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by H. GRATKOWSKI

PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION
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R. W. Cowlin, Director Portland, Oregon

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INTRODUCTION

Scattered throughout the forest lands of southwestern Oregon are brushfields ranging in size from small patches a few acres in extent to large continuous areas of more than 10,000 acres. Evidence on many of the brushlands shows that some sites once supported excellent stands of timber. Such areas are potentially productive commercial forest lands if economical methods can be found to control the brush.

Brush species which occupy these areas are primarily woody plants varying in size from low bushes to small trees. Much of the shrubby vegetation is of the broad-sclerophyll type characterized by dense, stiff branches and thick, hard, evergreen leaves. In many areas, brush species form a chaparral which is almost impenetrable, not only to humans but to wildlife and livestock as well. Land occupied by excessively dense brushfields performs only a somewhat questionable watershed function, and--in many cases--perhaps even the watershed function might be better served by a more productive forest type.

This publication presents: (1) a discussion of the extent and importance of the brushlands, (2) a review of some historical information concerning these brushfields, and (3) a brief presentation of climatic, geological, and other factors affecting brush and tree growth in various parts of the area. Finally, brush problems are discussed in relation to forest-land management, and a program is suggested for brushfield reclamation research in southwestern Oregon.

GEOGRAPHY OF SOUTHWESTERN OREGON

The region designated as southwestern Oregon is composed of Coos, Curry, Douglas, Jackson, and Josephine Counties (fig. 1). From the Pacific Ocean on the west, the region extends eastward to the crest of the Cascage Range; and from the Siskiyou Mountains on the south, northward to the Smith River drainage in the Coast Range and the Calapooya Divide between the Willamette and Umpqua Valleys. Eighty-nine percent of the area is classified as forest land (Moravets, 1951).

Topographically, southwestern Oregon consists of a relatively low and narrow coastal strip along the Pacific Ocean and a broad area of interior valleys interspersed with and surrounded by mountain ranges. The

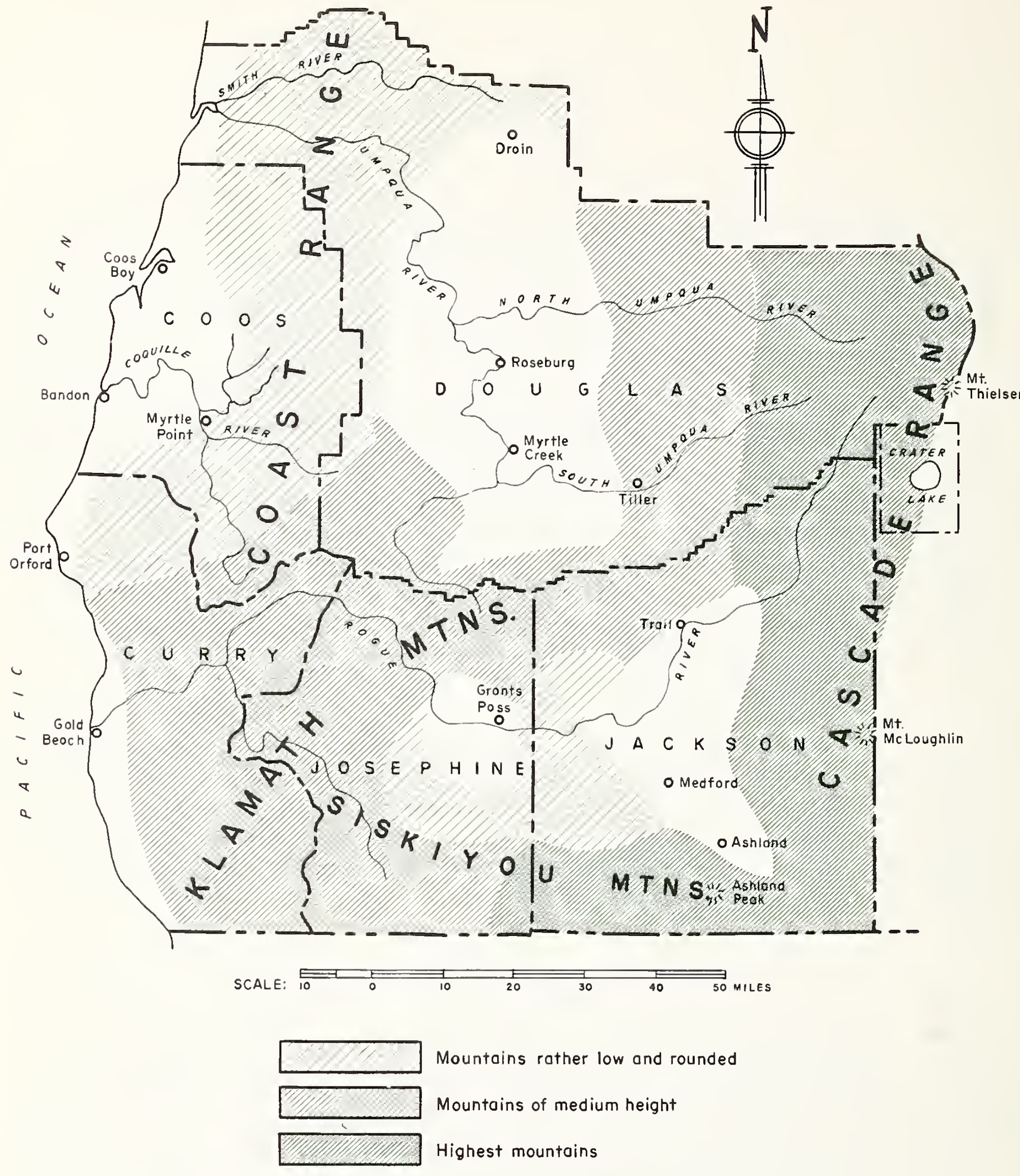

Figure 1—Geography of southwestern Oregon.

two lowland areas are separated by the Oregon Coast Range, which enters the northwest corner of the region and extends southward parallel to the coast until it merges with the Siskiyou Mountains. The Rogue-Umpqua divide, projecting westward across the interior valley area from the Cascade Range to the Coast Range, divides southwestern Oregon into two major drainages. The southern part is drained by the Rogue River and the northern part by the Umpqua River. Both streams flow westward through the coastal mountains to the sea.

Most of the large brushfields in southwestern Oregon are in the area south of the Rogue-Umpqua divide. The most extensive are on the western slopes of the Cascade Range, in the Siskiyou Mountains, and in the southern end of the Coast Range.

HISTORY OF BRUSHFIELDS

Writers in the early 1900's were in general agreement that the large brushfields in southwestern Oregon were the result of forest fires. The excellent report of J. B. Leiberg (1900), who examined the timber resources in the southern part of the Cascade Range Forest Reserve in 1899, is a typical example. Leiberg was concerned over the brush growths following fire in this area. He wrote:

> ... tracts on which a condition of temporary semiaridity has been artificially induced consist chiefly of old or recent burns in the forested subhumid areas. ... They are now covered with brush growths composed of species characteristic of semiarid lands, and their aspect is exactly like that of the semiarid chaparral slopes of California.

Leiberg stated that fires in mixed stands of ponderosa pine[1/] and Douglas-fir on the lower and drier sites in this area were commonly followed by increased growths of ceanothus and manzanita brush, and brushlike or arborescent forms of Pacific madrone. In the more humid upper areas nearer the crest of the Cascade Range, he observed that "...fires, instead of being followed by reforestations, give rise to enormously dense brush growths."

H. E. Haefner (1912), writing of the large brush areas on the Siskiyou National Forest, reached a similar conclusion concerning the origin of the brushfields in that area. He wrote:

> ...the chaparral areas should not form the large acreage that they now do. The cause of their existence, however,

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1/ Scientific names of tree and brush species are listed in the appendix.

> is not difficult to ascertain, and is seen on every hand. The charred stump, tree trunk, and fallen log tell plainly that fire was the cause, and has done its work.

Fire was singled out in one of these early publications as an important factor in reproduction of at least one brush species. H. D. Foster (1912), describing relations between brush and tree growth in the Crater (Rogue River) National Forest, stated that "As far as I have observed, there is nowhere any Ceanothus [evidently snowbrush ceanothus]...where there is no evidence of forest fires." Foster's observation has since been verified, for results of tests have shown that fire can increase the germinative capacity of snowbrush ceanothus seed stored in damp soils (Curtis, 1952).

Leiberg was greatly impressed by the vast brushfields which occupied burned-over forest lands on the western slope of the Cascade Range. In his paper, one of these areas is described as follows:

> ...The southern boundary of the township (T. 35S., R. 4E.) marks the beginning of the immense burns, which stretch northward along the summit and the western declevities of the main range for a distance of at least 40 miles. Throughout the central and western areas of the township and almost through the next one north, a distance of about 11 miles with a width of 5 miles, there is one solid burn, where scarcely a tree is to be seen outside of the swampy or wet slopes of a few of the larger canyons. It is the most thorough and complete sweep of a standing forest by fire that I have ever seen. The burned areas have become covered with brush composed of huckleberry, manzanita, garrya, service berry, and vellum-leaved Ceanothus, the latter being the most abundant and conspicuous species.

This impressive brushfield is known today as the Cat Hill Burn. The area burned once again in 1910. Today, 50 years later, species composition of the brushfield closely resembles Leiberg's description. Snowbrush ceanothus, manzanita, and serviceberry are still among the most abundant and conspicuous brush species in the burn (fig. 2).

Leiberg's report reveals that forest fires increased in both size and number during the early days of settlement. He stated that the early settlers were very careless in their use of fire in the forest. He believed that "many of the conflagrations spread from camp fires, which the settlers rarely took the trouble to extinguish when breaking camp." Many fires were deliberately set to destroy underbrush when building roads and trails and to facilitate traveling through the forest. Fires set to burn windfalls out of traveled roads were allowed to escape and burn over thousands of acres of surrounding timberlands. During the summer of 1899, Leiberg observed several fires that he believed were started to lure deer, which would stand in the smoke to escape the attacks of gnats and flies. He believed that only about 5 percent of the fire damage in the southern part of the Cascade Range could be attributed to Indians. The balance of the damage was the work of early settlers.

Haefner, on the Siskiyou National Forest, agreed with Leiberg. Although he couldn't determine the exact age of the fires there, he believed that Hudson's Bay trappers were responsible for most of the early fires. Later, forest lands were burned by Indians, hunters, stockmen, and miners. Sampson (1944) reached similar conclusions concerning the burning of brushlands in northern California.

Figure 2.—A small part of the Cat Hill brushfield as it appears today.

Butler and Mitchell (1916), in a report on the geology and mineral resources of Curry County, revealed that before the national forests were created, it was customary for prospectors to set a forest fire before prospecting a slope or mountain. Quoting from their report:

> Second-growth timber and under-brush is so rapidly filling trails once well defined and easily traversed that it will not be long before many will be utterly unusable. ... This condition has greatly retarded prospecting and development of the country. In the old days it was customary to start a forest fire whenever it was desired to prospect a certain slope, and the country was kept comparatively clear by such means. With the creation of National Forests, such methods

> have become unlawful, yet no substitute for the drastic measures earlier employed has been suggested. It is not to be wondered at, then, that some prospectors feel much dissatisfaction with present conditions, and sometimes revert to old practices, especially when the ground which they wish to clear is covered with under-brush and scrub-growth of no value, yet so thick as to be impenetrable. The Forest Service has built some splendid trails, but at the present rate of work, it is improbable that a large part of the county will ever be opened up by such means. In fact, it is getting less and less accessible as time goes on. Whether the benefits accruing from timber protection over-balance the stagnation in development resulting from the presence of extensive areas of thick under-brush is a question that should receive careful consideration at an early date.

