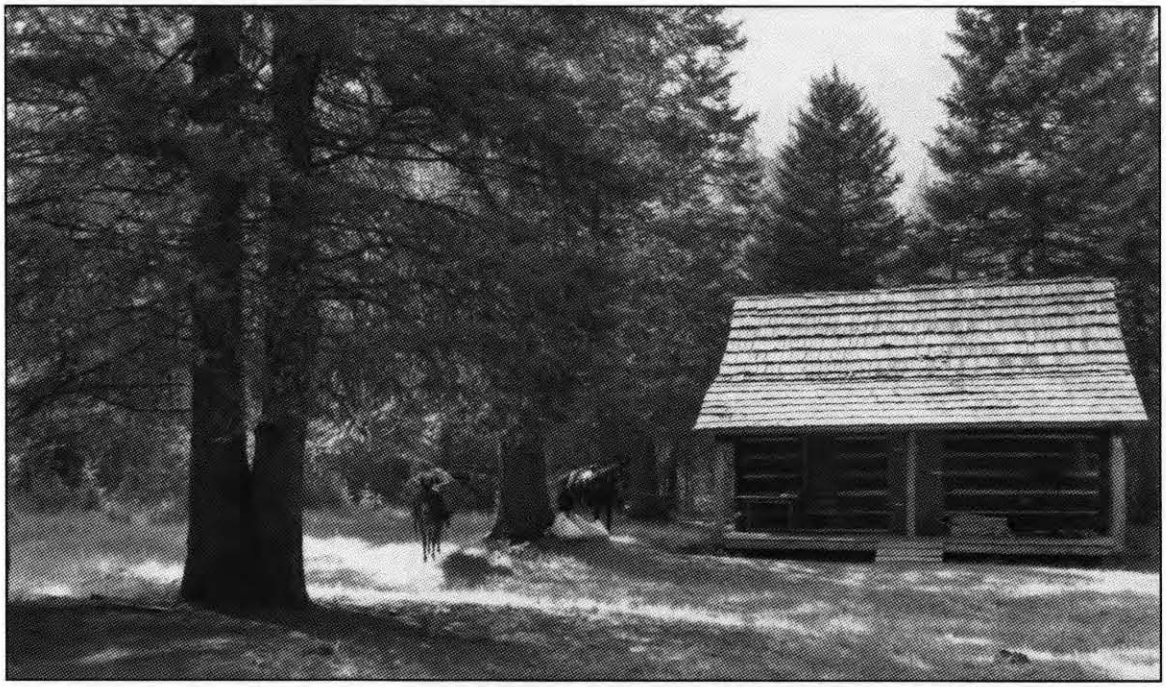

Figure 39b—1992. Overstory trees are Engelmann spruce and grand fir with an occasional Douglas-fir and lodgepole pine. The grand fir to the left of the cabin porch is in excess of 1 meter in diameter at breast height (d.b.h.), which indicates a growth rate of about 6 millimeters per year (about four annual rings per inch). The 10-hectare horse pasture around the cabin is nearly devoid of forage due to tree crown closure.

Throughout this series of photos, improvement in the ecological status of meadows was apparent. Several mountain meadows had lost weedy and noxious species such as skunk cabbage and western coneflower, while at the same time gaining in climax grass and grasslike composition.

In forage resource value for wild or domestic ungulates, Blue Mountain meadows have improved markedly from conditions early in the 20th century (Pickford and Reid 1942a). But, the aquatic habitat and much of the streamside riparian habitat are in unacceptable condition for salmonid production. Along wet meadows and stream banks, many of the woody species important to wildlife and fish have been eliminated through reading, drainage, logging, clearing, or grazing.

Roads and railroads in mountain meadows and along their edges tend to disrupt drainage patterns and to dry out natural wetlands. Longley Meadows (fig. 34) shows a succession of these changes. The woody shrub component that shades waterways often suffers when construction is in meadow bottoms, such as along the upper Grande Ronde River (fig. *32}.*

Perhaps the most contentious rangeland problem in the Blue Mountains centers on controlling ungulate grazing to improve the streamside habitat and thus restore the aquatic conditions. Mountain meadows respond quickly to grazing management systems but are slow to recover from season-long grazing (Bohn and Buckhouse 1985).

Several photos, such as Lyman Meadows (fig 36), show reductions in woody shrub vegetation as a result of grazing by ungulates, probably cattle Other photos show woody coniferous vegetation encroaching into new locations, such as Rock Creek Meadows (fig. 33) and Bear Creek Guard Station (fig. 39) If this conifer invasion is permitted to continue in mountain meadows, their recreational appeal and usefulness for ungulate grazing are diminished. •

Subalpine grasslands

This landscape is characterized by stringers of subalpine fir and patches of whitebark pine interspersed throughout rather expansive open grasslands. Under pristine conditions and perhaps until as late as 1870, nearly solid stands of green fescue grass prevailed over this high country.

Later, thousands of cattle and hundreds of thousands of sheep grazed the restricted subalpine ecosystem heavily for over 50 years. For example, in about 1910 Leonard Johnson of Wallowa County ranged 200,000 head of sheep, most of which were trailed to high.mountain pastures (Wentworth 1948) Jay Dobbin operated 21 bands (1,000 sheep to a band) at the west end of the Wallowa Mountains, and Pete Beaudoin had 29 at the east end. Besides these large operators, there were hundreds of small operators.

Sheepgrowers were known as woolgrowers because, at that time, there was a ready market for wool. Almost all progeny were retained as there was little demand for lamb as meat. Regulation and grazing fees in 1906 eliminated heavy transient herds and cut grazing pressure by half. That first year, only 250,000 head of sheep were permitted on the Wallowa National Forest (see footnote 9). Subsequent reductions have eliminated nearly all flocks from these landscapes

Heavy stocking resulted in the removal of large amounts of herbage cover and eventually loss of soil.'" With heavy grazing came a degraded weed stage of bare soil, erosion pavement, and pioneer species like pokeweed fleeceflower, western coneflower, western yarrow, penstemon, and sometimes mountain big sagebrush. This later gave way to a mixed grass-weed stage. Here subalpine needlegrass and bottlebrush squirreltail along with weeds like tailcup lupine and gland cinquefoil predominated for. an extended period. Grasslike plants such as Hood sedge and Parry rush may also occur. Under light ungulate grazing, subalpine ranges can eventually be restored to mainly green fescue and a few sedges (Reid 1941).

Subalpine grasslands probably suffered greater depletion than any other rangeland type. One reason was the great demand for green feed relative to supply. These high-elevation ranges are at their best for grazing when other lower ranges are seasonally exhausted of nutrients or available forage.

The subalpine ecosystem has only about 90 days of adequate growing season. The winter snowpack remains late into springtime, and killing frosts arrive in early autumn. Soil moisture, however, remains ample to maintain green succulent plants into late summer, and this is highly sought by domestic livestock and wild ungulates alike.

Bark beetle infestations were widespread at high elevations with serious damage occurring to whitebark pine between 1910 and 1920 and between 1975 and 1985.

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[10] Pickford and Reid (1942a) found that 1180 metric tons per hectare was the average loss of soil from subalpine grasslands on the Tenderfoot Sheep Allotment study area of the Wallowa Mountains

Figure 40—North Fork Imnaha Panorama, Wallowa County, OR.
In the eastern Wallowa Mountains 14 kilometers south of Wallowa Lake, this view of Tenderfoot Basin is seen from the old wagon road to the bogus Tenderfoot Mine. This area has one of the few remaining actively grazed sheep allotments in the Eagle Cap Wilderness Area. In the past 30 years, this region above the main forks of the Imnaha has become exceptionally well-stocked elk summer range. Deer that were abundant here in the early 1950s have dwindled to a low but stable population.

