

POTENTIAL TIMBER VALUES AS COMPARED TO  
GRAZING VALUES OF THE OREGON STATE COLLEGE  
FOOTHILL PASTURE LANDS

by

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# POTENTIAL TIMBER VALUES AS COMPARED TO GRAZING VALUES OF THE OREGON STATE COLLEGE FOOTHILL PASTURE LANDS

## INTRODUCTION

For many years, dating back to the time of the early settlers in the Willamette Valley, the foothill lands surrounding the main valley floor have been devoted to the grazing of domestic livestock. In general, this type of land is marginal or submarginal for crop production and much of it will continue to be used for grazing. However, there are some areas now being invaded by unpalatable species of shrubs and inferior forage. They threaten continued grazing use of the land. The Oregon State College Agricultural Experiment Station conducted a study on fifty-four hill pastures throughout the Willamette Valley in 1934 and 1935 and found that, on the average, about one-third of the total pasture areas studied were waste land or covered with trees and brush. This left but two-thirds of the total acreage to produce forage (5, p.13).

### Statement of the Problem

A large area of the Oregon State College foothill pasture lands has been invaded by certain species of trees and shrubs which are not palatable to most livestock. For the most part, these species are Douglas-fir (Pseudotsuga taxifolia) and poison oak (Rhus diversiloba). Pasturing

such an area rather severely with goats has been considered an economical method of controlling poison oak where cultivation is impracticable (13, p.4). Since 1942, Angora goats have been concentrated heavily on this area for the specific purpose of suppressing the poison oak by browsing. In spite of the concentrated browsing this plant is becoming more dense and is spreading into new areas.

Since the area is being invaded by woody species and the grazing value is being depreciated under present use, it is possible that an alternative use, namely, Douglas-fir timber production, may yield greater returns.

#### Purpose of the Study

The specific purposes of this study are:

1. To determine the increase or decrease in the numbers of Douglas-fir seedlings and poison oak plants over a five-year period and under the different cover types found within the area.
2. To analyze the apparent factors affecting the ecological changes taking place.
3. To determine whether grazing or timber production will yield greater returns from the area.

### Location of the Study

This study was conducted on the Oregon State College Agricultural Experiment Station lands located approximately two miles northwest of Corvallis, Oregon. The specific area covers approximately 160 acres and is located in the south half of the northeast quarter and a small portion of the north half of the southeast quarter of section 29 and the southwest quarter of the northwest quarter and a small portion of the northwest quarter of the southwest quarter of section 28, Township 11 South, Range 5 West, Willamette Meridian.

### Methods Employed in the Study

During the winter of 1940-41 a system of plots to be used in collecting the necessary information was established by Max Robinson, a graduate student in the School of Agriculture. A base line was run in a north-south direction and points were established along this line at intervals of four chains (see map). From these points, transect lines were cut in an east-west direction on the west side of the base line and extended to the west boundary of the pasture lands. Reference points were set at four chain intervals along these transect lines. To eliminate the effect of cutting the brush, offset points

were established eleven feet north of each point on the transect lines and used to mark the center of the sample plots employed in the inventory. The sample plots are circular, 100 square feet in area, each having a radius of 5.64 feet. All points along the base line and transect lines were marked with iron stakes. The sample plots were also marked with iron stakes. Distances were measured by pacing.

The basal stems of poison oak and Douglas-fir seedlings were counted and recorded on each plot. These counts were made during the winter and spring of 1940-41 and the winter and spring of 1946.

#### Limitations of the Study

This study was made in the Willamette Valley on one area, which was typical of many foothill pastures within the valley. No other land use besides grazing and Douglas-fir timber production has been considered in the scope of this report.

## HISTORICAL BACKGROUND

### Review of Literature

The effects of livestock grazing on many species of tree reproduction have been thoroughly investigated. Stickel and Hawley (26, p.860) found that the benefits of grazing outweighed the damage done to pine plantations when the season of grazing, species and numbers of animals were regulated. Krauch (15, p.605), in his investigations on Douglas-fir reproduction in the Southwest, states that areas open to cattle were heavily grazed but no direct evidence of grazing damage was found. Ingram (8, p.1001), in his investigations with sheep, considers it safe to say that where moderate grazing occurs, damage and loss of Douglas-fir seedlings are distinctly of minor consequence. Further studies by Ingram (9, p.416-417) indicate that moderate grazing use is not seriously inimical to forest regeneration in the Douglas-fir region. Young, Dell, Harris, and Blaisdell (28, p.43) conclude that moderate grazing by sheep is beneficial to white pine reproduction and that it has little effect on other coniferous species in Idaho, while continuous overgrazing is harmful to coniferous reproduction.

Despite numbers of reports concerning the effects of sheep, cattle and horses grazing on reproduction, there

is little information concerning the effects of goat browsing on coniferous reproduction.

There is practically no information concerning the effect of any type of livestock browsing poison oak. Quotations taken from letters (2, p.347-371) state that goats have been used to clean brush from land in all parts of the country. Most of the letters stated or implied that goats will eat all kinds of brush while two letters definitely stated that they would eat all kinds of brush with the exception of poison oak. One other exception was laurel. Nelson states (24, p.9-13) that goats are used to clear out brush which is largely of the oak type in the Willamette Valley and other sections of the state of Oregon.

#### Brief History of the Area

The area on which this study was conducted has been subjected to grazing use as far back as is known. It has been grazed to varying numbers of cattle and sheep during all seasons of the year. The original owners had a few goats and grazed them along with other livestock on the area. In 1940 it was acquired by Oregon State College and has been used for experimental purposes since that time. It was grazed to sheep until the fall of 1942, at which time the sheep were removed and goats were concentrated

on the area for the purpose of suppressing the poison oak. The area was purposely overstocked with goats so that it would be necessary for them to eat the more unpalatable shrubs. This was facilitated by fencing off smaller grazing units and concentrating the goats on one unit at a time. The whole area, about 160 acres, is comprised of two complete units and a portion of two other grazing units (see map). The number of goats has varied from 50 to over 100 head since they were first put on the area, with an average of 90 head during the past year.

There is evidence that this tract of land was used also as a woodlot in conjunction with the grazing use. Most of the area supports a rather dense growth of Oregon oak (Quercus garryana). Much of the smaller oak up to a diameter of twelve inches is coppice, that is, growth from stump sprouts. Much of the original oak was probably cut about 1880 when one of the heaviest snowfalls in the history of the region covered the ground. The farmers, not being prepared to feed hay, had to cut the native Oregon oak as a last resort in order to provide feed for their livestock.

This coppice growth is also evidence that goats were not heavily concentrated on the area during that time. Goats relish tender young stump sprouts and buds and will

eat them before turning to other feed.

### Climatic and Physical Features

#### Rainfall

The recorded average annual rainfall at Corvallis, Oregon for the 57-year period prior to January 1946 was 39.06 inches. The largest amount of rainfall, 58.06 inches, occurred during the year 1937 and the lowest, 23.68 inches, in 1930. Despite this apparent abundant supply of precipitation, it is unequally distributed over the seasons and a near drought prevails during the months of July and August when the rainfall is normally less than one-half inch during each month. There is usually less than two inches of precipitation per month covering the period from May through September. The periods of heavy precipitation occur during late fall, winter and early spring.

#### Temperature

The temperatures at Corvallis and the surrounding area are usually moderate. This is due to cool ocean breezes in the summer and to warm moisture-laden westerly winds in the winter. The mean temperature at Corvallis during the month of August is 66.2 degrees Fahrenheit and



the average maximum temperature is 81.1 degrees. The mean temperature during January is 39.3 degrees with the average minimum being 32.9 degrees.

The highest temperature recorded over the 57-year period prior to 1946 was 106 degrees on July 13, 1935. The lowest temperature recorded was minus 14 degrees on December 12, 1919. The average frost-free period in this locality is 187 days, usually beginning in the latter part of March and ending in October.