This statement concerning restrictions on use of fire in national forests is indicative of the attitude which confronted foresters in this area 40 or 50 years ago.

Fire has long been used by stockmen in southwestern Oregon to kill back brush and trees in order to promote the growth of grass and browse species. In 1900, Leiberg wrote the following concerning this use of fire in the southern part of the Cascade Range:

> With the advent of the stockman came the burning of the forest for the purpose of promoting grass growth. ... Fires in the middle and lower elevations usually stimulate brush growths. Some of these brush growths consisting of hazel, mountain mahogany, scrub oak, june or service berry, and various species of ceanothi are relished by cattle, and for the purpose of providing the stock with this sort of browse the timber is frequently burned.

This idea has persisted in southwestern Oregon until the present time. Each year, toward the end of the long, dry summer, many fires are set by ranchers in the Umpqua Valley to burn out brush growths and promote the growth of grass. Several instances have been observed where such fires have damaged or destroyed excellent young stands of conifer reproduction on areas being "reclaimed."

These early papers prove that many of our important brushfields now have histories of 100 years or more. The Cat Hill brushfield is a good example. In recent years, the origin of the Cat Hill brushfield has often been erroneously linked with a fire which swept that area in 1910. But early publications concerning the area (Foster, 1912; and Leiberg, 1900) show that the 1910 fire was only a reburn and that the area was a well-established brushfield long before. Leiberg, in fact, estimated from evidence on the area that the Cat Hill brushfield originated after fires which denuded the slopes in the 1850's. Such brushfields are well established on the sites they occupy and may have affected the physical or chemical characteristics of the soil.

Once brush has occupied a forest site, intense competition often excludes forest reproduction. Some brushfields restock naturally, but the process is very slow. Many brush areas remain understocked for a long time, and the sites produce only a fraction of their potential timber volume. When Leiberg examined the western slopes of the Cascade Range, he mapped the location of brushfields as shown in figure 3. Large parts of these brushfields were still occupied by brush or understocked stands when the area was reexamined in 1947 by Federal Forest Survey crews (fig. 4).

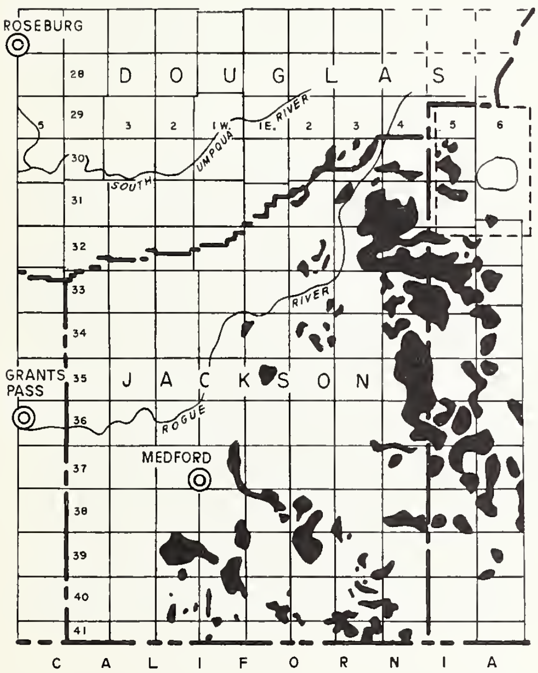


Figure 3.—Brushfields of the Cascade Range and Ashland Forest Reserves in **1899.**

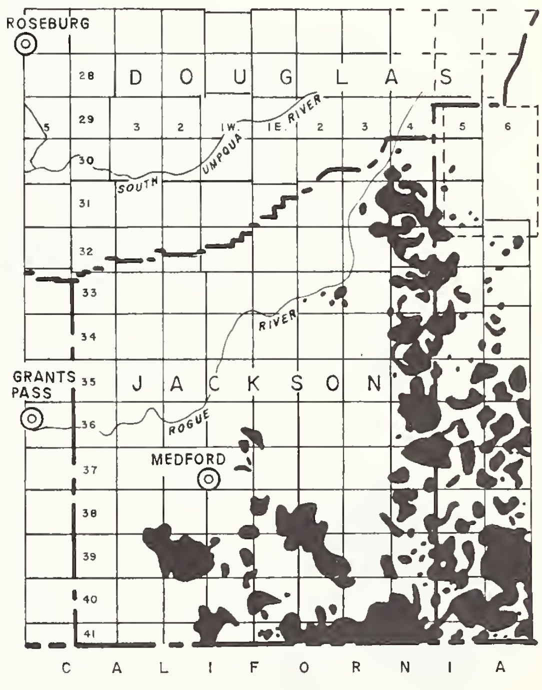


Figure 4.—Brushfields and understocked stands of the Cascade Range and Ashland Forest Reserve areas in **1947.**

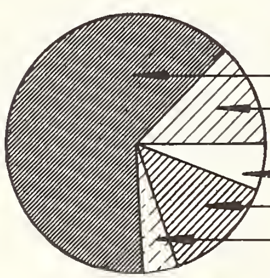
IMPORTANCE OF BRUSHFIELDS

Large brushfields on potentially productive forest lands are a troublesome management problem to foresters in southwestern Oregon. Some brushfields are surrounded by timber and are slowly being reclaimed by natural seedfall. Many brushfields are so large, however, that natural reclamation may take several centuries during which the areas will have to be protected from fire, with no return on the investment.

On drier sites, competition for sunlight and soil moisture results in stagnation of young trees, and the process of natural reclamation is often retarded or even forestalled. Artificial reclamation and reforestation will be required on most of these brushlands if the sites are to be brought back into timber production, but management cannot be expected to proceed with this effort until proven and economical methods of reclamation are developed. Meanwhile, protection of the nonproducing lands are a constant financial drain on forest land management in this area.

Extent of Brush Areas

The latest Forest Survey figures for southwestern Oregon (Moravets, 1951) show that there are 6,581,000 acres of commercial forest land in the area. Brushfields and brush problems are important management considerations on a substantial part of these lands. Survey figures list 315,000 acres of nonstocked burns and old cutovers in this area. These lands are usually occupied by a dense cover of brush. Another 865,000 acres are classified as supporting understocked stands of poletimber, seedlings, and saplings (222,000 acres poorly stocked; 643,000 acres medium stocked). A dense brush cover is probably present on at least 400,000 acres of this land. An additional 1 million acres have been estimated as supporting understocked stands of sawtimber, usually with a dense brush understory (Hayes, 1959). These figures indicate that brush control and brushfield reclamation are important land-management problems on about one-fourth of the commercial forest land in southwestern Oregon (fig. 5).



Type of stand	Percent
Well-stocked stands of all ages	63
Understocked stands less than saw-log size	13
Nonstocked burns and old cutovers	5
Understocked stands of sawtimber	15
Recently clear-cut lands	4

Figure 5.—Status of commercial forest land in southwestern Oregon in **1947.**

Effect of Brush on Land Management

Brushfield and brush control problems in southwestern Oregon are common to land management in many different fields, such as forest management, wildlife management, watershed management, grazing, and fire control. In general, land managers in all of these fields are interested in converting the brushfields to a more productive type of vegetation wherever possible and economically feasible. Some problems associated with management of brushlands are discussed briefly in the next few paragraphs.

Forest Management

Brushfields on forest land create many problems; some are economic, some biotic, and still others edaphic in nature. Economic losses are felt through delayed stocking, understocking, and reduced growth of trees at all ages. In addition, dense brushfields have completely taken over some logged and burned forest lands so that potentially productive sites are growing no timber at all.

In the biotic field, brush competes with seedlings and trees of all ages for light, moisture, and nutrients. In addition, brushlands harbor deer, rabbits, rodents, insects, and other forms of life that are often detrimental to trees.

In the edaphic field, some brush species add little humus to the soil and are poor soil builders. In southeastern Arizona, for example, mesquite invading an area resulted in deterioration of the surface soil. The condition thus created was more favorable for reproduction of mesquite than for reestablishment of the more desirable perennial grass cover which formerly occupied the site (Paulsen, 1953). A similar effect may be in progress on some areas in southwestern Oregon where logged and burned forest lands have been invaded by brush.

Watershed Management

The aim of watershed management is to cultivate a plant cover on a watershed which will maintain or improve the site while yielding the greatest amount of usable water throughout the year. When two different types of vegetation will serve this purpose equally well, then the type which will produce the greatest economic return in the form of merchantable products is usually the more desirable. Brush cover, for example, yields no return whereas a forested watershed can yield appreciable returns in the form of timber and other forest products. This, in turn, affects the amount of development which is economically feasible on a watershed. On a timbered watershed, roads can be built to provide access to the farthest reaches of the drainage for fire protection, stream maintenance, and erosion control. On a brush-covered watershed, construction of roads permitting this desirable protection and maintenance work may not be economically feasible. As a result, quality of water from brush-covered watersheds may be adversely affected by effects of large fires and excessive erosion in the inaccessible parts of the drainage.

On watershed lands in southwestern Oregon, however, conversion of existing brushfields to other types of vegetation is not feasible at present. Economical methods for brushfield conversion have not yet been developed, and little information is available concerning the relative hydrologic value of native brush species as compared with a cover of trees, grass, or other herbaceous vegetation. Even among brush species, desirability as a watershed cover may vary considerably. In California, for example, Kittredge (1949, 1955) recognized manzanitas--especially sprouting manzanitas--as a far more desirable watershed cover than pure stands of chamise. Chamise often grows in pure, open stands and lays down a light litter which does not adequately protect the soil against erosion. Manzanitas, on the other hand, form dense stands and lay down a heavy litter which protects the soil. In southwestern Oregon, greenleaf manzanita forms such a cover in the Siskiyou Uplands (fig. 6). Until more information is available concerning native brush species, and until effective and economical methods for brushfield conversion have been developed, brushfields on watershed lands in southwestern Oregon must be tolerated and protected.

Figure 6.—The layer of litter and humus is more than 3 inches deep under this greenleaf manzanita in the Siskiyou Uplands.

Wildlife Management

Many of the most important brush species native to southwestern Oregon--such as live oak, tanoak, and chinkapin--are relatively unimportant as wildlife food and browse plants (Van Dersal, 1939). In addition, some of the species less desirable for wildlife uses are so aggressive and occupy sites so completely that they exclude other more desirable vegetation. Many of the tough, sclerophyllous species in southwestern Oregon form a chaparral so dense that even big game finds it difficult to penetrate, and use of the area is curtailed. Finally, other brush species such as the wild currants and gooseberries, although valuable for wildlife conservation, are alternate hosts for tree diseases and must be eradicated at appreciable expense in regions where the host trees are being grown.

Grazing

Ranchers in southwestern Oregon often find that brush has encroached on and taken over their pasture lands. In some cases, selective grazing by cattle, sheep, and goats on stump pastures has eliminated the more desirable browse species and allowed less desirable brush species to occupy the area. Dense brush on many of the hill pastures forms thickets which exclude cattle from large parts of the area and substantially reduce grazing capacity. In some areas, graziers have spent considerable amounts of time and money on aerial applications of herbicides in an attempt to recapture pasture land being invaded by dense brush.