Photo by J.L. Peterson

Figure 40a—1915. A recent fire has swept up the canyon wall on the opposite side of the North Fork (lower right). Likewise, the forest across the Middle Fork (left midground) has been burned off except for several 10- to 20-hectare patches.

Figure 40b—1992. The restocking of timber and regeneration of the burned-over areas is striking. The large burn to the lower left of the high point across the middle fork, known as Bonner Flat, has been completely reforested.

Photo by J.L. Peterson

Figure 40c—1915. Perhaps the most striking feature is the evidence of old fires in the head of Tenderfoot Basin (extreme right) and the more recent one across the river (lower left).

Figure 40d—1992. Apart from the density of timber, the main change after over 75 years is the restocking of trees in the two burned areas. The remnants of whitebark pine snags in the right foreground, probably beetle killed, still remain. A slight increase in mountain big sagebrush in the foreground also is evident.

Figure 41—Standley Sheep Allotment, Wallowa County, OR.
Standley Ridge, 21 kilometers south of Wallowa, OR, was included in the enlargement of the Eagle Cap Wilderness Area in 1984. Jake Sturgill's sheep began grazing this open range around 1885, and Jay Dobbin bought him out in about 1895. Studies of range restoration were begun here by A.W. Sampson in 1907 (Sampson 1908). This flat was fenced in about 1940 and used as an administrative horse pasture receiving only moderate intermittent grazing thereafter. Sheep use was sporadic through the 1970s, and there was none in the 1980s. Today, for 6 to 8 months of the year, the area supports a large resident elk herd of the Minam unit.

Photo by A.W. Sampson

Figure 41a—1908. Sheep on the Standley Allotment graze a depleted range during mid-August. The snags of subalpine fir (left horizon) show evidence of fire.

Figure 41b—1992. This photo was taken from the exact position of the 1908 photo. Subalpine fir, whitebark pine, and some Engelmann spruce have encroached on the grassland. Old whitebark pine snags nearby show considerable scorching. New regeneration of subalpine fir is profuse; 42 seedlings, less than 15 years old, are in view.

Figure 41c—1992. This photo was taken about 100 meters forward of the 1908 picture to avoid the stand of trees that has grown up since the early picture. The foreground is in a grass-weed transition from the former weed stage. There is an abundance of rushes; some oatgrass, subalpine needlegrass, and squirreltail; and many showy forbs. There are a few seedlings of green fescue.

Figure 42—Standley Lookout Trail, Wallowa County, OR.
This sequence of photos is taken about 125 meters from Standley Springs in perhaps one of the most heavily grazed areas in the Wallowas. Reductions in number, season of use, and economic conditions brought domestic livestock use to an absolute halt in the mid-1970s. Today, many elk graze this summer range.

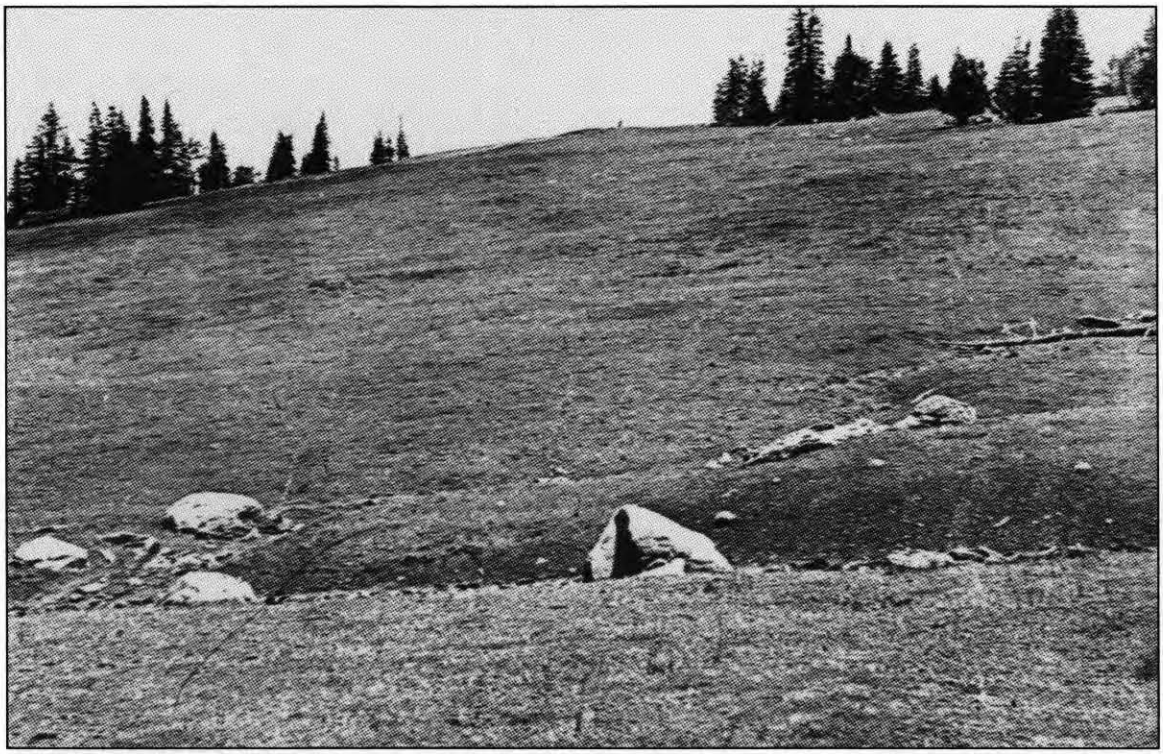


Photo by A.W. Sampson

Figure 42a—1908. A few scattered weeds and some grassy sod can be seen far up the slope. The foreground and midground are bare soil.

Photo by G.S. Strickler

Figure 42b—1955. Pioneer weeds have become established in the foreground, and the boulders and rocks seem to have subsided. Penstemon, coneflower, and skunk cabbage are common, and sedges and pioneer grasses like Columbia needlegrass are not uncommon.