Table 1 on the following page shows the normal rainfall and mean temperatures by months for the Corvallis area.

Table 1

## WEATHER DATA

Compiled by weather station at Oregon State College,  
Corvallis, Oregon, covering the 57-year period prior to  
January 1946.

Month	Normal Rainfall (inches)	Mean Temperatures (degrees Fahrenheit)
January	6.47	39.3
February	5.15	42.3
March	4.13	46.2
April	2.56	50.9
May	1.88	55.7
June	1.14	60.9
July	0.28	66.2
August	0.43	66.2
September	1.57	61.0
October	2.88	53.6
November	6.43	45.4
December	6.14	40.8

### Topography

The topography of the study area varies from flat land along the creek bottom on the east to moderate to steep hillsides over most of the area and again nearly level plateaus on the hilltops on the western portion of the pasture. The hillside slopes are rather even, with a gradual transition to level areas. The elevation varies from 325 feet above sea level at the creek bottom on the east to an elevation of approximately 640 feet on the hilltops to the west.

### Exposure

For the most part this area has an eastern exposure; however, all exposures can be found in varying degrees. Approximately 50 percent of the area can be classed as an eastern exposure, varying from northeast to southeast, 30 percent southeast to southwest and 18 percent northeast to northwest. Only about 2 percent has a southwest to northwest exposure.

### Soil

According to the Benton County soil survey (3, p.1449) the soil here, with the exception of a small portion along the creek bottom to the east, has been

classified as a shallow phase of Olympic clay. The surface soil is a brown to dark-brown, heavy, plastic clay. The subsurface soil is a grayish-brown or drab clay containing numerous rusty brown or black iron pellets and partly decayed fragments of the parent rock. Bedrock is found within six to twenty inches of the surface. Surface features vary from steeply sloping hillsides to the low rolling knolls of the lower foothills. Although bedrock is found within a short distance of the surface, there are no rock outcroppings on the area.

The small portion of land along the creek bottom is comprised of two types of soil, Cove clay and Wapato silty clay loam. These merge together and are dark-brown or dark grayish brown, smooth, heavy silty clay loams, eight to twelve inches deep. The subsoil reaches a depth of three feet or more and is a moderately compact drab or brown clay or clay loam mottled with rusty brown, yellow and gray. This type of soil is very plastic when wet. Upon drying it checks badly and loses moisture very rapidly.

The land type for this area has been classified by the Oregon State Agricultural Experiment Station as hill pasture land. It is highly acid in reaction, low in fertility, subject to erosion and drought and is chiefly adapted to pasture or forest production (1, p.10)(25,p.3).

### Drainage

This area is well drained. Although there are a few small springs here and there, the intermittent streams interspersed over the area allow good drainage. There are no boggy or constantly water-logged areas to be found.

### Erosion

Along the intermittent streams there is some gully erosion taking place. Most of it is found along the stream bed in the extreme northern portion of the area. Other small eroded areas can be found but none of them are considered to be serious at the present time. Some sheet erosion is taking place on a few of the steeper slopes which are open or have little ground cover. The constant trampling by goats accounts in part for the sheet erosion, which has not developed to serious proportions as yet.

### Site quality

Guise states (6, p.68) that a site is an area considered as to its physical factors with reference to forest or crop producing power. The productive capacity of an area can be determined by the combination of climate, soil, and physiographic factors. The character of the soil, moisture and drainage is particularly important. However,

a simpler manner of judging the forest site quality is by a study of the height growth of the trees.

According to McArdle (18, p.13) height measurements of 15 to 20 dominant and codominant trees and age counts of about 10 of them should be sufficient for site quality determination for Douglas-fir. Height measurements were made on 20 dominant and codominant Douglas-fir trees on the north portion of the area. The average height was found to be 98 feet. Ring counts on 10 stumps on adjacent land indicated that the average age of the stand was 50 years. An area producing timber of this height in a period of 50 years is classified as a site III area, and can be expected to produce timber having a height of 140 feet in 100 years (18, p.11-12).

There are no apparent differences in the soil, climate or physiographic features between the Douglas-fir timbered area and most of the total area considered in this study. Judging from the large amount of reproduction coming in among the oak and the scattered saplings throughout the area, it appears logical to assume that there are no substantial differences in the site quality.

## THE STUDY

### Classification of Types

To facilitate interpretation of the data obtained from the sample plots, cover types on the study area have been classified as shown on the accompanying map. There are eight types and these are described in the following pages.

#### Grass type

There are several areas of open grass land found on the hilltops in the western portion of the pasture and one other area bordering the large oak-bottom land type along the creek bottom in the eastern part of the pasture. A few scattered Oregon oaks occur here and there. Poison oak is found in scattered patches in the open and under the few trees. Along the borders of the grass type some scattered Douglas-fir seedlings are becoming established. This type is represented by nine plots in the study.

#### Grass-Oak transition type

There is only one area of this type. It borders the open grass type near the creek bottom in the eastern portion of the pasture. This type is grass land upon which Oregon oak has encroached. There are many small

oaks and a few scattered large oaks. Poison oak is found throughout and there are some Douglas-fir seedlings scattered here and there. This type is represented by only two plots in the study - not a representative sampling of the type.

#### Large oak - Grass type

This type represents the second largest plant community on the pasture. It is characterized by Oregon oaks 12 inches in diameter and larger, rather widely spaced, with some scattered small oak. The ground is covered with grass, and poison oak is found in patches over much of this type. Douglas-fir seedlings are quite numerous in certain portions. It is represented by 24 plots, giving a good over-all picture of the type.

#### Large oak type

This type is characterized by the large Oregon oak, 12 inches in diameter and larger, relatively closely spaced as in a normal oak stand. Grass is not found in this type. There is considerable poison oak covering the ground uniformly, not patchy as in some of the other types. Some Douglas-fir seedlings are found. Fourteen plots represent this type, giving an adequate sampling.



### Large - Small oak type

There is one plot of this type. It borders the grass type and the oak-grass transition type in the eastern portion of the pasture. It is composed of all sizes of Oregon oaks, including both young trees and small coppice growth. Poison oak is found in abundance as small plants which cover the ground, not in patches, but evenly distributed. Douglas-fir seedlings are found scattered throughout. The type is represented by five plots, an inadequate sampling.

### Large oak-bottomland type

This type is found only along the creek bottom on the extreme eastern portion of the pasture. It is comprised of large Oregon oaks and red alder. Grass covers the ground and there is much poison oak found in patches. This area has no particular significance in so far as this study is concerned since no plots were established in it.

### Small oak type

This is the largest area covered by any type found on the pasture. It consists of numerous small oaks, less than 12 inches in diameter, young trees and small coppice growth, and much scrub oak undergrowth. Abundant poison

oak covers the ground, much as in the large-small oak type. Many Douglas-fir seedlings are found scattered throughout. Along the northern portion near the Douglas-fir type, the Douglas-fir seedlings are particularly dense. There are also numerous Douglas-fir saplings up to 25 feet in height throughout the type beginning to overtop the small oak. This type is represented by 36 plots which gives the best sampling of all the types.

#### Douglas-fir type

This type is found in the extreme northern portion of the area and extends further northward on adjacent land. It is composed of second growth Douglas-fir up to diameters of 24 inches and some large and small Oregon oaks. Most of the large oaks have succumbed to the overtopping Douglas-fir. The small oaks are found in small open patches between the Douglas-fir. Poison oak is found in patches scattered throughout in the open areas along with the small oak. The three sample plots representing this type give inadequate data.

#### Inventory Procedure

The first inventory was made by Max Robinson, a graduate student in the School of Agriculture, and several other students under his supervision. The work was done

intermittently, starting in November 1940 and was completed in April 1941. Counts of Douglas-fir seedlings and poison oak plants were made and recorded for each of 94 sample plots which were systematically located over the area.