Figure 7.—In the Umpqua Valley, burning is commonly practiced on cutover forest lands to maintain open pasture. Some sites are reburned as often as every 4 years.

Prescribed burning is widely practiced in southwestern Oregon in efforts to convert cutover timberland to pasture and to reclaim pasture lands that have been occupied by brush (fig. 7). The reduction of brush by burning, however, is only temporary, and benefits are limited unless accompanied by additional measures, such as grass seeding. Both aerial and ground seeding methods have been used after burning in southwestern Oregon; but even the improvement resulting from this treatment is relatively short lived because seeding does not prevent brush from resprouting and reoccupying the site.

Fire Control

A dense chaparral of sclerophyllous vegetation develops in southwestern Oregon, where summer rainfall is very low and where annual rainfall in many areas is less than 30 inches. Such chaparral areas have long been noted for their flammability. Many of the brush species themselves are highly flammable, and this characteristic combined with steep slopes and severe fire conditions makes fire control in brushy areas very difficult. Many of the largest brushfields have no roads or trails, and access for fire control is difficult. In addition, construction of fire lines is a laborious process, fire fighters are hampered and restricted, and escape in emergencies can be difficult or even impossible.

BRUSH GROWTH CONDITIONS IN SOUTHWESTERN OREGON

Southwestern Oregon presents an unusually large variety of topographic, geologic, and climatic conditions. Elevations range from sea level along the coast to over 9,000 feet on some peaks in the Cascade Range. Soils are equally varied. Many soils in the Siskiyou Mountains are derived from some of the oldest rocks in western Oregon, while large areas of lava and pumice in the Cascades are of relatively recent origin. An average annual rainfall of 70 to 80 inches and a frost-free period of 7 or 8 months typify climatic conditions along the coast. In the interior, average annual rainfall ranges from about 70 inches near the crest of the Cascade Range to as little as 16.5 inches at Medford in the Rogue River Valley (Wells, 1941). Below freezing temperatures can occur during any month of the year at high elevations in the Cascade Range.

This great diversity of conditions is reflected in the vegetation of southwestern Oregon. And conditions are further complicated by the fact that this area is in what might be termed a tension zone between two different floral provinces: the Canadian or northern flora extends southward in the colder and wetter habitats of the Coast and Cascade Ranges; Californian or southern flora occupies the hotter and drier sites with low summer rainfall in the interior valleys and the Siskiyou Mountains.

Peck (1941) subdivided Oregon into nine different plant areas based on characteristics of climate and vegetation. Six of these plant areas are represented in southwestern Oregon. With some changes in boundaries and species, Peck's plant areas typify the major brush conditions found in southwestern Oregon. Peck's Rogue-Umpqua area, however, has been divided into its component valley areas, for differences in environmental conditions and brush species are believed sufficient to justify the additional zone. The resulting seven major brush zones are shown in figure 8 and their climatic characteristics summarized in table 1. Each zone has its own distinctive combination of environmental conditions and brush species.

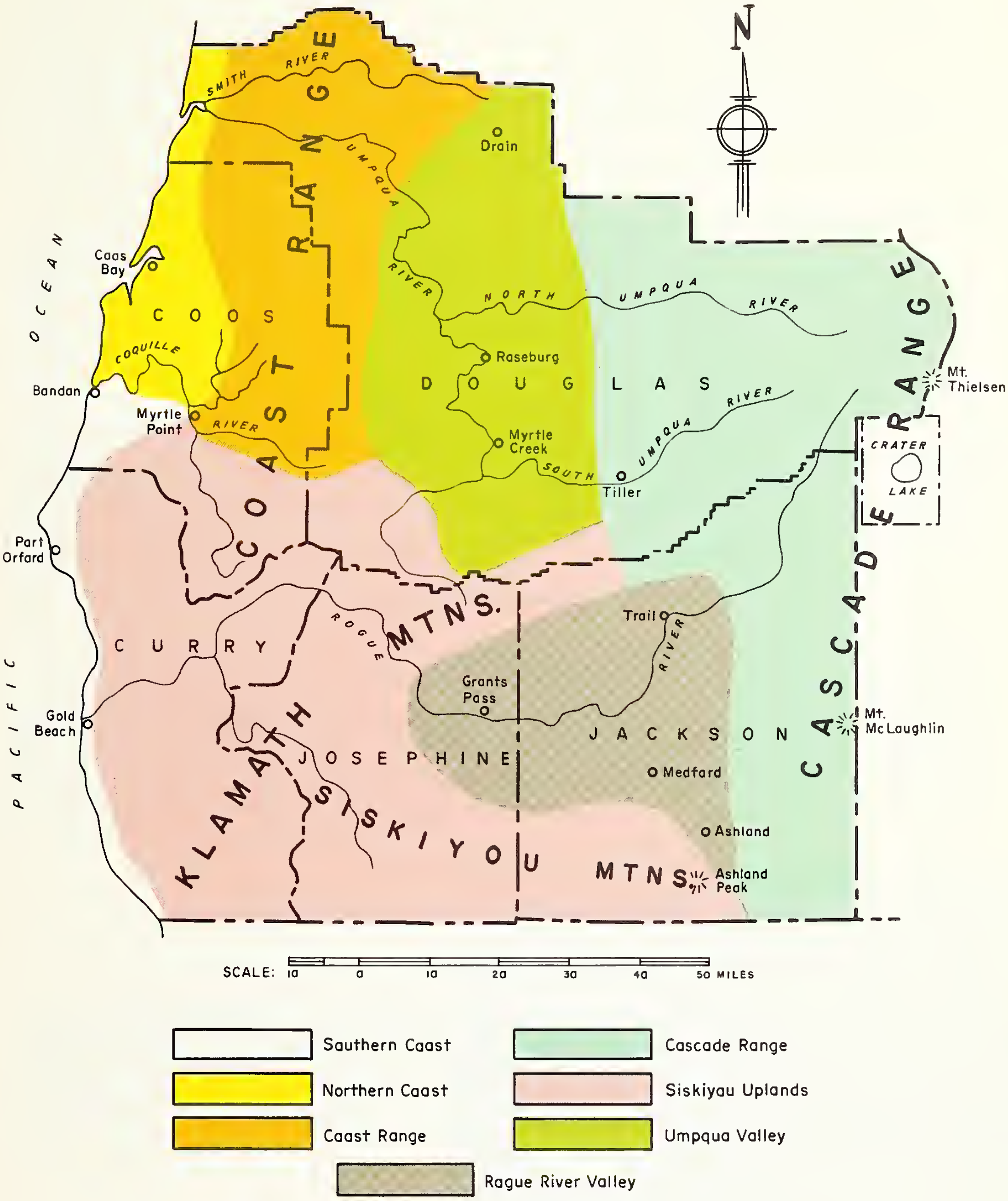


Figure 8.—Major brush zones of southwestern Oregon.

Table 1.--Average climatic conditions within the seven brush zones of southwestern Oregon

Brush zone	Temperature				Months frost free	Precipitation	
	Jan. av.	July av.	Maximum	Minimum		April-September	Annual
	°F.	°F.	°F.	°F.	Number	Inches	Inches
Southern Coast	46	58	100	15	8	16	72
Northern Coast	44	60	102	16	7	14	68
Coast Range	40	64	--	--	6	12	70
Cascade Range	30	63	104	-13	5	10	45
Siskiyou Uplands	36	64	--	--	5	9	50
Umpqua Valley	41	67	108	-1	7	7	34
Rogue River Valley	38	70	110	-4	5	5	22

Northern Coast

This zone consists of a narrow coastal strip extending southward from Siltcoos Lake to the mouth of the Coquille River, and includes the area of sand dunes and coastal terraces with fresh-water lakes and sphagnum bogs a short distance inland from the coast (fig. 9). The remnant river terraces of the Coos Bay-Myrtle Point area and the lower slopes on the western edge of the Coast Range are also included in this zone.

Figure 9.—Fresh-water lake and shifting sand dunes (center right) on clear-cut lands occupied by brush in the Northern Coast zone.

Sandy soils are characteristic of the entire Northern Coast zone, and a broad area of coastal and river terraces with sandy soils extending inland is a distinctive feature of the southern part of the zone. Geologically, the marine and river terraces show evidence of subsidence and uplift during the recent past (Allen and Baldwin, 1944). In the northern part of the zone, the coastal terraces give way to an extensive area of shifting sand dunes along the coast, while farther inland, sandstones predominate in the formations of the Coast Range along the eastern edge of the zone.

Climatic conditions in the Northern Coast zone are remarkably equable. Generally, the area is characterized by cool summers, a long frost-free season, and relatively warm temperatures during the winter (table 1). Foggy, rainy, or overcast weather prevails most of the year. Rainfall during the growing season is exceeded only by that in the Southern Coast zone.

Strong winds from the sea are a dominant influence on all forms of vegetation in the coastal area (Peck, 1941). Stands of lodgepole pine and Sitka spruce near the coast are often shrubby and deformed on the windward edge, increasing in height to leeward as degree of protection increases. Salal and box blueberry are particularly abundant among woody shrubs. Dense thickets of both species are common in somewhat protected locations, but box blueberry also occupies some of the more exposed slopes.

Some of the inland areas which were logged off in the past are now occupied by a dense cover of brush (fig. 10). Deciduous species such as salmonberry, western thimbleberry, red whortleberry, and red alder are far more abundant in these coastal brushfields than in the drier areas of the interior. The abundant presence of California-laurel is a distinctive feature of the remnant river terraces in the Coos Bay-Myrtle Point area.

Figure **10.**—*Extensive brush-covered clear-cut lands in the Northern Coast zones.*

Some of the more abundant and characteristic brush species of the Northern Coast zone are:

- bearberry
- box blueberry
- California-laurel
- hairy manzanita
- Hooker willow
- Pacific bayberry
- Pacific rhododendron
- red whortleberry
- salal
- salmonberry
- western thimbleberry

Among the many forest tree species represented in this zone are Douglas-fir, Sitka spruce, western hemlock, grand fir, Port-Orford-cedar, western redcedar, California-laurel, and red alder.

Southern Coast

The Southern Coast zone extends from the mouth of the Coquille River southward into California. Between Bandon and Port Orford, this zone extends inland for several miles. South of Port Orford, however, the Coast Range rises steeply from the sea and the zone is very narrow. Geologically, the coastal terrace north of Port Orford consists of Pleistocene marine sediments over older sandstones, conglomerates, and shales. South of Port Orford, the steep slopes above the sea are formed of sandstones, conglomerates, and shale of the Knoxville, Paskenta, and associated geological formations (Wells, 1955).

Climatic conditions in most of this zone are similar to those in the Northern Coast zone. Cool summers and warm winters are characteristic. Annual rainfall averages about 72 inches, with 16 inches of this total falling during the period from April to September (table 1). Cloudy weather, fog, and rain persist through most of the year.