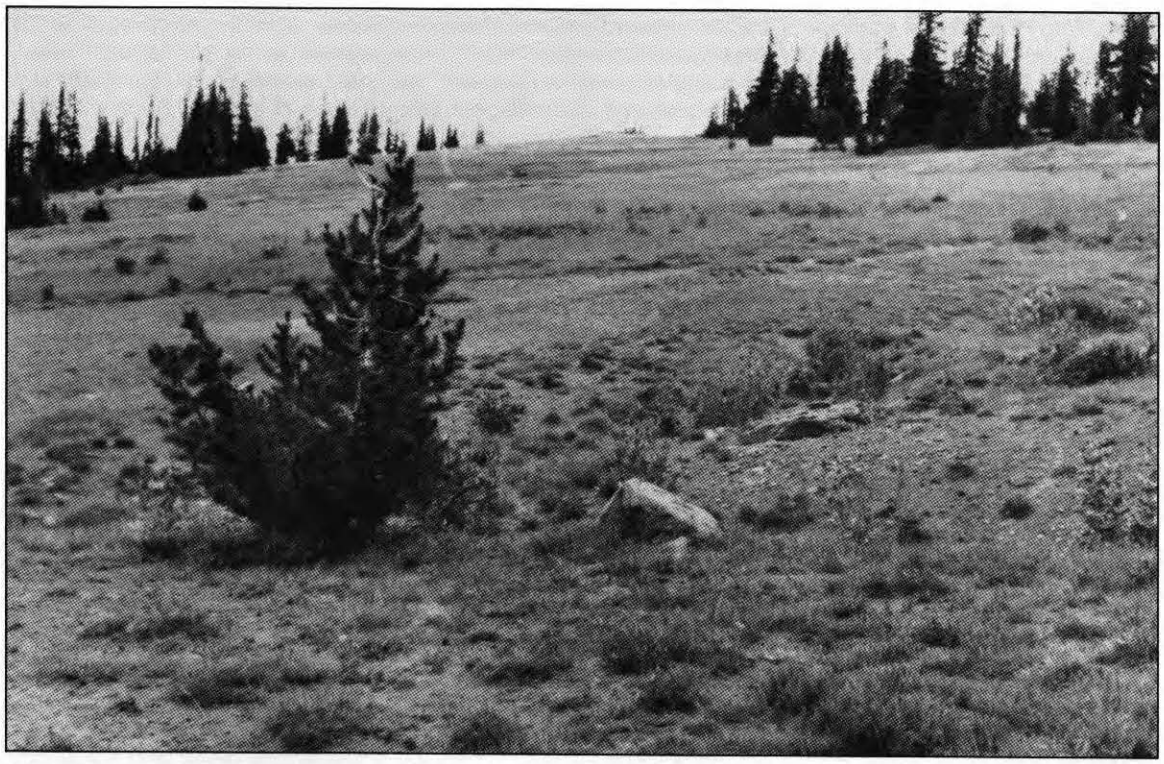


Figure 42b—1973. Penstemons and lupines have been replaced by perennial grasses, and the scar along the trail is healing. The trail leads down to a bare area, which has not revegetated at all.

Figure 42c—1992. A good cover has become established and young plants of green fescue have reappeared. Young trees have invaded the site, and the whitebark pine seedling to the left of the boulder in 1955 has now been replaced with a subalpine fir sapling. Eleven fir seedlings and a whitebark pine sapling have become established since 1973 in the gully behind the rock. A whole grove of fir trees has advanced upslope since 1955.

Figure 43—Bennett Peak, Baker County, OR.
Bennett Peak is on the south side of the Wallowa Mountains, 45 kilometers northeast of Baker City, OR. It is 3 kilometers east of Two Color Guard Station on Main Eagle Creek and about 4 kilometers south of the Eagle Cap Wilderness Area boundary. It was a fire lookout throughout most of the first half of the 20th century.

In the mid-1870s, W.H. Colton was one of the first operators to run sheep in this area, and his grandson, C.M. Colton, was one of the last. Soon after the Forest Reserves were created, the division between sheep (north) and cattle (south) started from near Two Color Guard Station, proceeded east over Bennett Peak past Mammoth Springs, and down Gold King Ridge into East Eagle Creek. Trespass was common along these breaks, and grazing pressure was heavy until about the middle of the 20th century. Neither sheep nor cattle has grazed this area for about 25 years.

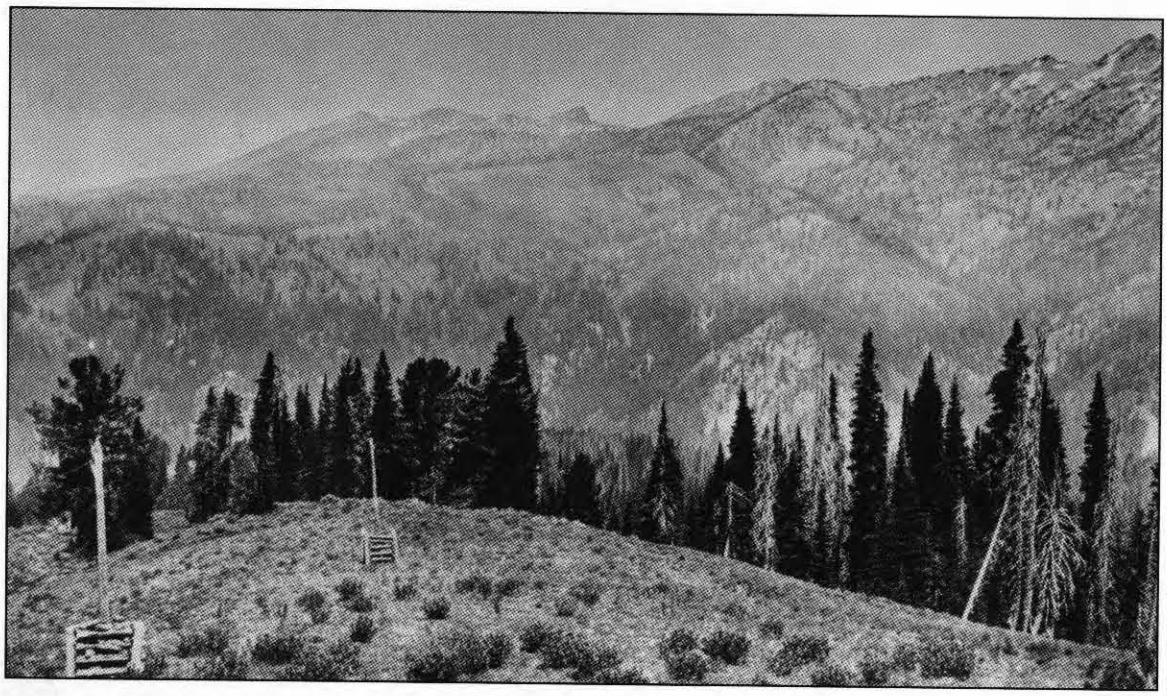


Photo by J.L. Peterson

Figure 43a—1914. This photo, which looks west over West Eagle Meadows (background), shows a generally scattered growth of timber across Eagle Creek on the distant slope. Vast quantities of dead standing subalpine fir snags appear to be selected victims of insects rather than killed by fire. Pokeweed fleeceflower is abundant in the foreground. The telephone line was to the fire lookout.