The second inventory was made by the author during the winter and spring of 1946. The work was started in February and completed in June. Counts of Douglas-fir seedlings and poison oak plants were made and recorded for each of the plots that were used in the first inventory, with but one exception. Much time was lost in locating the plots due to the rank growth of underbrush in some areas. One plot had been destroyed by a road that had been put in during the five-year period between inventories. The missing plot was located in the large oak-grass type which occupies the second largest area on the pasture and is represented by the second largest number of plots. It is not believed that the loss of this particular plot has greatly affected the results of the inventories.

A summary of plant distribution follows in tabular form.

Table 2

## SUMMARY OF POISON OAK PLANTS BY TYPE

Type	Number of plots	Total number of plants per plot		Average number of plants per acre		Percent increase	Percent decrease
		1941	1946	1941	1946		
Grass	9	210	223	10,163	10,794	6.2	
Grass-oak transition	2	52	0	11,326	0		100.0
Large Oak-Grass	24	1,405	1,612	25,500	29,259	14.7	
Large Oak	14	916	1,493	28,501	46,452	61.7	
Small Oak	36	2,491	3,520	30,139	42,593	41.3	
Large-Small Oak	5	531	447	46,261	38,943		15.8
Douglas-fir	3	230	295	33,397	42,833	28.3	
Total Area	93	5,835	7,590	27,330	35,549	30.07	

Table 3

## SUMMARY OF DOUGLAS-FIR SEEDLINGS BY TYPE

Type	Number of plots	Total number of seedlings per plot		Average number of seedlings per acre		Percent increase	Percent decrease
		1941	1946	1941	1946		
Grass	9	0	0	0	0		
Grass-Oak transition	2	3	0	653	0		100.0
Large Oak-Grass	24	59	24	1,089	436		60.0
Large Oak	14	3	0	87	0		100.0
Small Oak	36	30	30	348	348		
Large-Small Oak	5	1	1	87	87		
Douglas-Fir	3	0	9	0	1,307	100.0	
Total Area	93	96	64	449	305		32.07

Table 4

COMPARISON OF NUMBER OF POISON OAK PLANTS  
TO NUMBER OF DOUGLAS-FIR SEEDLINGS

Type	Number of plots	Average number of fir seedlings per plot		Average number of poison oak plants per plot		Ratio of poison oak plants to one Douglas-fir seedling	
		1941	1946	1941	1946	1941	1946
Grass	9	0	0	23.33	24.78	-	-
Grass-Oak transition	2	1.5	0	26.00	0	17	-
Large Oak- grass	24	2.5	1.0	58.54	67.17	23	67
Large Oak	14	.2	0	65.43	106.64	327	-
Small Oak	36	.8	.8	69.19	97.78	86	122
Large-Small Oak	5	.2	.2	106.20	89.40	531	447
Douglas-Fir	3	0	3.0	76.67	98.33	-	33
Total Area	93	1.03	.7	62.74	81.61	61	117

### Evidence Obtained from the Inventories

Results of the two inventories show that for the total area of the pasture there has been a decided increase in the number of poison oak plants and a decided decrease in the number of Douglas-fir seedlings. Whether this is due to natural ecological changes or due to the concentrated goat browsing is debatable. Both influences have a definite effect on the survival of both species.

It is known (10, p.39-44) that the mortality of Douglas-fir seedlings is high during the first five years of growth under normal conditions. It also has been reported (13, p.3) that poison oak thrives and spreads in old pastures and range lands, being able to reproduce by rootstalks as well as seed.

It appears that the goats prefer to browse the Douglas-fir reproduction above the poison oak. However, this may not be true. The overabundance of poison oak on the area makes it more readily available, and poison oak does not show the effects of browsing as readily as Douglas-fir reproduction.

The effect of concentrated goat browsing  
on poison oak

It is true that goats do browse the poison oak. The effect is most noticeable in areas such as the open

grass type and the large oak-grass type where it grows in clumps. Browsing causes a somewhat hedge-like appearance in the clumps. Goats eat the terminal buds for the most part but in the spring and summer they will also take some of the foliage. They do not eat the larger stems of the poison oak as they do some other plants but seem to prefer the young, tender root sprouts and the terminal buds. However, if the root sprouts are not eaten soon after appearing, they become woody and are not eaten at all.

In areas such as the small oak type where the poison oak is more regularly spaced and not clumped, the effect of the browsing is not as readily noticeable. It is doubtful that the goats work in this type as readily as they do the clumps.

A comparison of the two inventories (Table 2) of the poison oak reveals that in all but the grass-oak transition type and the large-small oak type the number of poison oak plants had increased. Since these two types are represented by only two plots and five plots respectively, it is not believed that they give a true picture of the types. Be that as it may, for the total area there was more than a thirty percent increase in the number of plants recorded.

It is believed that the goat browsing caused the poison oak plants to produce more root sprouts than normal



and consequently the plants have spread out, occupying larger areas. There is no substantiating evidence for this, however, since there were no check plots protected from goats.

The effect of goat browsing on  
Douglas-fir seedlings

On the total pasture area there was not a single Douglas-fir seedling found undamaged by goat browsing. Most of the terminal buds had been nipped off and some seedlings were practically stripped of all foliage. In many cases the bark had been stripped off along with the foliage. Remnants of barked dead seedlings can be found throughout the area; many have been broken and others have been bitten off, leaving stubs as much as one-half inch in diameter. Many of the smaller seedlings have been nipped off at the ground level.

The goats prefer the leaders and terminal buds of the branches. As many as five leaders are to be found on some of the seedlings, all of which have been nipped off at least once. It is not possible to tell the age of these seedlings from outward appearance because they have been eaten back so often. It is possible that some of them would have reached sapling stage if they had grown under normal conditions.

There are also many saplings ten to twelve feet high with terminal buds nipped. It is quite an experience to see how the goats are able to do this, since no goat could possibly reach that high. One animal will get astride a small sapling and ride it down, stripping off the buds as it goes. Sometimes one animal will hold the sapling down while others go to work eating off the buds and foliage.

Goats appear to be very erratic in their eating habits and at times will not touch the Douglas-fir reproduction while at other times they go to work on it with great energy. On several occasions they were observed to tear long strips of bark from saplings two to three inches in diameter.

A comparison of the two inventories of Douglas-fir seedlings (Table 3) shows that in the grass-oak transition, the large oak-grass type and the large oak type, there was a decline in the number of seedlings. The small oak type and the large-small oak type show no change. In all these types, some seedlings in the first inventory were found only as remnants when the second inventory was made. Some new seedlings were found on the plots during the second inventory and they seemed to be surviving the browsing.

The seedlings found on the plots in the Douglas-fir type were all new seedlings established during the

five-year period between inventories, since no seedlings were recorded in this type during the first inventory.

On the whole pasture there was more than a thirty-two percent decline in the number of Douglas-fir seedlings. It is believed that this decline was due almost entirely to the goat browsing. While it is true that Douglas-fir seedling mortality is high under normal conditions, there is an abundant supply of seed available from second growth Douglas-fir trees. Considering this abundant source of seed and other favorable factors to the establishment of the seedlings, it is believed that under normal conditions, the number of seedlings would have increased rather than decreased.

The relationship of dense stands of poison oak  
to the establishment of Douglas-fir seedlings

A comparison of both inventories of Douglas-fir seedlings and poison oak plants (Tables 2 and 3) for the total area of the pasture shows that the percentage increase in number of poison oak plants is almost proportional to the percentage decrease in numbers of Douglas-fir seedlings. However, a comparison by types reveals that there is no correlation between densities on different types. This is particularly evident in the three largest types, the small oak type, the large oak-grass type and the large oak type. In all three, there was an

increase in poison oak plants. There was no change in the seedling counts in the small oak type and the large oak type, while there was a decrease in the number of seedlings in the large oak-grass type.