Brush species are typical of the Californian flora and differ considerably from the species encountered in the Northern Coast zone. Especially prominent among the shrubs are blueblossom and common gorse (fig. 11). A list of some brush species characteristic of this area include:

- blueblossom
- common gorse
- common juniper
- dwarf blueberry
- hairy manzanita
- Menzies gooseberry
- Sitka alder
- varnishleaf ceanothus
- wavyleaf silktassel
- western azalea

Lodgepole pine and Sitka spruce are less prevalent in this zone than farther north. Among the more important tree species along the southern coast are Douglas-fir, Sitka spruce, Port-Orford-cedar, western hemlock, incense-cedar, and grand fir. Three hardwoods are tanoak, red alder, and California-laurel.

Figure 11.—An impenetrable stand of common gorse on the coastal terrace near Bandon.

Coast Range

This zone corresponds fairly well with the southern end of Peck's Northern Coast Mountain area. Both slopes of the Coast Range from the Smith River drainage southward to the Coquille River are included. On the seaward side, the zone is bounded by the narrow coastal area; on the east side, the lower slopes merge into the low, rounded hills of the Umpqua Valley.

Topographically, the Coast Range was at one time a regionally flat surface which was elevated and dissected during the geologically recent past (Forest Soils Committee of the Douglas-fir Region, 1957). Streams and rivers have eroded deep canyons, and the original surface of low relief has been cut up into a mountainous topography. The mountains are low and rounded, with some of the higher summits reaching elevations between 3,000 and 3,500 feet. The bulk of the Coast Range is formed of Tyee sandstone, and sandstone and shale are the predominant rocks exposed. Mudstones and basaltic lavas are exposed in some locations in the southern part of the area.

Climatic conditions on the western slope of the Coast Range resemble those of the coastal strip, but the eastern slope becomes increasingly drier and hotter as it drops into the Umpqua Valley. Average annual precipitation on the western slope ranges from 80 to 100 inches per year; on the eastern slope it drops to 50 inches at the western edge of the Umpqua

Valley. Annual precipitation for the zone as a whole averages about 60 inches (table 1). Rainfall during the growing season also averages less than in the coastal strip.

At present, brushfields and brush problems are not as extensive or widespread in the Coast Range zone as in other parts of southwestern Oregon. Brushy areas are present, however, on some old burns and cut-over lands which have not regenerated. The brush species found here are the same as those found further north in the Coast Range, and some characteristic species are:

creambush rockspirea	red whortleberry
Delnorte manzanita	salmonberry
hairy manzanita	vine maple
Pacific red elder	

The Coast Range is heavily timbered. Douglas-fir is by far the most abundant and important species, but Sitka spruce is present at lower elevations on the west slope. Other timber trees include western hemlock, western redcedar, Port-Orford-cedar, and grand fir. Site quality of Douglas-fir lands in the Coast Range and Northern Coast zones is better than in any other part of southwestern Oregon.

Siskiyou Uplands

The area designated as the Siskiyou Uplands zone includes the Siskiyou Mountains and the southern end of the Coast Range south of the Coquille River. On the west it is bounded by the southern coastal strip, and on the east by the Umpqua and Rogue River Valleys. The area is largely undeveloped.

The Siskiyou Uplands zone contains some of the most rugged mountain topography in southwestern Oregon. Slopes are steep, and elevations range from sea level to over 7,500 feet. The coastal mountains increase in height south of the Coquille River, and mountains of 4,000 to 5,000 feet in elevation are common. The Siskiyou Mountains are even higher, with many peaks of 6,000 to 7,000 feet in elevation. There are no distinct differences in topography between the two ranges where they merge in the western part of this zone.

The Siskiyou Uplands zone includes most of the area designated by Baldwin (1959) as the Klamath Mountain region. One of the earliest land masses raised above the seas in Oregon (Condon, 1910), this area contains the oldest rocks in the western part of the State. Subsequent uplifting, folding, and erosion produced the existing topographic features of the area. Rocks are extremely varied, and the soils formed by decomposition are complex. In the western part of the zone, the Coast Range is formed of sandstones, shales, and siltstones interspersed with a few large areas of volcanic rocks. Soils in the central part of the Siskiyou Uplands zone are derived from altered volcanic rocks, tuffaceous sediments, limestone, quartz diorite, and granodiorite. Large areas of peridotite and serpentine are an especially prominent feature in the western part of the zone. Soils on such areas are often shallow and have a low calcium content but high levels of magnesium, nickel, and chromium (Walker, 1954). Vegetation on soils derived from peridotite and serpentine is generally sparse and distinctly different from vegetation on more normal soils in the same area (fig. 12).

Climatic conditions also vary considerably within this zone. A long, dry season with high temperatures during the summer is characteristic of most of the area. The western part of the zone next to the coastal strip, however, has an average annual precipitation of 90 to 120 inches (U.S. Corps of Engineers, 1957), average January temperatures of about 42° F., and 14 to 16 inches of rainfall during the growing season. Eastward, the climate becomes increasingly drier. At the east end of the Siskiyou Mountains, average annual precipitation is about 25 to 30 inches,

Figure **12.**—*Open stand of Jeffrey pine on serpentine soil at right contrasts sharply with denser stand of Douglas-fir, sugar pine, and incense-cedar on soils derived from sandstone and shale at left.*

average January temperatures are about 30° to 32° F., with only 4 inches of rainfall during the growing season.

Brushfields are larger and far more abundant in the Siskiyou Uplands than anywhere else in southwestern Oregon, and casual observation from the air leaves one with the impression that at least one-third to one-half of this area is occupied by brushfields. Evergreen species predominate. Most of these are of the broad-sclerophyll type, with dense, stiff branches and thick, hard, evergreen leaves. Manzanita, live oak, madrone, tanoak, chinkapin, and ceanothus species are especially abundant (fig. 13).

Figure **13.**—*A typical dense brushfield of manzanitas, canyon live oak, ceanothi, and other evergreen shrubs in the interior of the Siskiyou Uplands.*

This dense evergreen chaparral is part of the Chaparral Association of the Broad-Sclerophyll Formation, which attains its best development in the coastal mountains of California (Weaver and Clements, 1938; Oosting, 1948). The existence of chaparral under a wide range of rainfall conditions in the Siskiyou Uplands is characteristic of the formation. An evergreen chaparral attains its best development in a climate with long, dry summers and mild winters with heavy rainfall. Annual precipitation usually ranges from 10 to 30 inches, with less than one-fifth of the total falling during the summer. Where rainfall approaches 50 inches or more (as in the western part of the Siskiyou Uplands), chaparral can develop only where insolation greatly increases water loss or where soil types or soil conditions preclude adequate storage of soil moisture for use during the dry summer season.

On normal soils, growth of brush species reflects the variation in climatic conditions within the zone. In the area of heavier rainfall near the coast, brush grows tall and dense and on many sites consists of a broad-sclerophyll forest association of tanoak, chinkapin, and madrone species. Intermingled with this and in the more xerophytic areas of the interior are extensive areas of chaparral composed of various species of manzanita, oak, cascara, silktassel, and ceanothus.

Chaparral probably is the climax formation on many sites in the Siskiyou Uplands, especially on the drier slopes in the eastern part of the area, where annual precipitation reaches critical levels for forest growth. Chaparral will probably also prove to be climax on many severe south and southwest slopes and on shallow soils with low moisture-storage capacities in the wetter parts of the zone. Moisture on such sites can reach critical levels during the hot, dry summers characteristic of this area.

On many sites, however, chaparral may be a fire-induced subclimax. This is probably true of many areas in the western part of the zone, where annual rainfall reaches 120 inches per year and extensive brushfields occupy many sites where timber stands were destroyed by fire. Chaparral in the Eagle Creek area of the Chetco drainage appears to be a fire subclimax. Where scattered conifers survived the fire, natural seedfall has produced numerous tree seedlings, and many of these are growing satisfactorily among the brush in this area of heavy rainfall. In time, the young trees will overtop and shade out brush around them. On large parts of the Eagle Creek area, however, no seed source survived, and the brush will persist for a long time unless artificial reclamation speeds the process.

Repeated fires a few years apart favor perpetuation of chaparral over conifers. Fewer and fewer trees and seedlings survive the successive fires until finally all are eliminated. On the other hand, most chaparral species resprout after fire and usually produce more new sprouts than the original number of stems. To minimize future expansion of chaparral in the western part of the Siskiyou Uplands, understocked stands with a heavy understory of brush must be protected from fire.

Some of the more abundant and characteristic brush species in this zone include:

boxleaf silktassel	golden evergreen chinkapin
California buckthorn	greenleaf manzanita
California-laurel	Hinds willow
canyon live oak	hoary manzanita
Fremont silktassel	huckleberry oak

Hupa gooseberry	pinemat manzanita
mountain whitethorn ceanothus	pygmy mahonia
	Sadler oak
Oregon kalmiopsis	scrub tanoak

Douglas-fir is the most widespread and important forest tree in the Siskiyou Uplands. Port-Orford-cedar is found in the heavier rainfall area near the coast, especially in the northwestern part of the zone. Other noteworthy timber trees include ponderosa pine, Jeffrey pine, sugar pine, and incense-cedar. Two evergreen hardwoods usually not regarded as commercial species also attain good size and form in parts of the Siskiyou Uplands. These are tanoak and golden chinkapin.

Umpqua Valley

This zone in the interior takes in the main valley of the Umpqua River system. The Calapooya Divide separates the Umpqua Valley from the Willamette Valley on the north, and the Coast Range bounds the area on the west. On the south, the Umpqua and Rogue River valleys are separated by the Rogue-Umpqua Divide, which extends southwestward between the two drainages from the Cascade Range near Diamond Lake to the Coast Range near Galice. The foothills of the Cascade Range form the eastern boundary of the zone.

The Umpqua Valley has very little level alluvial land. This is an area of low, rounded hills with narrow valleys along the streams. In the central part, soils are often shallow and rock outcroppings are common. Elevations in the valley increase from 290 feet at Drain in the north to 750 feet at Canyonville in the south.

A variety of geological formations are represented in the Umpqua Valley. Andesites and other volcanic rocks are found along the eastern edge of the valley, while Tyee sandstone and sandstone and shale of the Umpqua formation are predominant in the northern and western parts of the area (Diller, 1898). A large area of resistant diabase is present in the central part of the valley around Roseburg. Further south, conglomerate, sandstone, and shale of the Myrtle formation are most abundant; and a strip of serpentine runs northeastward through the valley from west of Riddle to Little River, about 3 miles southeast of Glide. The Myrtle formation gives way, in turn, to metamorphosed sedimentary materials and igneous intrusives at the southern end of the valley. The area south of Myrtle Creek, and the Rogue-Umpqua Divide west of the Tiller-Trail highway, are largely formed of Galice and Rogue formations typical of the Siskiyou Uplands. Northeast of the highway the divide is formed of volcanic rocks typical of the Cascade Range.

The Umpqua Valley is one of the most xerophytic zones in southwestern Oregon (table 1). Average annual rainfall in the valley area is about 34 inches per year, with only 7 inches during the growing season. And high daytime temperatures are characteristic of this interior valley during the dry summer season. Peck (1941) points out that the combination of low summer rainfall, high temperatures, and the loose character of the soil--which results in a rapid loss of moisture at the beginning of the summer--produces a more xerophytic vegetation than the annual rainfall would indicate.