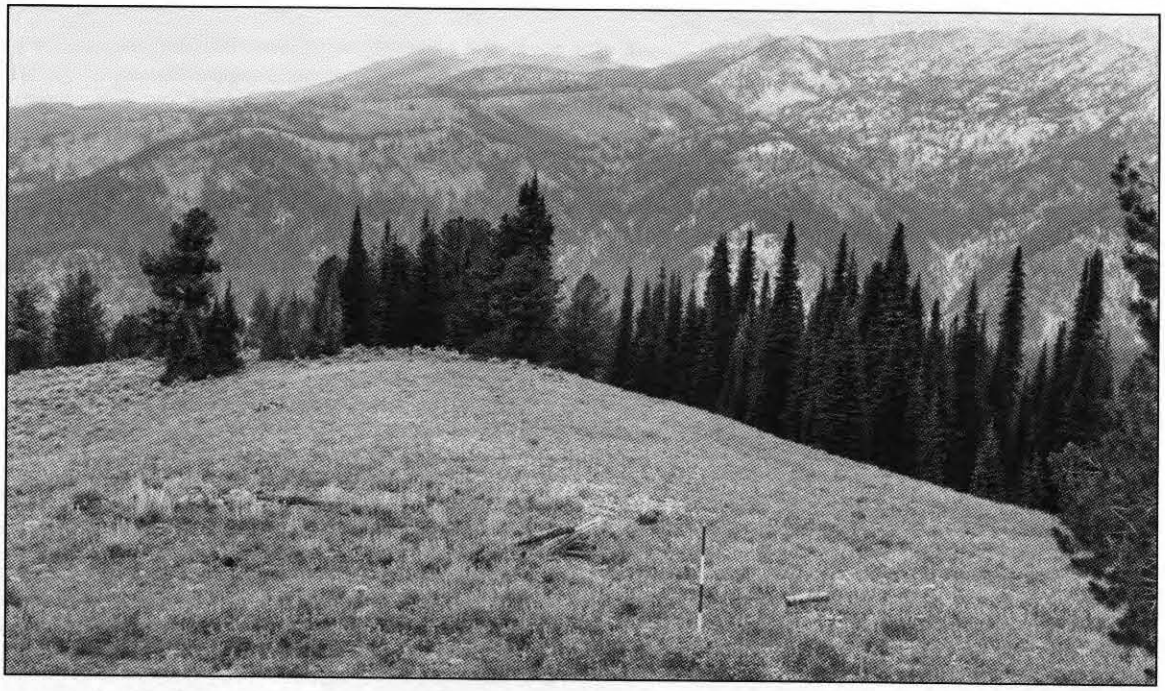


Figure 43b—1967. Perhaps the most striking feature 53 years later is the complete disappearance of pokeweed fleeceflower. This species readily invades depleted high-elevation sheep range. In its place are tailcup lupine and a species of penstemon. The mountain big sagebrush community in the left midground seems to have remained stable over the years, but young sagebrush plants are now established in the foreground. Ground cover has increased and consists mainly of green fescue, bottlebrush squirreltail, and Columbia needlegrass, which seems to have increased despite some continued sheep use.

Figure 43c—1992. Mountain big sagebrush has become well established. The forest edge seems to be static probably because of limited soil moisture on this rocky knob. A small 10-hectare shelterwood cut is visible across Eagle Creek to the left of the flat-topped whitebark pine tree.

Figure 44—Mammoth Springs, Baker County, OR.
Mammoth Springs is at the headwaters of O'Brien Creek east along the ridge trail from Bennett Peak to East Eagle Creek. This area was closed to grazing for several years after about 1914. Management and judicious use has allowed this former sheep bedding ground to improve remarkably. Very light sheep grazing was permitted for several decades, then grazing was discontinued in the 1970s. Elk summer use of this and the flats near Two Color Lake has been on a steady increase since the middle of the 20th century.

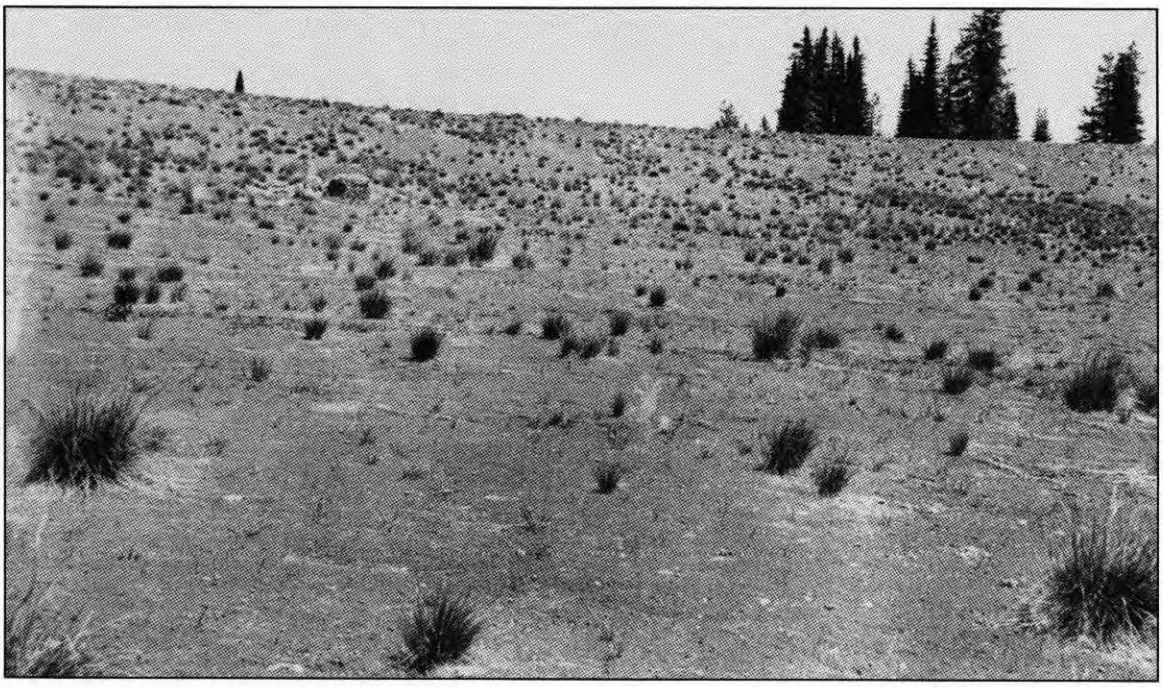


Photo by J.L. Peterson

Figure 44a—1917. Some seedling establishment can be seen between grass clumps. Bare soil makes up over 95 percent of the cover in the foreground.

Figure 44b—1967. The only plants common in 1917, Columbia needlegrass, bottlebrush squirreltail, and pokeweed fleeceflower, have been replaced by green fescue, subalpine needlegrass, and several sedges. Tailcup lupine and lesser forbs, such as penstemons and hawkweed, are now commonplace. Herder Dewey Mullins points to where the sheep will bed for the night.

Figure 44c—1992. Although cover has not improved, the composition shows an increase in green fescue and a slight reduction in lupine. The community is now beyond the grass-weed transition stage and can be considered in fair ecological condition.

Figure 45—Lakes Lookout, Baker County, OR.
This divide is about 1 kilometer due west of Anthony Lake. The photo was taken looking west toward the Trail Creek photo point (fig. 24), which is 10 kilometers distant over Black Butte, the low rocky hill seen in the left background. Quite probably this low knob in the middle ground was a sheep camp and bedding ground each summer between about 1880 and 1930, after which grazing was closed. New management features are two roads and erosion stabilization trenching.

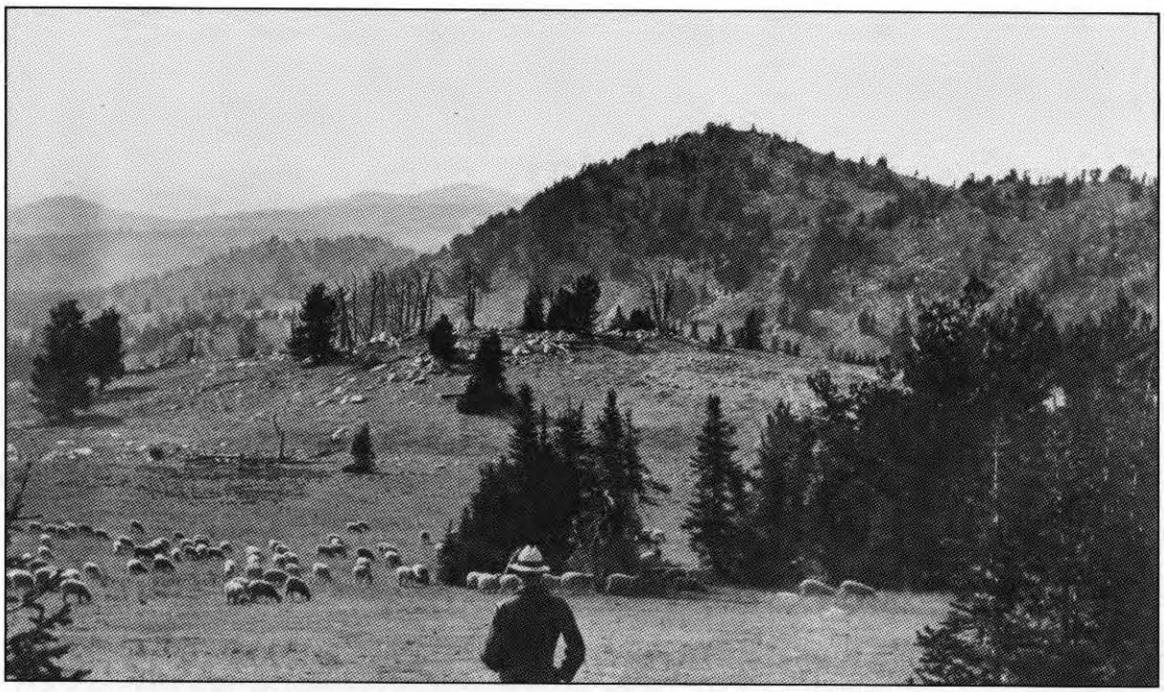


Photo by D.C. Ingram

Figure 45a—1922. Snags of whitebark pine on the low knob beyond the sheep were probably killed by mountain pine beetles during the 1910-11 outbreak. Some of these snags can still be seen in the 1992 photo.