Isaac has noted (10, p.59) that Douglas-fir seedlings become best established in the partial or moderate shade of competing vegetation and once established, survive heavier cover. Kummel, Rindt and Munger (16, p.122) state that in certain respects, vegetative cover is helpful and in other ways detrimental to survival and growth of young trees. It helps check soil erosion; the shade is beneficial in reducing loss of moisture from the soil and also from the seedlings; it reduces temperature; and the mulch formed by decaying vegetation assists in preserving moisture and in enriching the soil. The detrimental effects are that the plants compete with the trees for light, soil, nutrients, and moisture. The combined effect is somewhat injurious to the young trees, but to a greatly varying degree, depending on the species represented and the density of the cover.

The comparatively heavy shade of bracken fern was found by McCulloch (20, p.485) to favor the establishment of Douglas-fir seedlings on some of the drier sites in and around the Willamette Valley.

It is possible that poison oak may have beneficial

effects in that it furnishes partial shade for the seedlings. The foliage is not particularly heavy except in places where it grows in thick, bushy clumps. It is not believed that growing space is a critical factor. Whether the shade of the poison oak reduces the transpiration of Douglas-fir seedlings sufficiently to offset the increased competition for soil moisture is not definitely known.

Since there is no apparent correlation between the density of the poison oak and the number of Douglas-fir seedlings, it may be assumed that the poison oak has no particular inhibiting influences on the establishment of the seedlings.

The relationship of dense stands of Oregon  
oak to the density of poison oak

On the basis of the three largest types, large oak-grass, large oak and small oak types, the inventories show that Oregon oak favors the growth of poison oak (Table 2). On all three types the number of poison oak plants was large and there was a decided increase in the number of plants over the five-year period.

In the large-small oak type, there was a decrease in the number of poison oak plants. This was probably due to the keen competition and to the more dense shade offered by the combination of large and small Oregon oaks. In this type, the poison oak grows more as single, one

stemmed plants. Those that grow to any size, trail along the ground, or sometimes twine around the tree trunks for support, reaching up for more direct sunlight.

In the open grass type, poison oak appears to grow and spread. It grows both singly and in clumps but does not grow to such large size as under other more favorable conditions.

From observations made in the field, it appears that poison oak thrives best under conditions of partial shade and protection and where competition is not too keen, such as is found in the large oak-grass type. Under this kind of protection it grows to heights of eight to ten feet without support. Much of it grows in clumps so dense that it appears that neither man nor goat could work through them.

#### The relationship of Oregon oak to the establishment of Douglas-fir seedlings

The inventories show that Douglas-fir seedlings are found in all the types except the grass type. While the general trend is toward fewer seedlings, this has been attributed to the goat browsing rather than to any adverse influences of the site.

It was pointed out previously that Douglas-fir seedlings become better established under partial shade

than in open areas. This is further substantiated by McCulloch (19, p.288) who reports that Douglas-fir thrives beneath a stand of Oregon oaks. This has been found to be true also of this area. The partial shade as well as the general site improvement offered by the oaks is favorable for the establishment of Douglas-fir seedlings.

Seedlings can be found on all parts of the pasture where there is some protection offered by the oaks. In some instances they can be found where there is no protection. The seedlings are found to be more dense near the Douglas-fir type and around the two large Douglas-fir trees found near the center of the study area. However, scattered seedlings can be found as far as a quarter mile from any seed source and in some instances on the opposite side of a hill from any seed source.

Neither size nor density of the Oregon oaks appear to have any significance in the establishment of fir seedlings since they are found in all situations. Seed source seems to be the main factor. Where there is abundant seed, there is an abundance of seedlings. The greater the distance from seed source, the fewer the seedlings.

The relationship of second growth Douglas-fir  
to the density of poison oak

A comparison of the inventories of poison oak in the Douglas-fir type (Table 2) with that of the other types

found on the pasture reveals that second growth Douglas-fir shows no inhibiting effects on the poison oak. There is no great difference to be noted either in the number of plants per acre, nor in the trend, a condition agreeing with that found in the other types.

In this type the poison oak grows mostly in patches in and around the small oaks. Some of it is found beneath the firs where it twines around the trunks of the trees and with this support grows to heights of twenty to twenty-five feet.

Field observations made here and elsewhere in the Willamette Valley show that Douglas-fir does not inhibit the growth of poison oak but that it does not grow as densely beneath the firs as in more open areas.

From these observations and the preceding discussion of the influence of shade on poison oak, it appears conclusive that poison oak thrives under partial shade and protection. In situations where there is complete shade, such as is found in a full stand of second growth fir, it will grow but does not become nearly as dense. Here it exhibits the tendency to twine around the trees in order to reach up for more light.



## THE LAND USE PROBLEM

One of the purposes of this report was to determine whether grazing or timber production would yield the greater returns from the area studied. It is recognized that both grazing and forestry are important enterprises in this part of the state of Oregon, particularly in the Willamette Valley and in Benton County.

During the fifteen-year period 1925-39 the annual saw log production averaged approximately 74 million board feet in Benton County (21, p.12). There were 21 active, small capacity sawmills in 1940. Several of the mills were of semi-portable type and were owned by farmers and operated during the slack period of the year. Although there are no large scale operations, the forest industry of Benton County has been fairly stable and prospects of a future sustained forest industry are favorable for the county (21, p.15).

The production of livestock has also been an important industry, and the sheep industry has come to be the most important. The number of sheep in the county increased from a few hundred in 1850 to more than 32 thousand in 1935 (17, p.134).

There are two phases of the sheep industry in this region (23, p.5). The first and most important phase is the production of commercial spring lambs, an enterprise

for which this region is well adapted. Purebred rams are mated to grade ewes and are wintered on grass as much as possible. Some supplemental feeding is necessary but this is kept to a minimum, depending upon the amount of pasture land available. The lambs are dropped in the early spring and are grown, fattened, and marketed by May or June. There is a ready market for these lambs because they are produced and put on the market earlier in the year than lambs from Eastern Oregon.

The second phase of the industry in this region is the production of purebred rams, which are raised for the range herds of Eastern Oregon and for the commercial flocks in the western portion of the state.

Since both grazing and lumbering are of major significance in this area, the use to which land is put is important. Other things being equal, if land will yield greater returns by producing sheep than timber, then it should be devoted to that purpose. Conversely, if timber production constitutes a higher use, then grazing should be subordinated to the establishment of a forest cover. Under either plan of management, one use is not compatible with the other under the conditions prevailing. If the area is to be grazed continuously, the establishment of coniferous trees cannot be expected, since the livestock keep the seedlings browsed down and eventually will kill

them.

It is recognized that under the present system of management, the area is producing neither forage nor timber to a satisfactory degree. In order to bring about an effective timber or forage crop, it will be necessary to treat the area in such a way as to favor the production of one at the expense of the other. This will involve time, labor and expense.

In the following analyses of the area for the production of both timber and forage, a number of assumptions were made. The area has also been treated as though it were private land involving taxes and other necessary expenses such as would be encountered under private ownership.

#### Grazing Use

The value of this area for grazing is very low in its present undeveloped, brush covered condition. With the exception of the few grass areas, the forage is inferior and has little value. It is estimated that it would require 4 to 6 acres of this land to furnish enough feed for one sheep for one year.

Goats have been pastured here for several years under the assumption that they would browse the brush and small trees and eventually kill them and that the ground

cover would revert to grass. From observations made in this study the goats did not achieve those desired results. The use of goats would ordinarily be the cheapest method of converting brush land into pasture land, but in this particular case, some other method may prove to be of more practical use.

In two counties in southwestern Oregon, Hotchkuth and Gorton (7, p.36) found that the livestock industry was profitable where cut-over or brush covered land was converted to pasture land. The method used in that area consisted of slashing the trees and brush, burning to clear the land and to establish a seedbed, and seeding and fencing.