Open areas occupied by grasses and low herbaceous vegetation are characteristic of the Umpqua Valley zone, especially on the many areas of shallow soil in the central part of the area. Oregon white and California black oaks intermixed with Pacific madrone and Pacific poisonoak form a stunted, open cover on the low, rounded hills (fig. 14). Scattered conifers, mostly Douglas-fir, are common in the oak–madrone woodland. On some sites, good stands of naturally established Douglas-fir reproduction are found under Pacific madrone, which seems to form an excellent nurse cover for the young trees. Patches of sweetbrier rose and Pacific poison-oak invading pasture lands are a common sight, and deerbrush ceanothus is also abundant throughout the valley.

Figure 14.—Pacific madrone interspersed with Oregon white oak and Douglas-fir covers many low hills in the Umpqua Valley. The pasture (foreground) is infested with sweetbrier rose and Pacific poisonoak.

Some of the brush species characteristic of the Umpqua Valley zone are:

canyon live oak	Pacific madrone
deerbrush ceanothus	Pacific poisonoak
hairy manzanita	sweetbrier rose

Fair stands of Douglas-fir occupy the crests of the higher hills in the valley area, extending downward into the oak-madrone woodlands along the creeks and on northern slopes. In the wetter northern end of the valley, the stands of Douglas-fir approach the valley bottom and replace the oak-madrone woodland on many slopes. Two additional conifers abundant in the Umpqua Valley zone are ponderosa pine and incense-cedar. Neither is as abundant as Douglas-fir.

Rogue River Valley

This zone takes in the southernmost of the two large interior valleys in southwestern Oregon. On the north, it is separated from the Umpqua Valley by the Rogue-Umpqua Divide, which forms a mountain barrier between the two drainages. The Siskiyou Mountains form a distinct boundary on the west and south, and the lower slopes of the Cascade Range form the eastern boundary. The valley is divided into two main lowland areas by a mountainous region extending northward from the Siskiyou Mountains to the Rogue-Umpqua Divide between Grants Pass and Medford. One of the lowland areas is centered around Grants Pass; the other is in the Ashland-Medford-Trail area.

Geology of the Rogue River Valley is intricate, but much of the area is similar to the southern end of the Umpqua Valley. Andesite and other volcanic materials again are found on the lower slopes of the Cascade Range along the eastern edge of the area. Especially noticeable in the western part are large areas of granodiorite and quartz diorite in the vicinity of Grants Pass and Merlin and areas of serpentine on the hillsides a few miles northeast of Merlin. Near Medford and Ashland, sandstones, shales, and conglomerates of the Umpqua formation are found along the eastern and northern edges of the valley. Several large areas of quartz diorite are found along the southern and southwestern edges. Extensive level lands along the river are formed of alluvial deposits in both the eastern and western ends of the valley. Between Grants Pass and Medford, metavolcanic rocks of the Applegate group form a mountainous area extending northward from the Siskiyou Mountains to the Rogue-Umpqua Divide.

The Rogue River Valley is the most xerophytic area in southwestern Oregon. Average annual rainfall for both of the lowland areas is about 22 inches per year, with an average of only 5 inches of rainfall during the growing season (April through September). High summer temperatures are characteristic. Climatic conditions in the western part of the valley at Grants Pass are similar to those in the Umpqua Valley. The xerophytic condition is most severe in the eastern end of the valley around Medford, where average annual rainfall is only about 16.5 inches per year (Wells, 1941).

Vegetation of the Rogue River Valley appears even more xerophytic in aspect than that of the Umpqua Valley. Oak-madrone woodlands like those of the Umpqua Valley are again a prominent part of the vegetation, but evergreen brush species are far more prevalent here. Whiteleaf manzanita and buckbrush ceanothus are especially abundant in all parts of the Rogue River Valley (fig. 15). The latter species occupies many very dry sites with shallow soil, especially in the central and northeastern parts of the area. Large brushfields are far more abundant than in the Umpqua Valley.

Figure **15.**—*Rogue River Valley brushfields, showing buckbrush ceanothus (left) and whiteleaf manzanita (right) intermixed with oaks.*

Some of the more characteristic or abundant brush species in the Rogue River Valley include:

- brown dogwood
- buckbrush ceanothus
- deerbrush ceanothus
- Pacific poisonoak
- skunkbush sumac
- white alder
- whiteleaf manzanita

Ponderosa pine and sugar pine are far more abundant in the Rogue River Valley than in the Umpqua Valley to the north, but Douglas-fir is still one of the most important conifers. Incense-cedar, with its wide range of adaptation, is also common throughout the Rogue River Valley. On serpentine areas, ponderosa pine is replaced by Jeffrey pine. Red alder of the coastal areas is largely replaced by white alder along streams and rivers in the dry Rogue River Valley.

Cascade Range

This important zone consists of a strip along the western slope of the Cascade Range from Willamette Pass southward to the California line. On the west, the lower slopes blend into the dry Umpqua and Rogue River Valleys. The eastern boundary is the crest of the Cascade Range.

A large range of elevations is represented in the Cascade Range zone. Most of the area lies above an elevation of 1,500 feet in the north and above 2,400 feet in the south. The general level of the crest of the Cascade Range in this area is at an elevation of about 5,500 to 6,000 feet, but many peaks rise much higher. Two of the most prominent are Mount Thielsen (elevation 9,182 feet) in the north and Mount McLoughlin (elevation 9,495 feet) in the south. A striking feature is the presence of a large, relatively level plateau on the western slope below the crest. Ranging between elevations of about 2,500 and 5,300 feet, this plateau extends in varying width almost the entire length of the zone from north to south.

The western slope of the Cascade Range is almost entirely composed of lava flows and other volcanic rocks of varying ages. The western slopes below the plateau and most of the eastern end of the Rogue-Umpqua Divide are composed mainly of volcanic rocks ranging in age from the Eocene to the Miocene epochs. These rocks are mostly of andesitic and dioritic composition interspersed with fine-grained rhyolitic tuffs. Between the upper part of this area and the crest of the Cascades, younger volcanic rocks are exposed. These are largely olivine-bearing basalts and basic andesites. A large area of these younger rocks in the vicinity of Crater Lake and northward, and much of the level plateau area southward past Prospect to Butte Falls, are covered by scoria flows and pumice ejected during the eruption of Mount Mazama (Crater Lake). The large pumice flats of the plateau are a striking feature of the high Cascades in southwestern Oregon (fig. 16).

Climatic conditions vary considerably with elevation in the Cascade Range. Generally, precipitation increases while temperature and length of frost-free season decrease with increasing elevation. The southern end of the area in the lee of the Siskiyou Mountains is much drier than the area farther north. Average annual precipitation in the northern part ranges from 40 to 60 inches, with 8 to 12 inches falling during the growing season. In the area east of Medford, average annual precipitation is only about 19

Figure 16.—Mountain whitethorn ceanothus in a logged and burned clearcut on pumice soil of the plateau northwest of Crater Lake.

inches, and only 6 or 8 inches falls during the growing season.

The great range of elevations combined with the variation in climatic and soil conditions produces a number of different environmental conditions for plant growth in the Cascade Range zone. To a degree, brush growths reflect these changes in environmental conditions. Ranges of some species are restricted to relatively small areas particularly suited to their requirements, while other species with greater ecologic amplitude are much more widely distributed through the area.

Figure 17.—A dense stand of varnishleaf ceanothus on a recent clearcut in the foothills of the Cascade Range. A stand of Douglas-fir similar to that in the background was logged from this area 8 years before.

As may be expected, vegetation of all types, including brush, shows a tendency to zonal distribution with increasing altitude in the Cascade Range. Two closely related varieties of ceanothus are a good example of this condition. Varnishleaf ceanothus is a coastal variety (McMinn, 1951) which is also found at elevations up to 2, 500 to 3, 000 feet in the foothills of the Cascade Range east of Roseburg (fig. 17). Snowbrush ceanothus, the other variety, grows mainly at elevations of 2, 500 feet and above, and its range extends across the crest of the Cascades eastward to the Rocky Mountains. The reason for this elevational distribution of the two closely related varieties of ceanothus cannot readily be explained by any single factor. However, the occurrence of varnishleaf ceanothus only at lower elevations in the Cascade Range may possibly be linked with such factors as warmer temperatures or seasonal distribution of rainfall.

The southern end of the Cascade Range east of Ashland is much drier than similar elevations on the western slope farther north. Annual and seasonal patterns of precipitation in this area are more like those of the dry Rogue River Valley and eastern Oregon, and this condition is evident in the vegetation. Grasslands and oak woodlands of the interior valleys extend to much higher elevations here than on the western slopes farther north. Some brush species typical of eastern Oregon also occur here. Among these are Sierra evergreenchinkapin and birchleaf cercocarpus.

Many extremely large brushfields occupy commercial forest lands on the western slope of the Cascade Range. One of the best known is the Cat Hill brushfield, which extends 9-1/2 miles northward from Mount McLoughlin with an average width of 1-1/2 miles. In extent, these brushfields are exceeded only by those in the Siskiyou Uplands. Like other brushfields in southwestern Oregon, they are composed of a mixture of evergreen and deciduous brush species, but deciduous species are far more prevalent in the Cascade Range than in the Siskiyou Uplands.

Some of the more important and characteristic brush species in the Cascade Range zone are:

- big whortleberry
- birchleaf cercocarpus
- CraterLake currant
- deerbrush ceanothus
- golden chinkapin
- hoary manzanita
- Howell manzanita
- mountain whitethorn ceanothus
- myrtle pachistima
- redstem ceanothus
- Rocky Mountain maple
- rusty menziesia
- saskatoon serviceberry
- snowbrush ceanothus
- squawcarpet ceanothus
- stink currant
- undergreen willow

A large number of tree species are represented in the Cascade Range, but Douglas-fir is by far the most important in terms of both volume and range. The more important timber species show a rather distinct zonation with increasing elevation. Ponderosa pine is most abundant on many of the drier sites of the foothills. With increasing elevation, the dominant species are Douglas-fir, white fir, and Shasta red fir, in turn. Sugar pine grows intermixed with the ponderosa pine and Douglas-fir, and the range of western white pine extends from the Douglas-fir type upward through the Shasta red fir stands. Many other species occur in combination with the trees named above.

PROBLEM EVALUATION

Brush Control and Brushfield Reclamation Problems on Forest Land

The many questions involved in brush problems on forest lands can be grouped in several ways. In the final analysis, the questions to be answered are those of forest-land management, but so little is known of the overall problem that these practical questions cannot be answered directly. More fundamental questions concerning methods of brush eradication, ecology and physiology, soils and water, and economics must be answered first.

Forest-Land Management

Some of the practical questions to which the land manager needs answers before he can make any long-range plans for brushfield reclamation are:

1. Under the multiple-use concept, what is the best single or combined use for brushlands on different sites in southwestern Oregon?

2. Will conversion of brushfields improve watershed and other multiple-use values? Will improvement in these values be enough to help defray costs of conversion?

3. What brush-covered lands will produce commercial forests and pay for brushfield conversion? Which of these lands are potentially the most productive?

4. How can established brushfields be converted to productive forests economically?

5. How can we best assure that current cutting areas, and especially young plantations, will not be taken over by brush?

6. How can established conifer reproduction be released from brush competition economically? Under what conditions is such release necessary and profitable?

7. How should we manage understocked stands of sawtimber with dense understories of brush? How can such areas be converted economically to well-stocked, productive young forests?