Figure 45b—1974. Perhaps the most striking change is the increase in tree cover on the distant ridges. A line of saplings has become established at the foot slope beyond where the sheep were in the 1922 photo. There is a continuous rim or reef of exposed white rock (granodiorite) that appeared only as a cluster of large separate boulders in 1922. This is an indication of a tremendous loss of soil from the site and the reason for the grazing closure. Signs of elk and deer are plentiful, and grazing on forbs and elk sedge is light.

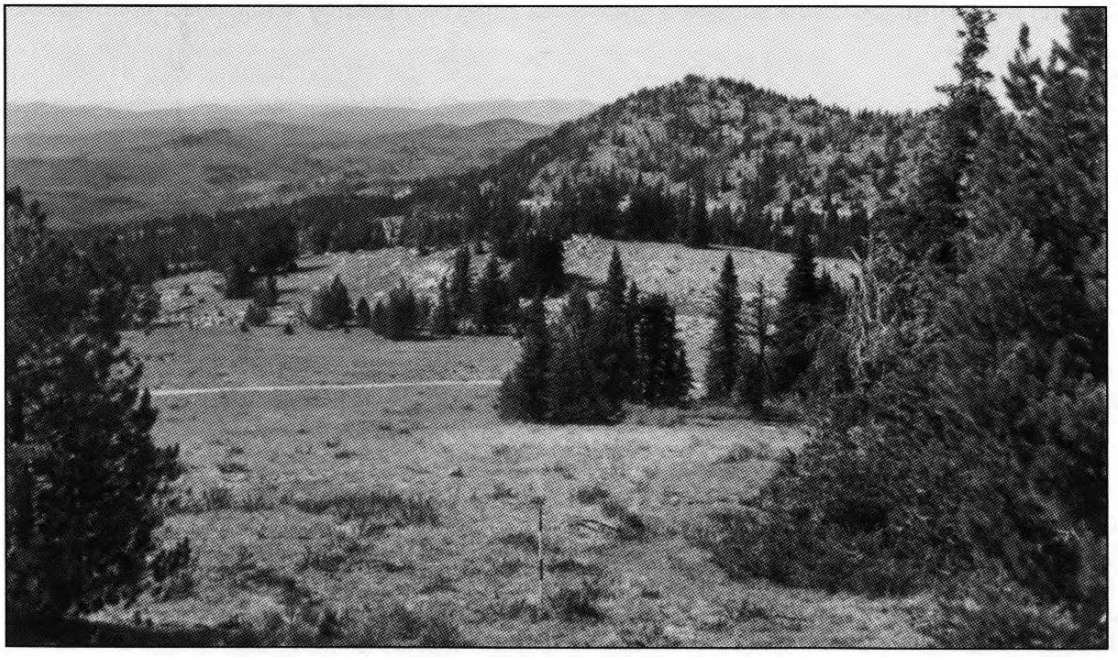


Figure 45c—1992 There are thousands of acres of dead, standing trees (mostly lodgepole) encircling Black Butte due to the Clear fire, 1986 The significant die-off of whitebark pine on the butte (right center) was caused by bark beetle damage, possibly an extension of the same mid-1970s western and mountain pine beetle outbreak that affected Black Butte (fig 24c) Grassland cover has increased, and the weedy pokeweed fleeceflower (foreground) has diminished slightly Signs of elk and deer are again plentiful Grazing on abundant forbs and elk sedge has increased from light in 1974 to moderate use in 1992.

A vivid recovery in plant density has occurred on nearly all the Blue Mountain subalpine ecosystem. Grassland recovery came about mostly through a massive reduction in sheep numbers; however, improved range management also contributed. An appalling loss in topsoil resulted from the early abuse as evidenced by the Lakes Lookout photos (fig. 45). Some badly degraded areas like the Standley Trail area (fig. 42c) have not gained cover in over 80 years. Despite heavy soil losses, these ranges began showing considerable improvement by the mid-1900s (Reid and others 1980, Strickler 1961).

Subalpine ranges were at one time, perhaps in the late 1930s, in poor to very poor condition and since have improved at least one full condition class. Improvement has restored much of the former plant diversity and stabilized erosion through increased plant cover. Most of the depleted areas have progressed from pioneer weeds to reestablishment of green fescue. Where woody mountain big sagebrush was present, however, it has expanded coverage.

The forest has been quick to regenerate after fire such as on the Imnaha North Fork (fig. 40b). Encroachment of subalpine fir into these natural grasslands is apparent under some conditions, such as the Standley Allotment (fig. 41 b) where historically fire, in the absence of abusive grazing, probably reduced tree invasion. •

Summary

one of the most noticeable long-term trends in Blue Mountain ecosystems, and one transcending all landscapes, has been a gradual but wholesale shift from herbaceous communities to communities of woody shrubs and trees. This has taken place across all zones, from the arid grassland steppe being invaded by big sagebrush and western juniper to the subalpine grasslands being colonized by subalpine fir and whitebark pine.

CHANGES IN NONFORESTED LANDSCAPES

In many ways, change in the nonforested landscapes is more striking than in the forested landscapes, especially in the drier zones. Much of what is today a shrub steppe-juniper woodland was grassland steppe before settlement. The Sheep Creek series (fig. 5) in Grant County provides a classic example of this wholesale ecological conversion from a herbaceous to a woody community. These conversions that began 100 years ago resulted from heavy, often year-long grazing accompanied by the elimination of wildfire.

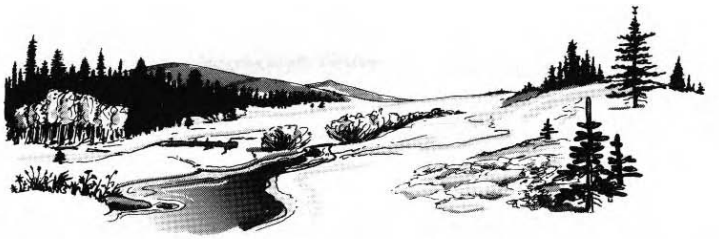
Encroachment of sagebrush, rabbitbrush, and juniper also is evident in western Malheur County in the Little Malheur River Panorama (fig. 2) and the Ironside Mountain series (fig. 3). Here soils and aspect are different from those of Sheep Creek, but the outcome and prospects are identical. All these comparisons show encroachment of sagebrush and western juniper along with a decrease in bunchgrass and an increase in cheatgrass and weeds. The latter indicates a loss in ecological stability, watershed, and ungulate grazing values.