It is possible that this method may be used to clear the Oregon oak and poison oak from the study area. However, since this brush is particularly dense, slashing must be kept to a minimum to keep the costs as low as possible, and it will be necessary to take extra precautions in burning.

All of the Oregon oak trees that are large enough and are accessible should be cut and sold for firewood. No attempt was made to determine the volume of the oak on the area, but there is a considerable amount and it should be utilized in so far as possible. Gorton states (5, p.24) that fuel wood is of sufficient value in the Willamette

Valley to pay for the cost of piling and burning the slashings after the wood is removed. The costs of cutting the wood and piling and burning the slash have been considered as defrayed by the sale of the wood and these costs have not been charged against the conversion of the area to grass pasture.

No information was found relative to clearing and converting this type of land to grass pasture. The plan in the following pages is suggested for this area but is not a finished plan; it is merely to be used as a guide for more thorough study and for experimental purposes.

The proposal for this area takes into consideration certain known facts along with a number of essential assumptions. Man hours of labor, wages and prices were figured as accurately as possible under prevailing conditions. The results to be achieved cannot be accurately predicted. Only by experience and experimentation can information be obtained upon which to base more accurate predictions.

Roughly, the plan to convert this land into productive grass pasture should consist of cutting the merchantable Oregon oak; slashing some of the scrub oak; controlled burning in the early fall; immediate seeding to a cheap annual grass; controlled reburning the following fall; and reseeding to perennial grasses.

Some maintenance will be necessary each year through spot burning and reseeding to grass the patches of Oregon oak root sprouts and poison oak that may be still growing. The use of commercial preparations for killing poison oak may prove to be more effective than burning. For large areas the cost would be prohibitive but for small patches, its use may prove to be more economical than spot burning and reseeding.

The application of some commercial fertilizer may be necessary at regular intervals after the pasture has been established and the nutrients released to the soil by the fires have been leached out.

### Slashing

Slashings from the trees to be cut for fuel should be piled on the oak stumps and in the poison oak patches with the expectation that the resultant hot fire will kill stumps and roots.

The main purpose of slashing some of the small scrub oak is to get enough material on the ground so that the fire will consume as much of the standing oak as possible. The brush and scrub oak have already been cleared out sufficiently along the north-south fence line that runs through the center of the pasture.

A large bulldozer should be used to clear out fire

breaks. They should be constructed to the approximate width of the bulldozer blade, on each side of the existing fences within the pasture and on the inside of the boundary fences. This will furnish adequate control for the fire by blocking off the pasture into four parts and it will also protect the fences from burning. A fire break should also be constructed along the edge of the Douglas-fir type in the northern part of the pasture since this small area should be left in its present condition and not converted into grass land. It is estimated that a large bulldozer can clear out the necessary fire breaks in a period of six hours.

#### Controlled burning

The first burn should be made as early in the fall of the year as possible in order to take advantage of dry weather. It is desired to obtain as hot and complete a burn as prevailing weather conditions will permit.

It will be necessary to obtain a burning permit from the district fire warden. The time and date for the burning will, of necessity, be determined by him. However, the earlier in the fall the better, in order to burn as much of the brush and slashings as possible. The fire warden should be contacted early in the year and definite arrangements made for him to be on the scene at the time

of burning in order to supervise. No charge for his services is anticipated.

The best burn would be obtained in September when there is a slight breeze from the west. The fire should be set starting from the east to burn uphill against the wind. This will give the best results for a hot burn and should also keep the fire from spreading too rapidly. Each of the four sections of the pasture should be burned separately, allowing one day to complete the job. It is estimated that it will require four men to set the fire and to keep it under control.

It is not anticipated that all the scrub oak will be burned at this time. It should be killed and the ground litter and poison oak should be consumed. It is known that fire will not eradicate the poison oak, but a hot fire should materially reduce the sprouting capacity of the poison oak roots and many of the underground roots of the oak will be killed.

#### Seeding with annual grass

Immediately following the burning, the area should be seeded with annual rye grass (Lolium multiflorum). This grass is cheap and will both form a ground cover and later serve as a source of flashy fuel. Seeding should be done as soon as practicable after the ashes have become



cold and before it has rained, if possible. Ashes make an excellent seedbed and the first rains will plant the seed in the ground. The amount of seed to be used per acre will vary since the area already in grass will not require any seed. For the pasture as a whole, an average of 20 pounds per acre should be used.

The job of hand seeding will be slow because there will be many stubs and dead trees to interfere with the planter. The possibility of having the area seeded by airplane was considered but it was found that the cost for this service exceeded the cost of seeding by hand. Initial costs must be kept to a minimum and therefore hand seeding should be used.

In the coastal area of southwestern Oregon it was found that the acreage covered in seeding burned land varied from four to eighteen acres per man day (7, p.37). It is estimated that one man can seed on the average of six acres per day on this area, taking into consideration all the factors that will tend to make the job difficult.

The annual rye grass will germinate and grow following the first rains in the fall and will establish a cover for the area before the heavy rains arrive later in the year.

No grazing should be allowed during the winter or the next year following this seeding. The grass should be

allowed to make as luxuriant a growth as possible before dry weather arrives, and by early fall there should be a large amount of dry grass covering the area.

Early in the summer, following the seeding to annual rye grass, the fire breaks that were constructed the previous year should be cleared out. This can be accomplished by seorching the grass with a flame thrower before it has dried. The green grass will burn under the heat of the flame thrower but it will not carry a fire. It is estimated that one man can burn out the fire breaks in one day.

#### The second controlled burn

The second burn should be made in the fall of the second year just as early in the season as weather conditions will permit. As before, the aid of the district fire warden should be obtained. This burn should be conducted much the same as the first burn. A much hotter fire is anticipated due to the large amount of dense, dry grass and to the dead oaks not consumed in the first fire and now dried out. Due to the greater danger of this burn as compared to the first, it is estimated that it will require eight men to keep it under control and that two days will be required to complete the job.

This burn should result in a thorough clearing of

the land with the exception of the larger stumps. The fire should have burned with intense heat and the stumps that were not killed in the first fire should be killed at this time. No stump sprouts are expected after this fire but some of the roots will probably send up sprouts again in following years. All of the aboveground portions of the poison oak will be burned but it is not known if the roots will again sprout. Poison oak is known to be resistant to fire but how much intense heating of the ground the roots will withstand is not known. If root sprouts do come up again, in all probability they will not be very vigorous. The protective shading of the Oregon oak will have been eliminated and it is not expected that the poison oak will offer much of a problem.

#### Seeding to perennials

Immediately following the reburn, the area should be seeded to a good mixture of perennial grasses. The following table shows a mixture that has been found to be well adapted to this type of soil. Excellent results have been obtained with this mixture on similar land within the Willamette Valley and it has been recommended for use on this area.

<u>Kind of seed</u>	<u>Pounds per acre</u>
Alta fescue ( <u>Festuca elatior</u> )	8
English rye ( <u>Lolium perenne</u> )	6
Burnett ( <u>Sanguisorba minor</u> )	4
Subterranean clover ( <u>Trifolium subterraneum</u> )	2
Orchard grass ( <u>Dactylis glomerata</u> )	4
Total	24

This second seeding should be easier than the first, because of the elimination of the dead oaks and other debris. It is estimated that one man can seed ten acres per day under these conditions.

Fires are known to release a considerable amount of mineral material to the soil which generally brings about an increase in herbaceous vegetation for several years (27, p.384). Isaac and Hopkins state (12, p.276) that it is not known how long the increase in available plant food resulting from slash burning can be expected to last.