8. Under what conditions will eradication of brush from pole-sized and larger stands be justified by increased growth?

Solutions to these practical problems of forest-land management will be possible only after research has provided answers to some of the more fundamental questions listed below.

Methods of Brush Eradication

Efforts to control or eradicate brush species in southwestern Oregon have been singularly unsuccessful, but woody brush is being successfully controlled in other parts of the Nation, including the Pacific Northwest. Methods used in other areas should be tested in southwestern Oregon problem areas. Although hormone herbicides offer especial promise, older methods of mechanical control, burning, and combinations of these with chemical control using the new herbicides should not be neglected. Some typical questions for which answers are needed are:

1. What methods of brush eradication are most effective and economical? For what brush associations and under what conditions of soil and terrain?

    a. Mechanical
    b. Chemical
    c. Fire
    d. Combinations

2. How susceptible are the important brush species to different herbicides? What concentrations, carriers, and seasons and methods of application are most successful?

3. Physiologically, how do the most effective herbicides act on brush species? How are they absorbed and translocated, and how do they kill woody plants?

4. What is the physiological basis for selectivity of herbicides?

5. What methods of chemical spray application are best suited to local conditions?

6. What can be done to eliminate grasses and sedges on clearcuts to be reforested? These are sometimes more undesirable than brush.

7. For some combinations of environment and brush composition, forests can invade successfully and take over. Can such combinations, in the absence

of natural seed source, be reclaimed by aerial seeding without brush killing? Which brushfields and environments? Which tree species will be most successful? How many seedings will be needed? What supplementary measures, such as rodent (including rabbit) control, will be needed?

8. In almost impenetrable brush on rugged terrain, does a combination of aerial spraying to control the brush, aerial rodent control, and aerial seeding offer a chance of being reasonably successful?

9. Under what conditions can herbicides be used to release established conifer reproduction?

The number of methods and combinations of methods which can be used at different seasons of the year in varying conditions of vegetation and terrain are, of course, too numerous to list completely. Methods for a particular problem area will have to be designed to obtain the information needed.

Ecology and Physiology

Very little is known about the ecology and physiology of our important brush species. Many observations of brush conditions have been recorded in connection with studies in forest regeneration, but very few studies have been designed to furnish specific information concerning the brush species themselves. Such information is vital if any lasting progress is to be made in the field of brush control.

Information on the physiology of shrubs and on species composition and ecological relationships in southwestern Oregon brushfields is practically nonexistent. Information is also needed concerning the reproductive habits of the various brush species, their response to environmental changes, and their growth and rooting habits. A knowledge of the environmental conditions which favor brush species and those which are detrimental to brush might indicate practicable changes in silvicultural methods which would prevent any further increase in the acreage occupied by brush species. Fundamental studies in ecology and physiology of brush species should be carried on concurrently with studies of methods of brush control. Examples of questions which need to be answered are:

1. What is the position in succession of the various brush species or associations on different environments? Are some climax? Will others be replaced by trees in reasonable time where there is a seed source?

2. Which brushfields in different environments will restock without aid? How long will it take? What kinds will not restock in a reasonable time, and in what environments?

3. Are any brush species or associations indicative of site quality or of the suitability of the environment for different forest tree species? Is brush size and density indicative of site quality?

4. How seriously do the various species and associations interfere with regeneration, establishment, growth, and ultimate size of trees?

5. In some cases brush seems to favor and in others to hinder forest regeneration. Why these differences? Through what environmental factors is the influence of the brush exerted?

6. What are the differences in root distribution of the more important brush species? Do differences in rooting habit help to explain why some brush species seem to hinder and others help tree seedling establishment?

7. What tree species will most effectively compete with brush? What is the physiological basis for this ability?

8. Under what conditions will existing tree seedlings respond satisfactorily to release from brush? What species, age, and degree of suppression? On what environments and in what kinds of brush?

9. If the existing brush cover is killed, how rapidly will it return? If killed by herbicides? By fire? By mechanical means? What changes in composition will take place?

10. What are the seed characteristics of our native brush species? Periodicity? How disseminated? How long can the seed remain dormant and viable on the forest floor? For how many years after logging and slash burning will seed stored in the forest floor continue to produce new shrub seedlings?

11. Are there any biotic agents (insects or disease) which might prove useful in controlling important brush species?

12. How can brush-threat areas be recognized in advance of logging?

13. What roles have forest removal, soil disturbance, slash burning, and other harvesting practices played in discouraging or encouraging brush? Can harvesting practices be modified to discourage brush? Should harvesting practices differ for different environments?

14. What measures should be taken when harvesting brushy, understocked stands to assure prompt restocking and rapid tree growth?

15. What effect will brush control and brushfield reclamation have on game birds and game animals in the area? If the brush is killed, what effect will game have on tree reproduction?

16. Does grazing of restocking cutovers by big game and livestock favor or hinder brushfield formation? How does it affect the relative competitive positions of the brush and tree seedlings?

17. Are the standing dead remains of chemically killed brush beneficial, unimportant, or harmful to tree seedlings?

18. How do individual plants or small clumps of each of our important brush species affect the environmental factors important in germination, establishment, survival, and growth of tree seedlings?

    a. Soil moisture
    b. Soil temperature
    c. Relative humidity
    d. Evaporation
    e. Light

Soils and Water

Soils are an important part of the environmental complex of brushlands, and studies of soil conditions in our more important brush associations are a necessary and important adjunct of fundamental studies in ecology of brush species. Studies are needed to furnish information on the present condition of soils in brushfields and their potential productivity if the brushfields can be converted to forests economically. Studies are also needed to obtain information on changes which take place in the soil when a logged-off site is occupied by brush. In addition, information is needed concerning the influence of brush species on erosive qualities and hydrologic efficiency of soils on watersheds. Several questions which might be answered by soil studies are:

1. What changes take place in the chemical and physical properties of soil when a site formerly occupied by forest is invaded by brush? When a brushfield is converted to forest?

2. What is the relative effectiveness of different brush species as soil protectors, soil builders, and watershed cover?

3. Have soils under any of the brushfields deteriorated to the point where they will no longer support a forest of the original type?

4. Is soil degradation continuing under cover of the different brush associations? How fast?

5. What soil improvement can be expected under coniferous forests? How rapidly can improvement be expected?

6. Will soil improvement have an economic worth for forest production or streamflow regulation, a worth which can be measured and which will help defray the expense of brushfield reclamation?

7. On what environments will conversion of brush to forests yield the most value in terms of soil protection, soil building, and water regulation?

8. What effects do various methods of brush control and eradication (chemical, mechanical, burning, biological, and combinations of these) have on structure, fertility, and erosion of soils in brushfields? How do these methods affect the watershed functions of the soil?

Economics

The importance of the brush problem in southwestern Oregon is obvious to everyone engaged in land management in this area, but only a very limited amount of reliable information is available concerning the acreage involved and the potential productivity of the brushlands for forest growth. Listed below are some questions which need to be answered:

1. What influence does competition of different brush associations on various environments have on growth of trees in the (a) seedling, (b) sapling, (c) pole, and (d) sawtimber stages?

2. How much does brush competition on different environments lower site quality, as measured by height over age, in understocked stands?

3. What economic losses accrue in different kinds of brushfields on different environments from delayed stocking, understocking, and curtailed growth?

4. How much can be spent for brushfield reclamation on different sites?

5. On what environments and for what kinds of brushfields will conversion of brush to forest yield the greatest returns on the investment?

6. What are average costs per acre for different methods of brush eradication?

7. What acreage of forest land in southwestern Oregon is occupied by unstocked brushfields? By understocked stands having an understory of brush?

8. What part of the forest land is occupied by each of the different brushfield types? What does each part represent in terms of potential forest production?

Experience from Past Efforts in Brushfield Reclamation

The large brushfields of southwestern Oregon and the problem of converting these brushfields to forest production have been a challenge to foresters for the past 60 years. Quoting from a paper by one of these men:

> The reforestation of the chaparral areas is one of the big problems in Forest management today, and will continue so for many years in the future. On the Siskiyou National Forest there are approximately 327,000 acres... covered with chaparral of many species...

This statement, which sounds very much as if it were written today, is taken from an article published 47 years ago (Haefner, 1912).

Seeding and Planting After Brush Fires

Earlier publications and records show that foresters have attempted several brushfield reclamation projects in southwestern Oregon during the past 50 years. Most of these were centered on the 10,000-acre Cat Hill brushfield in the Rogue River National Forest. The earliest attempt at reclamation evidently occurred soon after the Cat Hill fire of 1910, which destroyed the brushfield observed on this area by Leiberg in 1899. Foster (1912) mentions an unsuccessful seeding in the fresh burn.

A 72-acre plantation of ponderosa pine established on Snowshoe Butte within the Cat Hill burn during April 1912 proved much more successful. The plantation was established in the 1910 burn, but evidently where a stand of timber had been destroyed by the fire rather than in the area occupied by the old brushfield. The establishment report states that the plantation was "... situated in the midst of what was once a fine merchantable body of yellow pine, sugar pine, Douglas and white fir, but now it is a blackened stand of fire-killed timber..." and that "The brush is also thick in some places and not any in others, while the most of it is of a light density."[2] The Coeur d'Alene Forest in Idaho is listed as the seed source for the planting stock. Forty-five years after establishment this plantation is in excellent condition and growing satisfactorily.

A 20-acre plantation of the same stock was established at the same time in a nearby part of the old brushfield burned over by the 1910 fire. The area was described by White as "...treeless and covered with a medium dense amount of fire-charred manzanita and snowbrush which is sprouting vigorously from the roots." Trees were planted sparsely among the resprouting brush. Four years later the planting was judged a failure because of "Brush too thick and too much shade."

The failure of the planting in the resprouting brushfield is indicative of the severe competition provided by resprouting brush in well-established brushfields. Reforestation of brushfields will be much more difficult than regeneration of formerly timbered areas after cutting or fire. Even on the latter areas, if a brush threat is recognized, immediate replanting with vigorous stock is recommended (Ruth, 1956).

2/ White, W. E. Memorandum dated May 8, 1912, concerning establishment of Snowshoe Butte plantations. In files of Supervisor, Rogue River National Forest, Medford, Oreg.

Planting in Tractor-Cleared Lanes

Another attempt was made to reforest the Cat Hill brushfield during the period 1935-38.[3] In three successive projects, ponderosa pine from several sources was planted in lanes bulldozed through the brushfield. No fires had swept the area since 1910, and the brush was again well established after the lapse of 25 years.

In the first project, 13 lanes, each about 1,100 feet long, were cleared during the summer of 1935. Average width of the lanes was 6 to 8 feet, and about 16 feet of undisturbed brush was left between cleared strips. Deschutes National Forest 1-1 ponderosa pine seedlings were planted at 12-foot intervals in the center of these lanes during November 1935. In April 1936, similar stock was interplanted in some lanes to create a 6-foot spacing between trees. Best survival was obtained with the spring planting, so trees were planted in spring in the succeeding projects.

In 1936, 11 more lanes were cleared. Each lane was about 1,180 feet long, creating a total of 2.5 miles of lanes, and only 8-foot strips of undisturbed brush were left between successive lanes. Three-year-old Deschutes ponderosa pine trees used as planting stock were of two types, 1-1Pl and 1-2. Roots of the former had been pruned during their second year in the transplant beds; roots of the latter had not. Although survival of normal stock seemed better, no definite conclusions were reached on the value of root-pruned versus unpruned stock because the cleared lanes were heavily trampled by cattle.