Canyonlands and associated foothills have not been altered greatly in terms of hydrological or ungulate grazing values. On a case-by-case basis, some sites like Branson Creek (fig. 11) have deteriorated slightly, whereas Chico Trail (fig. 10) is static and Cemetery Ridge (fig. 8) improved somewhat.

Except for a few private holdings, canyonlands are in fair condition ecologically and appear stable in terms of erosion hazard and ungulate forage output. There are, however, symptoms of instability from recurring invasions of alien plants and rodent outbreaks. Canyonlands provide excellent winter habitat for wild ungulates.

Valley grasslands and associated foothills have improved in general and are stable. Surrounding foothills are only in poor to fair condition but are trending upward in ungulate forage values and watershed stability. Foothills have produced a low but sustained output of forest and range resources. Nonforested landscapes have been converted from range grazing to more intensive land use in several instances. McKay Creek canyonland (fig. 12), Unity Valley lowlands (fig. 13), and Longley Meadows (fig. 34) were converted from deteriorated grazing land to productive pasture. In one case, however, a former hayfield along Branson Creek (fig. 11) reverted to pasture.

CHANGES IN FORESTED LANDSCAPES



The most obvious trend in the forest landscapes has been toward an increase in density of coniferous stems. This began nearly a century ago when destructive grazing broke up the protective soil cover and in the process prepared a bed for tree seedling establishment and survival. Heavy grazing also reduced the dry grass that provided fine fuels for fires that once eliminated the undergrowth. This was best evinced by the afforestation of Fly Ridge (fig. 22) and the Standley Sheep Allotment (fig. 41). This process later was intensified by fire suppression efforts beginning early in the 20th century.

Along with the increase in competing stems there was a rapid increase in crown closure of the conifer cover types. This change reduced light received on the forest floor, thus favoring shade-tolerant fir and inhibiting the regeneration of intolerant pine, best shown in the McGraw Springs photos (fig. 25). Crown closure also reduced herbaceous cover that fueled cooler burning fires, which once killed the thin-barked fir seedlings. It also increased the risk from crown fires due to lateral spread of canopy fuels.

Timber harvest practices based on removal of all maturp trees were most apparent in the forest profiles of the Bear Wallow (fig. 31) and Upper Grande Ronde River (fig 32) photo series. Old-growth trees are missing from all the forested photos except for pockets on the steep slope of Lookinglass Creek (fig. 19) and Sluice Creek (fig. 9). Logging by crawler tractor replaced horse logging in the 1940s, thereby causing additional ground cover disturbance, which contributed to the growing problem of overstocked timber stands.

The combination of timber harvest selection for prime species (ponderosa pine and western larch) together with overgrazing and fire suppression led to stand conversion on many sites. The Pelican Creek overview (fig. 21) presents a good example of stand conversion in the mountain forested zone.

Following these early phases of forest management came the era of clearcutting with its associated shelterwood and seed tree entries. Between 1982 and 1992, this form of silviculture became increasingly common across the forest landscapes monitored in this report. In 1982, only one photo sequence showed these activities; in 1992, there were six.

Destructive insect damage became evident in the photo series in the mid-1970s, and by 1982 three photo points showed salvage operations had been underway. Three more were completed by 1992. These operations were mostly clearcuts and mainly in lodgepole pine. Another change shown by several photo series was the reduction in large snags. Twenty-five years (1950 to 1975) of fire control policies and timber management practices called for the elimination of snags.

Mountain grasslands, though being encroached by forest regeneration such as on Fly Ridge (fig. 22), are in fair condition and are stable in hydrological terms. Stock concentration areas and old driveways like Bear Wallow (figs. 30 and 31) have not rebuilt their soil A-horizons and may remain scab flats for decades with only tarweed for cover. Most cultural practices, such as reseeding or fertilization, have been failures.

Mountain meadows generally have improved in species composition bufsome drier meadows, such as West Lyman Meadows (fig. 37), have not improved in over 75 years. Riparian habitats are not improving on mountain meadows. In fact, they have been degraded in areas such-as the Upper Grande Ronde River (fig. 32) and in all other locations depicting original wetland characteristics.

Subalpine ecosystems have improved in watershed and forage production capabilities without exception; however, a loss of grassland to forest encroachment has occurred. Losses of grassland or meadow in areas dedicated to recreation eventually will diminish the aesthetic value of these landscapes Forage for recreational livestock is also at risk.

The striking disturbance between 1982 and 1992, however, was the vast acreage of forest devastated by wildfire. Evidence of six fires showed in the 1992 photos and they averaged nearly 10 000 hectares each. These resulted from drought conditions, insect damage, fuel buildup, and ladder fuels enabling crown fires to start.

If there is one single trend that stands out in all these long-term photo comparisons, it is that of an everchanging landscape. Various stages of succession have moved across the landscapes transforming plant composition, density, and structure. These modifications were in response to disturbances causing a change in secondary succession.

Presettlement ecosystems had a unique set of landscape patterns and successional processes based on natural disturbances. Postsettlement ecosystems have, during the 20th century, been subjected to human-dominated disturbances. More recently, modern-day management practices have been overlayed on these disturbances, thereby creating a complicated mosaic of landscape patches in fragmented stages of succession.

Some of the ecosystem trends are viewed as improvements overtime; others are considered degradations. We based our interpretation of these trends on resource conditions as they related to ecological stability and not to economic commodity outputs. Others who study the pictures may reach different conclusions based on their knowledge, experience, or inclination.

This document is an illustrated guide to landscape ecology of Blue Mountain ecosystems. It is a visual aid in understanding how the ecosystems have changed and are changing. It provides a record of how natural and human forces have given particular landscapes their character. A record such as this can be a model component of the monitoring used to assess the effectiveness of strategies implemented to restore productive, healthy ecosystems for the 21 st century. •

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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^2)	0.39 square mile
1 square kilometer (km^2)	247.1 acre
1 hectare (ha)	2.47 acre
1 liter (l)	1.06 quart (liquid)
1 ton (metric)	1.10 ton (English)
1 kilogram (kg)	2.20 pounds
1 ton (metric)/hectare	0.45 ton (English/acre

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Appendix I—Common and Scientific Names of Species

Plants'

Trees—

Alder	*AInus* spp.
Cottonwood, black	*Populus tnchocarpa* Torr. & Gray
Douglas-fir (interior)	*Pseudotsuga menziesii* var. *glauca* (Beissn.) Franco
Engelmann spruce	*Picea engelmannii* Parry ex Engelm.
Grand fir	*Abies grandis* (Dougl.) Lindl.
Lodgepole pine	*Pinus contorta* Dougl. ex Loud.
Ponderosa pine	*Pinus ponderosa* Dougl. ex Loud.
Subalpine fir	Abies *lasiocarpa* (Hook.) Nutt.
Western juniper	*Juniperus occidentalis* Hook.
Western larch	*Larix occidentalis* Nutt.
Whitebark pine	*Pinus albicaulis* Engelm.

Shrubs-

Antelope bitterbrush	*Purshia tridentata* (Pursh) Oc.
Big sagebrush	*Artemisia tridentata* Nutt.
Common snowberry	*Symphoricarpos* a/bus (L.) Blake
Chokecherry	*Prunus virginiana* L.
Hawthorn, black	*Crataegus douglasii* Lindl.
Huckleberry, big	*Vaccinium membranaceum* Dougl. ex Hock
Mountain big sagebrush	*Artemisia tridentata vaseyana* (Rydb.) Beetle
Mountain-mahogany	*Cercocarpus ledifolius* Nutt in T. G.
Lewis mockorange	*Philadelphus lewisil* Pursh
Ninebark	*Physocarpus malvaceus* (Greene) Kuntze
Rose	*Rosa* spp. L.
Rubber rabbitbrush	*Chrysothamnus nauseosus* (Pall) Brit.
Serviceberry	*Amelanchier ainifolia* Nutt.
Stiff sagebrush	*Artemisia rigida* (Nutt.) Gray
Sumac	*Rhus diversiloba* T. & G
Willow	*Salix* spp. L.