Fowells and Stephenson (4, p.181) conclude that nitrification in forest soils is stimulated by burning and by the liberation of basic ash materials. However, at the Northrup Creek Experiment Station in northwestern Oregon and in other areas in western Oregon, experience has shown that this effect is short lived and that within a few years there is a deficiency of nitrogen in the soil.

The use of leguminous plants grown in conjunction with grass will help to offset the nitrogen deficiency of the soil. Subterranean clover is seeded in the mixture above, but this one legume is not sufficient. Lotus (Lotus corniculatus) is well adapted to this acid type soil and it has been recommended for use here. Seeding of the lotus for best results should be done in the early spring following the seeding of perennial grasses. One pound of seed per acre is sufficient and it is estimated that one man can seed the total area in two days.

Once the grass has become established it is expected that the area will produce good grass pasture. The site is wetter than the surrounding areas and it should give a high forage yield. Continuous maintenance probably will be required in order to keep the brush from becoming reestablished. It is estimated that the carrying capacity will be high, about one and a half acres per sheep per year; or, one acre to furnish 240 sheep days of grazing per year.

#### Estimate of costs of conversion to productive pasture

The costs of cutting the salable oak and piling the slash have not been charged against the conversion costs of the study area since the sale of the wood is expected

to defray this charge. The sale of the wood will also cover the charge of burning the slash, but since this burning cost is included in the cost of burning the total area, it cannot be separated. For this reason, a 20 percent deduction has been made in the cost of burning the total area the first year.

The costs of hiring a bulldozer and an operator were figured at \$7.50 per hour for actual work performed. Six hours of work at this rate will amount to \$45.00, or a per acre charge of \$.23. *Tro Low*

Slashing costs amount to \$24.00, figured on the basis of four man days at the current rate of \$.75 per hour for labor. This gives a per acre charge of \$.15. *Very Low*

The first burning cost, figured at four man days at \$6.00 per man day, amounts to \$24.00. Deducting 20 percent of this charge for the sale of the oak wood leaves a total charge of \$19.20 for the first burn, or a per acre charge of \$.12.

Twenty pounds of annual rye grass seed per acre at present prices amounts to a charge of \$1.60 per acre. Labor cost for seeding is \$1.00 per acre on the basis of seeding six acres per man day. This gives a total cost of \$2.60 per acre seeding cost.

The following list is a summary of the costs per acre for the first year:

Bulldozer and operator	\$ .28
Slashing	.15
First burn	.12
Seeding annual grass	2.60
Total cost	\$3.15

The second year, the cost of cleaning out the fire breaks in the spring amounts to wages for one man for one day or \$6.00. This is chargeable to the total area and will be a per acre charge of \$.04.

The cost of reburning the area the second year amounts to \$96.00, figured at 16 man days at \$6.00 per day, or a per acre charge of \$.60.

The cost of the mixture of perennial grass seed at present prices, sown at the rate of 24 pounds per acre, will amount to a per acre cost of \$9.10. Labor cost for seeding, figured at 10 acres per man day at \$6.00 per day, amounts to \$.60 per acre. Total seeding costs will be \$9.70 per acre.

The following list is a summary of the costs per acre for the second year:

Clearing fire break	\$ .04
Second burn	.60
Seeding perennial grass	9.70
Total cost	\$10.34

In the spring of the third year there will be a cost for one pound of lotus seed amounting to \$1.50 per acre. Labor cost for seeding will amount to \$12.00 for two man days for the total area, or \$.08 per acre. This gives a total cost for seeding of lotus of \$1.58 per acre.

The actual amount of money necessary to convert this area into pasture land will amount to \$15.07 per acre.

The annual charges against the area as pasture land are broken down into administration, taxes, and maintenance. An administration charge of \$.05 per acre is included to cover the costs of general overhead and management.

The annual tax on this land will increase after it has been converted to productive pasture land. At the present time, the land is valued at \$10.00 per acre and the present annual tax would amount to \$.15 per acre. The second year after this operation is started, the value of the land will be expected to double, according to the Benton County tax assessor, and the tax will amount to \$.30 per acre.

An annual maintenance charge of \$.50 per acre has been included to cover the costs of reburning and reseeding to grass any small patches of poison oak and other brush that may be expected to become established from time



to time. This also covers a charge for maintenance of fences and other improvements.

The following summary shows the annual charges per acre after the grass pasture has become established:

Administration	\$ .05
Taxes	.30
Maintenance	.50
Total annual costs	\$ .85

The present value of the site for the  
production of forage

The average charge for rented pasture on private land in the Willamette Valley at the present time has been found to be approximately \$.30 per sheep month. This is considered to be a fair rental charge for this type of pasture and is the charge upon which this comparison of forage production to timber production is based.

It is estimated that the carrying capacity would be 240 sheep days per acre per year. This will give a gross annual income of \$2.40 per acre. Annual fixed charges of \$.85 per acre will be deducted, leaving an annual net income of \$1.55 per acre.

The present value of this income, at 3 percent interest will amount to \$34.95 per acre after all initial

costs of conversion have been deducted.

In order to make a comparison with timber production it is necessary to determine the value for grazing over a period of years. The value of the site for timber production is greatest for a 70-year period, as will be shown later in this report. Therefore, a 70-year period for grazing will be used for comparison purposes. The present value of \$34.95 will be worth \$276.80 at 3 percent interest in 70 years.

#### Timber production

The possibility of natural seeding of the pasture area is very favorable. That portion of the pasture along the northern boundary has already produced Douglas-fir timber which constitutes an excellent source of seed. There are two large Douglas-fir trees, one near the center and the other near the southern boundary of the study area, both producing seed. Several of the larger saplings also produced cones in the fall of 1946. Munger and Morris state that seed from young trees will produce just as vigorous seedlings as seed from any other age class (22, p.36). Therefore, these saplings can also be expected to produce seed for stocking the area.

Under normal topographic and climatic conditions, it has been found that Douglas-fir seed will disseminate

as far as a quarter of a mile from the seed source (11, p.19-22). Douglas-firs are known to produce seed almost every year with a seed crop failure one year out of every four or five years. There is also an abundance of seed produced one year out of every five or six years. The direction and velocity of the wind at the time the seed falls is the determining factor as to the distance of the seed flight before it reaches the ground.

From the amount and distribution of reproduction already established, it is evident that there is an adequate source of seed to stock the area and that site conditions are favorable to the establishment of the seedlings. The distance from the source of seed somewhat exceeds one quarter-mile to certain portions of the pasture. With the exception of that portion of the study area in the southwest corner, adequate stocking of seedlings can be expected within a period of five years.

The effects of Oregon oak and poison oak on the establishment of Douglas-fir seedlings was discussed earlier, and it was pointed out that in some respects they favored the establishment of the seedlings.

There are several areas in this pasture that are adversely exposed in so far as the establishment of seedlings is concerned. These areas face the south, southeast and southwest. Isaac (11, p.29) has found that air,

surface-soil temperatures and evaporation were higher and soil moisture was lower on southern exposures than on other exposures. He also found that temperatures of 123 degrees F. occurred on natural soil surfaces when air temperatures were about 80 degrees F. (11, p.43). A soil temperature of 123 degrees F. for several days following germination is likely to injure Douglas-fir seedlings and temperatures of 125 degrees F. or more will likely kill them. Southern exposures proved to be much more severe than other exposures.

For the most part the adverse areas with southern exposures are now covered by Oregon oaks with an understory of poison oak. This shade helps prevent the sun from drying out the soil and raising the soil temperatures sufficiently in the summer to kill the fir seedlings.

Since there is evidence of an abundant seed source and since seed trees are within seeding distance of most of the area, it is reasonable to expect that Douglas-fir seedlings will be established on all but the severely exposed southern areas.

#### Estimate of costs with natural regeneration

The Joint Committee on Forest Conservation of the West Coast Lumberman's Association and Pacific Northwest Loggers Association has devised a method of evaluating the

costs of producing timber in the Pacific Northwest (14, p.13-21). The calculations made in the following pages are patterned after this method with only the minor changes needed to fit this particular problem.