The third trial involved 20 bulldozed lanes, each about 2,600 feet long, for a total of 9.9 miles of cleared lanes. Again 8-foot-wide strips of undisturbed brush were left between successive lanes. Four types of planting stock from two seed sources were included in this test. One seed source was local (Fourbit Creek); the other was eastern Oregon (Deschutes). The stock from each seed source was divided into two groups. One group of the 3-year-old Fourbit trees (1-1Pl) had been root pruned the second year in the transplant beds; the other group (1-2) had not been root pruned. No age was recorded for the Deschutes trees, but the records show that some of the stock had been sprayed with strychnine to deter cropping by rabbits and deer. The balance of the Deschutes stock was used as an unsprayed control. Unfortunately, extensive trampling by cattle destroyed the experiment, and no conclusions concerning the treatments were possible.

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[3] Memoranda dated Oct. 15, 1935, to May 7, 1941, concerning Cat Hill plantings. In files of Butte Falls Ranger District, Rogue River National Forest, Butte Falls, Oreg.

Early survival of the planted trees was good in the cleared lanes, but later all three of the plantings failed. Causes of loss listed in the examination reports include trampling by cattle and deer, competition of resprouting brush, and cropping of trees by rabbits, deer, and cattle. One report on the 1938 planting stated that "Stock had promenaded up and down the rows until in some places they resembled barnyards." During 1939, the ends of the lanes on all three projects were fenced to keep the cattle out. However, heavy cropping by rabbits continued, the brush resprouted, and the plantations failed. After a lapse of 20 years, it is difficult to distinguish the cleared lanes from the undisturbed brush, and only scattered trees are to be seen emerging from the dense brush cover.

This project illustrates two important drawbacks of cleared strips in reforestation of brushfields. First, the lanes are apt to serve as passageways through the brush for cattle and deer, with a resultant trampling of the planted trees. Second, the trees are heavily browsed by deer and cattle using the lanes and are cropped by rabbits, which need hardly emerge from the undisturbed brush between strips to reach the planted trees. A large opening instead of lanes might reduce rabbit damage. In entering the opening, rabbits would be exposed to hawks, owls, and other predators which might reduce the rabbit population or deter the rabbits from entering the clearing.

Brush Control With Herbicides

Several attempts were made between 1947 and 1954 to control woody brush with 2, 4-D and 2, 4, 5-T on forest and range lands in southwestern Oregon. In the tests known to the author, the herbicides were applied as foliage sprays with ground equipment and with aircraft. Generally, these trials have been regarded as failures because the brush resprouted and after a few years there was little evidence that any spraying had been done. As far as is known, applications to control new sprouts and seedlings were not tried.

Because brush species are characteristically mixed in southwestern Oregon brushfields, repeated applications of herbicides will probably be necessary to secure an acceptable degree of control.

Discussion

In 1955, the Pacific Northwest Forest and Range Experiment Station began a brush control and brushfield reclamation research project at the Roseburg Research Center. The objective of this project is to develop practical and economical methods for reforestation of the extensive brushfields on forest lands in southwestern Oregon.

This section of the paper presents the author's evaluation of the importance of various phases of the brush control problem and discusses a possible research program to obtain some of the solutions.

Brush Prevention

"An ounce of prevention is worth a pound of cure" is an old adage which might well apply to our methods of handling cutover lands which are being occupied by brush. The 1947 Forest Survey revealed a total of almost 46,000 acres of old nonstocked cutover land in Coos and Douglas Counties (Moravets, 1951). Most of these cuttings are occupied by brush. This means that by 1947 we had already created the equivalent of 72 square miles of nonproducing cutover lands--most of which have reverted to brushfields--on some of the most productive forest land in southwestern Oregon.

Our first and most important task in brush control, therefore, is that of preventing expansion of existing brushfields and creation of new brush areas as a result of poor management practices. We will gain nothing if our silvicultural practices create new brushlands at the same rate as we control and convert existing brushfields to forest production.

Many areas logged in the past are now occupied by brush or by understocked stands of conifers with a heavy understory of brush. Little new reproduction is becoming established in many of these understocked stands, and the sites are growing only a fraction of the timber which they are potentially capable of producing. No information is available concerning the cost of controlling brush in these stands; but time, money, and effort will have to be spent on the sites if the lands are to be brought up to an acceptable level of stocking.

Preventing brush from taking over new cuttings should prove to be one of the more productive fields for brush control research. In this phase of brush control, we would definitely be working with lands capable of producing timber crops. In addition, brush seedlings and sprouts generally can be controlled more economically than mature brush of the same species. In brushfield reclamation, in contrast, many of the sites are of questionable quality. Even after economical methods for reclamation are developed, a reliable guide for judging potential timber productivity (probably a soil-site correlation) must also be developed to insure a wise selection of areas to be reclaimed. Therefore, it should cost less to hold one acre which threatens to revert to brush than to reclaim one acre in a well-established brushfield.

Studies are needed to learn whether there are practicable modifications of logging methods and other silvicultural practices which will create conditions on the cutover areas favorable for reproduction of tree species but unfavorable or less favorable for establishment of brush species. In order to develop such modifications, we will first have to acquire a sound knowledge of the ecology of the important brush species in southwestern Oregon.

Brushfield Reclamation

Brushfield reclamation research should be carried on concurrently with brush prevention work. Reclamation of even a part of the million or more acres of commercial forest land now occupied by brush or by understocked stands with dense understories of brush, obviously could greatly increase timber production in southwestern Oregon. This would represent an important contribution to the economy of the area. In addition, the recent Timber Resource Review (U.S. Forest Service, 1958) emphasized the national need for reclamation of potentially productive forest lands to supply the timber products which will be required for a constantly increasing population.

Although available data and estimates of acreage involved are too general to allow accurate calculation, a rough estimate of the loss in timber production due to brush was made to help evaluate the problem. Most brushfields in southwestern Oregon are within the Douglas-fir type and are probably located on poorer-than-average sites. Assuming an average site class IV and 75-percent stocking, the 315,000 acres of nonstocked old burns and cutovers could produce about 7.4 billion board feet of timber on a 100-year rotation after reforestation. If further assumed that production on half of the 1,800,000 acres that are now understocked could be increased 100 board feet per acre annually through brush control measures, these lands would provide an additional increase of 90 million board feet yearly. These rough estimates indicate that brush control and reforestation of brushlands in southwestern Oregon could result in production of an additional 164 million board feet of timber per year.

The brushfield reclamation project in southwestern Oregon can be subdivided into several categories: (1) methods of brush control, (2) economics, (3) ecology of brush species, and (4) effects of brushfield reclamation. Obviously, none of these can be completely divorced from the others. A study designed to answer a question in one category will usually yield information in one or more of the other categories as well.

Research on methods of brush control should receive first priority during the early phases of the project. The initial studies should be designed to learn if and how the more important brush species can be controlled sufficiently to allow reforestation of brushfields or to release existing reproduction from brush competition. Ecology and physiology of brush species is assigned an almost equally high priority because such studies are a necessary part of the process of developing effective brush control measures. Economics of brushfield reclamation should receive third priority, although this aspect of the problem cannot be entirely disregarded during the early phase of the work. Effects of brushfield conversion are assigned fourth priority. Obviously, it would be foolish to worry about the effects of brushfield reclamation before we know whether we can control the brush.

If feasible and economical methods of brushfield reclamation are developed, however, the effects of conversion should be thoroughly investigated before we engage in widespread reclamation projects.

Chemical brush control should be stressed in the initial phases of the project. The hormone herbicides offer the most promise for effective and economical control, and small-plot tests should be used to learn which of these herbicides are most effective on important brush species in southwestern Oregon. Results of such tests would supplement, verify, and fill gaps in the results of earlier studies. The effect of herbicides on conifer reproduction should be studied at the same time. The Roseburg Research Center should also participate in brush control projects carried on by interested cooperators when such projects will furnish useful research information. Later studies can be designed to learn whether fire, mechanical methods, or biological methods can do the job more economically, or if any of these methods can be combined to achieve more effective and economical control.

Aerial spraying offers the most promise as a practical and economical method for application of herbicides on brushfields in southwestern Oregon. Most brushfields in this region are in rough, mountainous terrain where ground equipment would have access to only limited areas. Steep mountain slopes will also limit the use of mechanical methods for brush eradication.

Since aerial spraying is considered most promising, initial efforts should center on a search for chemicals which will control woody brush when applied as foliage sprays. Many new herbicides have been developed by chemical companies in recent years, and new chemicals are constantly being added. Considering the large number of brush species native to southwestern Oregon, the magnitude of the screening process becomes apparent. To keep the tests within reasonable limits, careful judgment will be required in selecting the herbicides to be screened and the brush species upon which they will be tested. The screening tests should be a continuing process, evaluating promising new herbicides as they are developed and retesting old herbicides as they are improved.

SUGGESTED RESEARCH PROGRAM

Extensive research will be required to answer the many problems associated with management and reclamation of brushfields on forest land in southwestern Oregon. In concluding this paper, an attempt has been made to list the many types of studies deemed necessary to obtain the answers to the more important problems. These studies are listed in approximate order of priority based on a personal evaluation of need for the answers and the necessary sequence of: (1) development of methods for brush control and brushfield reclamation, (2) application of the methods, and (3) effects of brushfield conversion. Of necessity, the study designations are broad in scope. Within each designation, individual studies will have to be designed to get answers to specific problems in the various brush zones of southwestern Oregon.

The priorities assigned are not to be considered restrictive on sequence of work in the brush control project. For example, as feasible and economical methods of control are developed for a species or a group of species, these results should be used on suitable areas while work continues on developing methods of control for more resistant species. In addition, the occurrence of particular conditions, facilities, or opportunities for cooperation may make it advisable to carry on studies in a classification of lower priority before those in a higher priority are completed or, perhaps, even begun. Finally, a periodic reevaluation of priorities and problems should be made to insure that the research effort is being directed to obtain the answers most urgently needed by management and to explore the most promising avenues for control as new chemicals or new methods are developed.

The proposed brush control studies are as follows:

1. Brush prevention in new cuttings.

   Objective: Determine whether current methods of logging and slash disposal favor brush encroachment; if necessary, develop practicable modifications of these methods in order to eliminate conditions favoring brush development.

   Method: Ecological studies of effects of fire, increased insolation, and logging disturbance on seeds and seedlings of brush species encroaching on new cuttings.

2. Evaluation of herbicides for use on woody brush in southwestern Oregon.

   Objective: Determine the most effective herbicides and best season for application for controlling important brush species on forest lands.

   Method: Periodic application of promising herbicides as foliage sprays on replicated plots or numbered plants of selected brush species. Measure degree of top kill, complete plant kill, and resprouting with each herbicide; determine season of application which produces best control.

3. Grass and sedge control.

<u>Objective</u>: Develop economical methods for controlling grasses and sedges which invade new cuttings and jeopardize reforestation.

<u>Method</u>: Small-plot tests of chemical control plus collaboration with interested cooperators in project-size tests of mechanical eradication or application of results of the chemical tests.

4. Effect of herbicides on conifer reproduction.

<u>Objective</u>: As a guide for selection of treatments in release projects, determine relative susceptibility of conifer reproduction to herbicides and learn which herbicides cause least damage.