' Nomenclature for plants, forbs, shrubs, and trees follows Garrison and others (1976).

Grasses and grasslike—

Annual hairgrass	*Deschampsia danthonioides* (Trin.) Munro ex. Benth.
Bluebunch wheatgrass	*Agropyron spicatum* (Pursh) Scribn. & Sm.
Bottlebrush squirreltail	*Sitanion hystrix* (Nutt.) J.G. Sm.
California oatgrass	*Danthonia californica* Boland.
Cheatgrass brome	*Bromus tectorum* L.
Columbia needlegrass	*Stipa occidentalis* Thurb. ex Wats. var. *minor* (Vasey) C.L. Hitchc.
Crested wheatgrass	*Agropyron cristatum* (L.) Gaertn.
Giant wildrye	*Elymus cinereus* Scribn. & Merrill
Green fescue	*Festuca viriduta* Vasey
Idaho fescue	*Festuca idahoensis* Elm.
Kentucky bluegrass	Poa *pratensis* L.
Onespike danthonia	*Danthonia unispicata* (Thurb.) Munro ex Macoun
Prairie Junegrass	*Koeleria cristata Pers.*
Red threeawn	*Aristida longiseta* Merrill
Rattle brome	*Bromus brizaeformis* Fisch. & Mey.
Sand dropseed	*Sporobolus cryptandrus* (Torr) Gray
Sandberg bluegrass	*Poa sandbergii* Vasey
Smooth brome	*Bromis inermis* Leys.
Subalpine needlegrass	*Stipa columbiana* Macoun
Timothy	*Phelum pratense* L.
Tufted hairgrass	*Deschampsia caespitosa* (L.) Beauv.
Western needlegrass	S//pa *occidentalis* Thurb. ex Wats

Grasslike—

Elk sedge	*Carex geyeri* Boott
Hood sedge	*Carex hoodii* Boott
Nebraska sedge	*Carex nebraskensis* Dewey
Parry rush	*Juncus parryi* Engelm.
Rush	*Juncus* spp. L.
Sedge	*Carex* L.

Forbs—

Balsamroot, arrowleaf	*Balsamorhiza sagitatta* (Pursh) Nutt.
Barrel cactus	*Pediocactus simpsonii* (Engelm.) Britt. & Rose
Biscuitroot, American	*Potygonum bistortoides* Pursh
Browns peony	*Paeonia brownii* Dougl. ex Hook.
California falsehellebore	*Veratrum cal'ifornicum* Durand
Camas root	*Camassia quamash* (Pursh) Greene
Clover	Tnfo/iumspp L.
Common dandelion	*Taraxacum officinal* Weber
Douglas blue-eyed grass	*Sisyrinchium douglasiif^.* Dietr
Geranium	*Geranium* spp. L.
Gland cinquefoil	*Potentilta glandulosa* Lindl.
Groundsels	Senecfo spp. L.
Gumweed, low	*Grindelia nana* Nutt
Hawkweed	*Agoseris* spp. Rat.
Lupine	*Lupinus* spp. L.
Mules ears wyethia	*Wyethia amplexicaulis* Nutt.
Oregon checkermallow	*Sidalcea oregana* (Nutt.) Gray
Penstemon	*Penstemon* spp. Mitch.
Plains pricklypear	*Opuntia polycantha* Haw.
Pokeweed tieeceflower	*Polygonum phytolaccaefolium* Meisn. ex Small
Red besseya	Besseya *rubra* (Dougl.) Rydb.
Rush pussytoes	*Antennaria* /uzutoi'ctesT. & G.
Sulphur lupine	*Lupinus sulphureus* Dougl. ex Hook.
St. Johnswort (goat weed)	Hyper/cum *perforatum* L.
Tailcup lupine	*Lupinus caudatus* Kell.
Tarweed, cluster	*Madia glomerata* Hook
Thistle	*Cirsium* spp. Adans.
Western coneflower	*Rudbekia occidentalis* Nutt.
Western yarrow	*Achiliea millefolium* var. *lanulosa* Piper
Wyeth buckwheat	*Eriogonum heragieoides* Nutt.

Animals

Mammals[2]—

California bighorn sheep	*Ovis canadensis californiana* (Douglas)
Mice	*Mycrotus* spp.
Rocky Mountain elk	*Cervus elaphus* (Linnaeus)
Rocky Mountain mule deer	*Odocoileus hemionus* (Rafinesque)
The Dalles pocket gopher	*Thomomys* spp.
White-tailed deer	*Odocoileus virginianus ochrourus* (Bailey)

Insects[3]—

Clearwinged grasshopper	*Camnula pellucida* (Scudder)
Douglas-fir beetle	*Dendroctonus pseudotsugae* (Hopkins)
Douglas-fir tussock moth	Orgy/a *pseudotsugata* (McDunnough)
Goat weed beetle	*Chrysolina gemellata* (Rossi)
Mountain pine beetle	*Dendroctonus ponderosae* (Hopkins)
Western pine beetle	*Dendroctonus brevicomis* (Le Conte)
Western spruce budworm	*Chonstoneura occidentalis* (Freeman)

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[2] Nomenclature for animals follows Nowak and Paradiso (1983).

[3] Nomenclature for insects follows Furniss and Carolin (1977)

Appendix II—Photograph Descriptions

Place Name	Figure'	Page	Legal Description					County						Ownership			
			T	S	R	S	QTR	B	G	M	UN	UM	W	PVT	PUB	TRI	MIX
Bally Ridge	6	14	2S	37E	18	NW	NW				X				X		
Bear Creek Guard Station	39	72	2S	42E	2	SE	SW						X		X		
Bear Wallow	31	60-1	38	32E	26	SE	SW					X			X		
Bear Wallow Driveway	30	58-9	3S	32E	27	SE	SE					X			X		
Bennett Peak	43	82-3	6S	43E	13	SW	SE	X							X		
Billy Meadows	18	39	4N	46E	15	SW	SE						X		X		
Branson Creek	11	22-3	2S	47E	23	NW	SE						X	X			
Burnt River Valley	13	27	13S	37E	16	NE	SW	X							X		X
Cemetery Ridge	8	18-9	4N	48E	34	NW	NW						X		X		
Chico Trail	28	55	3N	45E	30	NE	SW						X		X		
Chico Trail Closeup	10	21	3N	44E	25	NE	SW						X		X		
Crane Prairie	17	36	16S	34E	24	SE	SW		X						X		X
Fly Ridge	29	56-7	5S	35E	15	NW	SE				X				X		
Fly Ridge Afforestation	22	44-5	5S	35E	15	SE	NW				X				X		
Fly Valley	16	34-5	5S	35E	20	SE	NW				X			X			X
Hidaway Prairie	15	32-3	5S	33E	18	NE	NW					X		X			
Homestead Ridge	7	17	1S	49E	12	SE	SE						X		X		
Ironside Holding Pasture	4	11	14S	38E	19	NW	NW			X				X			
Ironside Mountain	3	10	15S	37E	32	SW	SW			X					X		
Lakes Lookout	45	86-7	7S	36E	13	NW	SE	X							X		
Little Malheur River	2	8-9	16S	37E	6	NE	NW			X				X			
Longley Meadows	34	66-7	3S	36E	11	SW	SE				X			X			X
Lookinglass Creek	19	40-1	3N	38E	10	NE	NE				X				X		