Natural seeding of the area is very favorable. Assuming that within a five-year period the area will be adequately stocked, there would be little expense involved in establishing it as a forest area. The costs shown in Tables 5 and 6 are based upon natural restocking. It would be necessary to continue to exclude all livestock. Fencing costs were not figured in this analysis since it was assumed that the present fences were adequate to restrict the livestock.

The annual costs of producing timber are broken down into administration, taxes and fire protection. These costs are all carried forward with interest at 3 percent, compounded annually.

The administration charge of \$.05 per acre is included to cover the costs of securing advice from a competent forester, and for general administration and overhead costs.

The annual tax on forest land in the state of Oregon is \$.05 per acre, if assessed on the special timber-growing taxation basis. It is here assumed that the land would be classified as reforestation land for the purpose

of this study.

The annual fire protection charge has been set at \$.15 per acre. This charge exceeds the average charge of \$.05 per acre for fire protection. Five cents per acre is probably entirely adequate in the hands of the State fire protection organization for this territory. However, to be conservative, \$.15 per acre has been used because this is the charge anticipated in the tree farm program in order to keep the annual fire loss to one-fourth of one percent of the area (14, p.14).

The initial fire protection development charge has been set at \$.50 per acre and covers the cost of eliminating fire hazards. Here again, this charge is considered in order to keep the annual fire loss to a low figure.

The net yields of timber are based upon trees 12 inches in diameter and over, scaled by the International Log Rule with one-eighth inch saw kerf (18, p.27). This log rule gives a true picture of the lumber yield of the small logs such as would be produced on this area. Deductions were made from the expected gross yield to allow for an annual fire loss of one-fourth of one percent. A further deduction of 25 percent of the net area remaining was allowed for incomplete stocking and incomplete utilization.

Table 5 shows a detailed breakdown of the costs of producing Douglas-fir timber on this area, based on site III quality. This table shows that the cost per thousand board feet is highest when the timber stand is 40 years of age. These costs decrease per thousand board feet, or the tree growth rate exceeds the carrying charges, until the stand reaches the age of 70 years. Beyond 70 years, the carrying charges increase at a faster rate than the growth of the trees; thus the costs per thousand board feet increase as the stand becomes older.

The present value of the site for timber production

The stumpage prices for second growth Douglas-fir under present market conditions are rather high. Considering the location of the study area in regard to markets, an average stumpage price of \$6.00 per thousand board feet has been considered as a reasonable price upon which to base a comparison of Douglas-fir timber production to forage production.

The State of Oregon levies a yield tax of  $12\frac{1}{2}$  percent of the stumpage value at the time of harvesting lands classified for reforestation purposes. Allowing for this deduction, the actual amount received for the stumpage amounts to \$5.25 per thousand board feet.

Table 5

THE COST OF GROWING DOUGLAS-FIR TIMBER ON  
SITE III QUALITY LAND, NATURALLY STOCKED

Age	Cost per acre			Actual amount spent per acre	Total amount spent plus 3% interest	Yield in M. Bd.Ft. per acre	Total cost per M. Bd. Ft.
	Initial outlay	Annual outlay					
	Fire protection development charge	Fire protection	\$.05 taxes \$.05 admin.				
	\$.50	\$.15	\$.10 total				
40	\$ 1.63	\$ 11.30	\$ 7.53	\$10.50	\$ 20.46	4.9	\$ 4.18
50	2.19	16.90	11.27	13.00	30.36	13.0	2.34
60	2.95	24.45	16.30	15.50	43.70	23.7	1.84
70	3.96	34.60	23.07	18.00	61.63	33.6	1.83
80	5.32	48.20	32.13	20.50	85.65	41.3	2.07
90	7.15	66.50	44.33	23.00	117.98	47.0	2.51



Table 6 shows the net income per acre and the present value of the site when the area has been naturally restocked, and managed to produce Douglas-fir timber. The table shows that the highest present value of \$14.51 per acre will be received when the age of the timber is 70 years. Therefore, that is the age at which it should be sold in order to give the greatest returns to the owner.

#### Estimate of costs with artificial regeneration

Table 7 gives a summary of costs should planting be necessary to restock the area. An average of 500 trees per acre would be adequate for this purpose. This would be rather wide spacing of trees for the area as a whole but the planting will not have to be done on every acre of the tract, some portions of which are already fully stocked. Other portions are only partially stocked and may need some planting. Seedlings that have grown in a seedbed for 2 years, designated as 2-0 seedlings, are considered to be best adapted for this region.

In this case, the same costs of producing timber are considered as in the previous case, except for the addition of the planting charge. Under present conditions, the cost of planting seedlings has been found to be approximately \$20.00 per acre. This covers the price of the seedlings, labor and all other charges for planting.

Table 6

VALUE OF THE SITE FOR TIMBER PRODUCTION  
UNDER NATURAL STOCKING

Age	Total costs per M. Bd. Ft.	Net income per M. Bd. Ft.	Yield in M. Bd. Ft. per acre	Net income per acre	Present value of site per acre
40	\$ 4.18	\$ 1.07	4.9	\$ 5.24	\$ 1.61
50	2.34	2.91	13.0	37.83	8.64
60	1.84	3.41	23.7	80.82	13.72
70	1.83	3.42	33.6	114.91	14.51
80	2.07	3.18	41.3	131.33	12.34
90	2.51	2.74	47.0	128.78	9.01

A study of Table 7 shows that the cost per thousand board feet is highest when the timber stand is 40 years of age. The cost decreases until the stand reaches the age of 70 years at which time it again increases. In this case, as in the former, the costs of producing Douglas-fir timber are lowest when the stand reaches an age of 70 years.

It will be noted in Table 7 that at all times the costs of planting and growing Douglas-fir trees amount to more than the price of stumpage. With a stumpage price of \$6.00 per thousand, the total cost of planting and growing Douglas-fir timber under present prices and market conditions on this site cannot be undertaken to return a profit to the owner.

Table 7

THE COST OF GROWING DOUGLAS-FIR TIMBER ON  
SITE III QUALITY LAND, PLANTING 500 TREES PER ACRE

Age	Cost per acre				Actual amount spent per acre	Total amount spent plus 3% interest	Yield in M. Bd. Ft. per acre	Total cost per M. Bd. Ft.
	Initial outlay		Annual outlay					
	Fire protection development charge	Planting costs	Fire pro- tection	\$.05 taxes .05 admin.				
	\$.50	\$20.00	\$.15	\$.10 total				
40	\$1.63	\$ 65.20	\$11.30	\$ 7.53	\$30.50	\$ 85.66	4.9	\$ 17.48
50	2.19	87.60	16.90	11.27	33.00	117.96	13.0	9.07
60	2.95	117.80	24.45	16.30	35.50	161.50	23.7	6.81
70	3.96	158.40	34.60	23.07	38.00	220.03	33.6	6.55
80	5.32	212.80	48.20	32.13	40.50	298.45	41.3	7.23
90	7.15	286.00	66.50	44.33	43.00	403.98	47.0	8.60

## SUMMARY AND CONCLUSIONS

This study was conducted on the Oregon Agricultural Experiment Station located approximately two miles northwest of Corvallis, Oregon. The land has previously been used for grazing purposes but the grazing value has decreased to the point where something must be done in order to bring the land into more productive use. Timber production has been considered as an alternative use.

One of the purposes of this study was to determine whether or not the poison oak plants and Douglas-fir seedlings were increasing or decreasing. A systematic series of plots was established in 1941 and counts of these plants and seedlings were recorded for each plot. Angora goats were heavily concentrated on the area for the purpose of browsing poison oak plants to suppress them.