<u>Method</u>: Foliage applications of herbicides on replicated plots or tagged trees.

5. Release of conifer reproduction from brush competition.

<u>Objective</u>: Learn how conifer reproduction can be released from brush competition economically and under what conditions release is necessary and profitable.

<u>Method</u>: Measurements of growth of reproduction after release by various methods on replicated plots.

6. Effect of brush on environmental factors affecting establishment, growth, and survival of conifer reproduction.

<u>Objective</u>: Determine degree of competition provided by the more abundant brush species on forest lands in the seven brush zones of southwestern Oregon.

<u>Method</u>: Measurements of light, air and soil temperatures, relative humidity, and soil moisture at varying depths under and around the shrubs. Correlation of the various factors with critical conditions for conifer reproduction.

7. Ecology of brush species.

<u>Objective</u>: Obtain a better understanding of response of brush species to logging, slash burning, and

reclamation treatments as a vital step in insuring development of successful methods for controlling brush.

Method: Distribution, seeding characteristics, and other studies of the ecology of the more important brush species.

8. Methods of brush control.

Objective: Develop quickest and most economical method or combination of methods for controlling brush in established brushfields. Methods include use of chemicals, fire, and mechanical equipment, and combinations of these.

Method: Collaboration with interested cooperators in trials of various methods in the different brush types.

9. Role of brush in trends of succession on principal habitats in the various brush zones.

Objective: As an aid in selecting sites for reclamation studies and later brushfield reclamation projects, learn to distinguish between sites on which brush is the climax vegetation and those on which the climax formation is conifer forest.

Method: Ecological studies of succession.

10. Aerial baiting and seeding for brushfield reclamation.

Objective: Learn whether reclamation of brushfields by aerial baiting and seeding with or without chemical brush control is possible in brushfields where natural reproduction becomes established and grows well in competition with the brush.

Method: Cooperation with national forests and private companies on measuring germination, survival, and growth of seedlings on trial areas.

11. Growth of planted trees of various species under different brush associations.

Objective: For possible underplanting in reclamation of brushfields, learn which tree species can best survive and grow in the various brush associations.

Method: Test plantings in the different brush types.

12. Harvesting and regeneration of understocked stands of sawtimber with dense understory brush.

    Objective: Develop methods for harvesting the timber on the 1 million or more acres of understocked stands and converting the areas to well-stocked, productive young forests.

    Method: Collaboration with interested cooperators on trials of brush control before and after logging combined with various methods of natural and artificial regeneration.

13. Growth of sapling and pole-sized conifers after release from brush competition.

    Objective: Learn whether eradication of brush from understocked young stands will result in increased growth of the conifers and under what conditions such release would be profitable.

    Method: Comparisons of growth in released and brushy stands.

14. Site quality of brushlands for timber production.

    Objective: Develop criteria to aid administrators in selecting the most productive sites for brushfield reclamation projects.

    Method: Probably a soil-site correlation, but brush associations and condition, annual and seasonal distribution of rainfall, and other environmental conditions should also receive consideration.

15. Natural reclamation of brushfields by seedfall from scattered trees in the brushfield, or from adjacent timbered areas.

    Objective: Learn which brushfields in the different brush zones will restock without aid and how long the process will take. Also, learn which brushfields will not restock naturally as a guide in selecting brushfields for study and treatment.

Method: By stocking studies and age and rate of growth measurements, determination of rate of reforestation by encroachment from adjacent timber or spread from scattered seed trees in brushfields.

16. Economic studies of brushfield types.

Objective: Obtain more reliable information on total acreage occupied by the various brush associations and what each represents in terms of potential forest production.

Method: Survey of area in each association combined with information developed by studies under study designation 14.

17. Effects of brushfield conversion.

Objective: Learn effect of brushfield conversion on watershed and other multiple-use values.

Method: Comparison of water yields and multiple-use benefits from converted vs. undisturbed brushfields.

Since 1955, studies have been made in several of the preceding 17 research designations. Among these were an evaluation of herbicides for brush control, a study of the effects of herbicides on conifer reproduction, screening tests of chemicals for grass and sedge control, and an appraisal of aerial application of herbicides. A discussion of results, however, is considered too lengthy for inclusion in this paper. One report on results of these studies has been published (Gratkowski, 1959) and others are in various stages of preparation.

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APPENDIX

Brush Species in Southwestern Oregon

alpine bog kalmia	Kalmia polifolia var. microphylla
American red currant	Ribes triste
antelope bitterbrush	Purshia tridentata
baldhip rose	Rosa gymnocarpa
bearberry	Arctostaphylos uva-ursi
big whortleberry	Vaccinium membranaceum
*birchleaf cercocarpus	* Cercocarpus betuloides var. macrourus
*bitter cherry	* Prunus emarginata
blood Sierra gooseberry	Ribes roezli var. cruentum
*blueberry elder	* Sambucus glauca
*blueblossom	* Ceanothus thyrsiflorus
bog kalmia	Kalmia polifolia
box blueberry	Vaccinium ovatum
boxleaf silktassel	Garrya flavescens var. buxifolia
brown dogwood	Cornus glabrata
buckbrush ceanothus	Ceanothus cuneatus
*California buckthorn	* Rhamnus californica var. ursina
*California hazel	* Corylus cornuta var. californica
*canyon live oak	* Quercus chrysolepis
Cascades mahonia	Mahonia nervosa
*cascara buckthorn	* Rhamnus purshiana
Columbian ledum	Ledum columbianum
common beargrass	Xerophyllum tenax
*common chokecherry	* Prunus virginiana
common gorse	Ulex europaeus
*common juniper	* Juniperus communis
common pipsissewa	Chimaphila umbellata
common snowberry	Symphoricarpos albus
CraterLake currant	Ribes erythrocarpum
creambush rockspirea	Holodiscus discolor
cutleaf blackberry	Rubus laciniatus
deerbrush ceanothus	Ceanothus integerrimus
Delnorte manzanita	Arctistaphylos cinerea
Douglas spirea	Spiraea douglasi
dwarf blueberry	Vaccinium cespitosum
Fremont silktassel	Garrya fremonti

In this list, common and scientific names preceded by an asterisk are in accordance with Check List of Native and Naturalized Trees of the United States (Little, 1953); names of other species are in accordance with Standardized Plant Names (Kelsey and Dayton, 1942).

*golden chinkapin	*Castanopsis chrysophylla
golden evergreenchinkapin	Castanopsis chrysophylla var. minor
grapeleaf California dewberry	Rubus ursinus var. vitifolius
greenleaf manzanita	Arctostaphylos patula
ground rose	Rosa spithamea
hairy manzanita	Arctostaphylos columbiana
Himalaya blackberry	Rubus procerus
*Hinds willow	*Salix hindsiana
hoary manzanita	Arctostaphylos canescens
*Hooker willow	*Salix hookeriana
Howell manzanita	Arctostaphylos hispidula
huckleberry oak	Quercus vaccinifolia
Hupa gooseberry	Ribes marshalli
Klamath gooseberry	Ribes klamathensis
Lewis mockorange	Philadelphus lewisi
Lobbs gooseberry	Ribes lobbi
Menzies gooseberry	Ribes menziesi
modest whipplea	Whipplea modesta
mountain whitethorn ceanothus	Ceanothus cordulatus
myrtle pachistima	Pachistima myrsinites
Nootka rose	Rosa nutkana
nutmeg currant	Ribes glutinosum
*oracle oak	*Quercus X moreha
Oregon kalmiopsis	Kalmiopsis leachiana
Oregon viburnum	Viburnum ellipticum
Oregon wintergreen	Gaultheria ovatifolia
Oregongrape	Mahonia aquifolium
osoberry	Osmaronia cerasiformis
ovalleaf whortleberry	Vaccinium ovalifolium
*Pacific bayberry	*Myrica californica
*Pacific dogwood	*Cornus nuttallii
Pacific poisonoak	Toxicodendron diversilobum
*Pacific red elder	*Sambucus callicarpa
*Pacific rhododendron	*Rhododendron macrophyllum
*Pacific serviceberry	*Amelanchier florida
*peachleaf willow	*Salix amygdaloides
pinemat manzanita	Arctostaphylos nevadensis
Piper mahonia	Mahonia piperiana
prickly currant	Ribes lacustre
pygmy mahonia	Mahonia pumila
*quaking aspen	*Populus tremuloides
redstem ceanothus	Ceanothus sanguineus
red whortleberry	Vaccinium parvifolium
*Rocky Mountain maple	*Acer glabrum
rusty menziesia	Menziesia ferruginea
Sadler oak	Quercus sadleriana
salal	Gaultheria shallon
salmonberry	Rubus spectabilis

*saskatoon serviceberry	*Amelanchier alnifolia
scotch broom	Cytisus scoparius
scrub tanoak	Lithocarpus densiflorus var. montanus
seage	Carex spp.
Sierra evergreenchinkapin	Castanopsis sempervirens
Siskiyou gooseberry	Ribes binominatum
*Sitka alder	*Alnus sinuata
*Sitka mountain-ash	*Sorbus sitchensis
skunkbush sumac	Rhus trilobata
snowbrush ceanothus	Ceanothus velutinus
spreading snowberry	Symphoricarpos mollis
squawcarpet ceanothus	Ceanothus prostratus
sticky currant	Ribes viscosissimum
stink currant	Ribes bracteosum
sweetbrier rose	Rosa eglanteria
*tanoak	*Lithocarpus densiflorus
undergreen willow	Salix commutata
varnishleaf ceanothus	Ceanothus velutinus var. laevigatus
*vine maple	*Acer circinatum
*wavyleaf silktassel	*Garrya elliptica
wax currant	Ribes cereum
western azalea	Rhododendron occidentale
western bracken	Pteridium aquilinum var. pubescens
western swordfern	Polystichum munitum
western thimbleberry	Rubus parviflorus
western wintergreen	Gaultheria humifusa
*white alder	*Alnus rhombifolia
whitebark raspberry	Rubus leucodermis
whiteleaf manzanita	Arctostaphylos viscida
winter currant	Ribes sanguineum

Common Tree Species in Southwestern Oregon

bigleaf maple	Acer macrophyllum
California black oak	Quercus kelloggii
California-laurel	Umbellularia californica
Douglas-fir	Pseudotsuga menziesii
golden chinkapin	Castanopsis chrysophylla
grand fir	Abies grandis
incense-cedar	Libocedrus decurrens
Jeffrey pine	Pinus jeffreyi
knobcone pine	Pinus attenuata
lodgepole pine	Pinus contorta
Oregon ash	Fraxinus latifolia
Oregon white oak	Quercus garryana
Pacific madrone	Arbutus menziesii
ponderosa pine	Pinus ponderosa
Port-Orford-cedar	Chamaecyparis lawsoniana
red alder	Alnus rubra
Shasta red fir	Abies magnifica var. shastensis
Sitka spruce	Picea sitchensis
sugar pine	Pinus lambertiana
tanoak	Lithocarpus densiflorus
western hemlock	Tsuga heterophylla
western redcedar	Thuja plicata
western white pine	Pinus monticola
white alder	Alnus rhombifolia
white fir	Abies concolor

In this list, common and scientific names are in accordance with Check List of Native and Naturalized Trees of the United States (Little, 1953).

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