' Abbreviations are defined as follows
TS, Township, R, Range, S, Section, QTR, Quarter Section,
B, Baker; G, Grant, M, Malheur; UN, Union, UM, Umatilla,
W, Wallowa, PVT, Private, PUB, Public, TRI, Tribal;
MIX, Mixed

Appendix II—Photograph Descriptions *(Continued)*

Place Name	Figure*	Page	Legal Description				County						Ownership			
			TS	R	S	QTR	B	G	M	UN	UM	W	PVT	PUB	TRI	MIX
Lyman Meadows (East)	36	69	12S	35E	13	NE SE	X							X		
Lyman Meadows (West)	37	70	12S	35E	13	SW NE	X							X		
Mammoth Springs	44	84-5	6S	43E	13	SE SE	X							X		
McGraw Springs	25	50	4S	48E	35	NE NE						X		X		
McKay Creek	12	24	1S	33E	4	SW SW					X				X	
Monument Ridge	26	53	1S	49E	17	NE NE						X		X		
Mormon Flat	27	54	2N	50E	30	NE NE						X		X		
Mosie Pasture	14	28-31	5S	32E	17	NW SE					X		X			
North Fork Imnaha	40	76-7	4S	45E	35	NW SW						X		X		
Olmstead Meadows	38	71	12S	35E	14	SW NE		X						X		
Pelican Creek	21	43	2S	37E	18	NW NW				X				X		
Richardson Hill	23	46-7	3S	36E	11	SW SE				X			X			X
Rock Creek Meadows	33	65	8S	37E	26	SE SE	X							X		
Rock Creek Bed Ground	35	68	8S	37E	26	SE SE	X							X		
Sheep Creek	5	12-3	12S	26E	10	SE NW		X					X			
Sluice Creek	9	20	1S	49E	36	NW SE						X		X		
Standley Lookout Trail	42	80-1	2S	42E	16	SW SE						X		X		
Standley Sheep Allotment	41	78-9	2S	42E	21	SE SW						X		X		
Target Springs	20	42	4S	46E	9	NW NE						X		X		
Trail Creek	24	48-9	7S	35E	11	NE SE		X						X		
Upper Grande Ronde River	32	64	5S	36E	31	SW NE				X				X		

[1] Abbreviations are defined as follows:
TS, Township, R, Range, S, Section, QTR, Quarter Section,
B, Baker, G, Grant, M, Malheur, UN, Union, UM, Umatilla,
W, Wallowa, PVT, Private, PUB, Public, TRI, Tribal,
MIX, Mixed

Skovlln, Jon M. and Thomas, Jack Ward. 1995. Interpreting long-term trends in Blue Mountain ecosystems from repeat photography Gen Tech. Rep. PNW-GTR-315 Portland, OR US Department of Agriculture, Forest Service, Pacific Northwest Research Station. 102 p

Photographs taken before 1925 were compared with photos taken as recently as 1992 to interpret changes within ecosystems in the Blue Mountains of Oregon For discussion purposes, 10 ecosystems were aggregated into seven broad landscape systems. Nearly all systems exhibited some degree of conversion from herbaceous to woody forms of vegetation. Nonforested ecosystems improved markedly except in the riparian-aquatic habitats Forested ecosystems were stressed from stand stagnation, conversion from pine to fir, serious insect infestations, and crown fires. This project shows how these ecosystems have changed since the advent of settlement by nonendemic people It was earned out to assist land managers and researchers to develop strategies to improve ecosystem stability and thereby provide for resource sustainability

Keywords' Blue Mountains, Oregon, photography (repeat), photo history, long-term change, landscape ecology, ecosystem stability.

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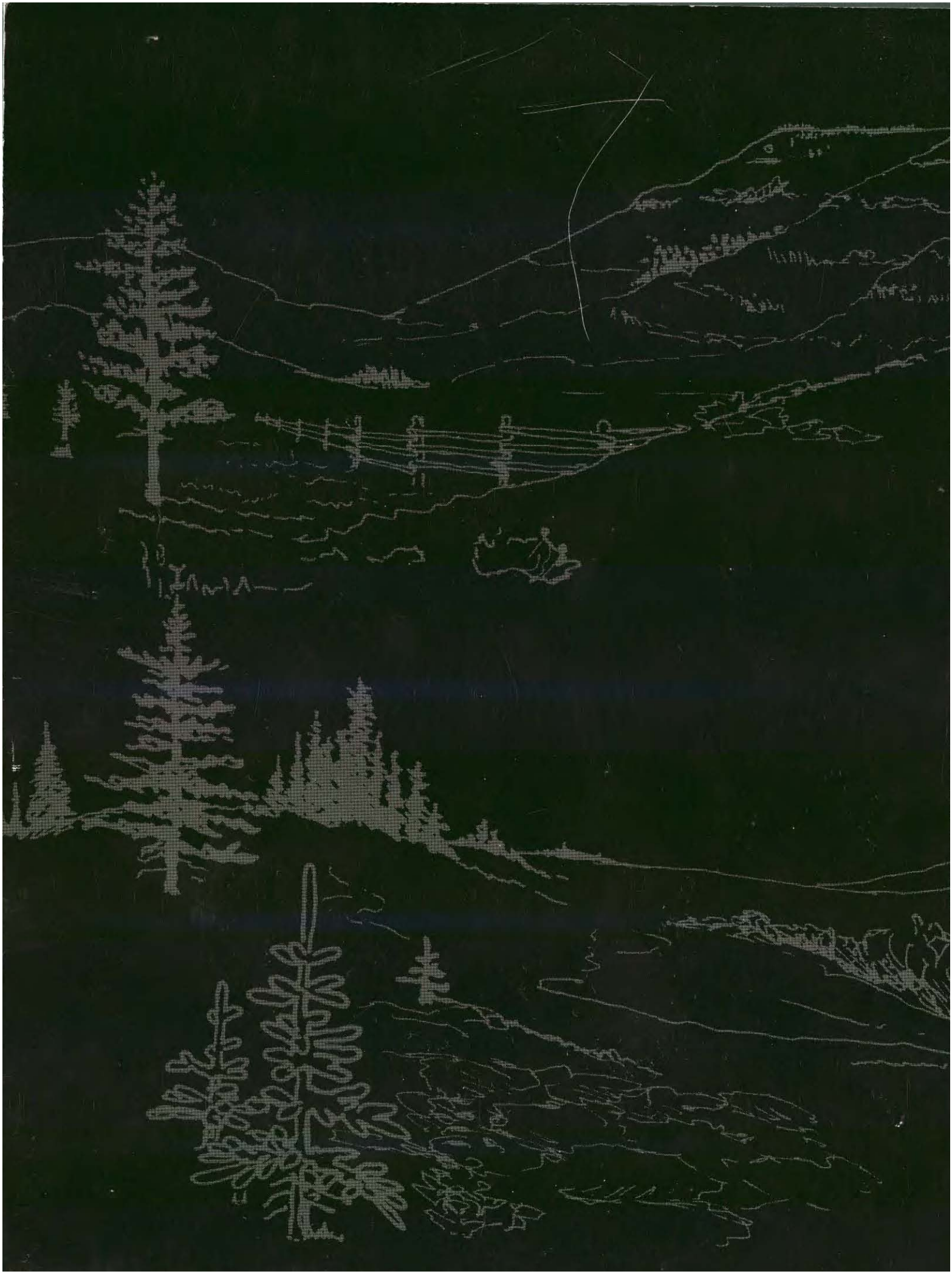
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