A second count of the poison oak plants and Douglas-fir seedlings was recorded for the same plots in 1946. A comparison of the counts showed that for most of the area the poison oak plants had increased in number while the number of Douglas-fir seedlings had decreased.

The second purpose of this study was to analyze the apparent factors affecting the ecological changes taking place on the study area.

Evidence was found that the goats had browsed the

poison oak plants. The goats showed a preference for the terminal buds and the young root sprouts and the foliage was also eaten at times. The effect of the browsing was more noticeable on the thick patches of poison oak than it was on isolated plants. It is believed that the goat browsing caused the poison oak roots to sprout more vigorously than is normal and thus the plants became spread over a larger area.

The Douglas-fir seedlings showed more severe effects of goat browsing. Many dead remnants were found almost entirely stripped of bark. All leaders and terminal buds of the seedlings showed evidence of having been nipped and much of the foliage was eaten. The decrease in number of seedlings on the area was attributed almost wholly to killing by goats.

No correlation was found between the density of poison oak plants and the density of Douglas-fir seedlings. It is believed that the poison oak has no inhibiting influence on the seedlings. It may even be beneficial in furnishing partial shade in which the seedlings may become established.

The Oregon oak favored the growth of poison oak in areas where the trees were not so dense as to cast complete shade. Poison oak does grow both in intense shade and in intense sunlight but it does not do well under

these conditions. It will thrive under partial shade where competition for moisture and growing space is not too keen. Under conditions of intense shade it either grows as small, single stemmed plants, or exhibits a tendency to twine around the tree trunks for support in order to reach up for more sunlight.

The Oregon oak was found to favor the establishment of Douglas-fir seedlings. The oak forms partial shade and in general improves the site, making conditions ideal for the establishment of the seedlings.

Second growth Douglas-fir had no significant effect on the number of poison oak plants but it did affect the form of the plants. Here again, the intense shade either suppressed its growth or caused it to twine around the trees.

The third purpose of this study was to determine if grazing or timber production would yield greater returns from the area.

In order to bring about satisfactory production of forage, some method of clearing the land would be necessary. No information was available that would be applicable in clearing this area and converting it into productive pasture.

A suggested plan for the work consists of cutting and removing the salable oak, slashing some of the scrub

oak, burning the area in the fall of the year, immediate seeding to annual rye grass, reburning the area in the fall of the second year, and reseeding to perennial grasses.

Assuming that a good stand of forage will be obtained and that invading brush does not offer a great problem of maintenance, grazing on the area will be profitable.

The total costs of converting the area for grazing under present prices will amount to \$15.07 per acre. The annual net income should be \$1.55 per acre. The present value of this income at 3 percent interest will amount to \$34.95 per acre after all initial costs of conversion are deducted. For comparison with timber production, this present value will be worth \$276.80 in 70 years at 3 percent interest.

Factors for natural stocking of Douglas-fir seedlings are favorable if grazing is excluded from the area. Initial costs will amount to \$.50 per acre. The annual carrying charges will be \$.25 per acre. At the age of 70 years the timber stand should yield the highest returns. The present value of the expected 70-year income at 3 percent interest is \$14.51 per acre. The timber stand should yield a net income of \$114.91 per acre at the end of the 70-year period.



In order to show a more complete picture of the costs of timber production, the costs for artificial regeneration were also figured. Allowing an initial charge of \$20.00 per acre for all planting costs plus the other charges figured under natural stocking, it was found that at 70 years of age the cost of growing timber would be the lowest, amounting to \$6.55 per thousand. At the current stumpage price of \$6.00 per thousand, it would not be profitable to plant Douglas-fir seedlings on this site.

A comparison of the timber values to the grazing values of the study area shows that, under present conditions, grazing will yield the greater returns provided that the plan for converting the area into grass pasture can be put into effect and that it results in as productive a pasture as anticipated.

#### Recommendations

It is recommended that the plan for converting the study area to grass pasture be tried on an experimental basis. A small portion of the area could be temporarily fenced to exclude all livestock until it has been converted to grass land.

The experiment should determine if the first fire will be hot enough to kill the roots of the oak and the poison oak; if the second fire will kill those roots not

killed in the first fire; if either one or both fires will completely clear the land; if the costs of maintenance will be within reason to make the plan practical; and if the application of a commercial fertilizer will be necessary after the pasture has become established.

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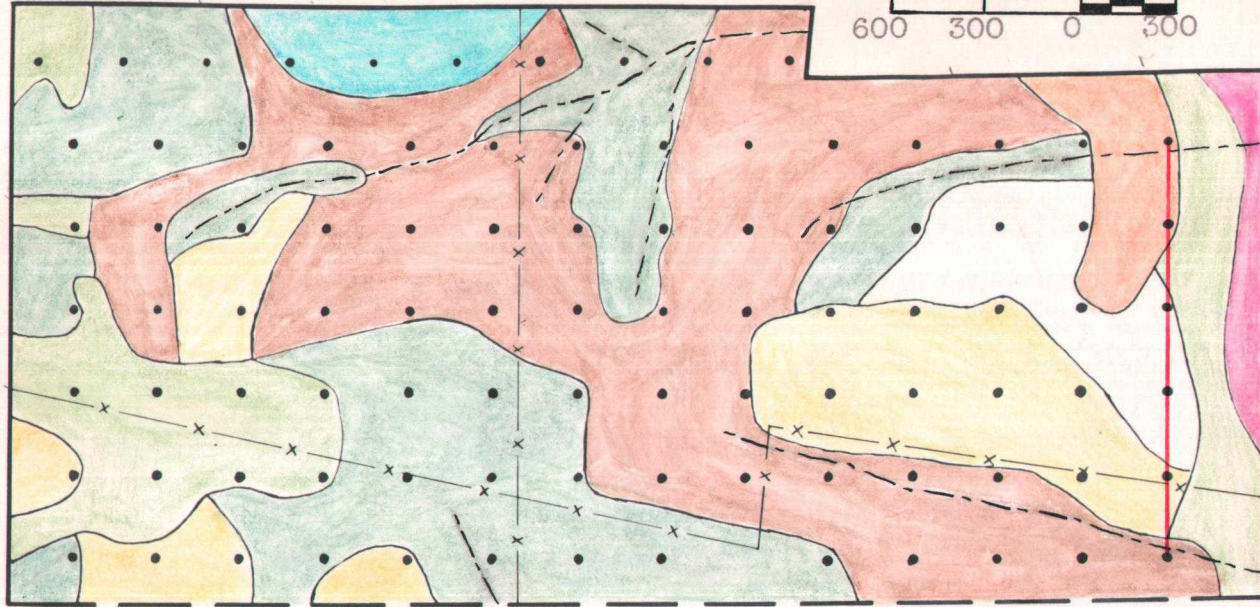
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## **APPENDIX**











Scale 1 inch = 600 feet





600 300 0 300

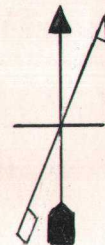


Cover Types

	Grass		Small oak
	Grass-oak transition		Large-small oak
	Large oak-grass		Douglas-fir
	Large oak		Large oak bottomland

TYPE MAP OF STUDY AREA

<u>Legend</u>	
	Plot
	Intermittent stream
	Fence line
	Base line





The study area in the background





The small oak type; Douglas-fir type in the background



Large oak-small oak type



Grass-oak transition type





Small oak type. Note the "browse line" on the trees  
and the abundance of poison oak beneath.



Large oak-grass type



These young Douglas-firs will soon overtop the Oregon oak





Douglas-fir seedlings after goats have browsed them



Goat browsing causes a hedge-like appearance in  
clumps of poison oak.





Stubs are all that remain after goats have browsed small seedlings.



Goat browsing has stripped the lower branches of foliage on these Douglas-fir saplings. Note the tree to the left, completely stripped.



Aerial rootlets enable poison oak to adhere to tree trunks for support.