NATURAL REPRODUCTION ON THE TILLAMOOK BURN

FOUR YEARS AFTER THE FIRE

PACIFIC NORTHWEST FOREST EXPERIMENT STATION

PORTLAND, OREGON

JANUARY 10, 1938

NATURAL REPRODUCTION ON THE TILLAMOOK BURN FOUR YEARS AFTER THE FIRE

(A supplement to the report of March 1935)

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Introduction

Two years after the Tillamook fire of August and September 1933, a study was made to determine the status of natural reforestation on the burn and to gather information regarding certain phases of the natural reproduction of Douglas fir (Pseudotsuga taxifolia) and associated species. The results of this study are contained in a mimeographed report,1/ which is available on request. Since 1935, salvage logging has made considerable progress into the burned timber, and public agencies have become increasingly conscious of the necessity for

1/ Isaac, L. A., and Meagher, G. S. Natural Reproduction on the Tillamook Burn Two Years After the Fire. Pacific Northwest Forest Expt. Sta. March 1936. (Mimeographed.)

bringing this important area back into a state of productivity. A second study was therefore made, during the fall of 1937, to determine the trends of restocking and the changes in general conditions that have occurred during the interim. This supplement to the original report brings the information on restocking conditions up to date.

The Tillamook fire spread over approximately 380 square miles of highly productive forest land in northwestern Oregon and killed 10 billion board feet of merchantable timber.2/ It covered the main watersheds of the Trask, Wilson, and Kilchis Rivers, and portions of the watersheds of the Miami, Nehalem, Tualatin, and Yamhill Rivers. The elevations of the burned area vary from 50 feet above sea level at the western edge to more than 2,000 feet at the summit of the Coast Range. The entire area is well drained, and is cut up by a great many steep ridges that run in a general east-west direction.

Most of the area was occupied by the Douglas fir forest type. The stand was dominated by old-growth Douglas fir and western hemlock (Tsuga heterophylla), and contained a mixture of western red cedar (Thuja plicata) and a scattering of lowland white fir (Abies grandis). On the western edge, where the Douglas fir type merged with the spruce-hemlock type of the coast, Sitka spruce (Picea sitchensis) and western hemlock composed a large proportion of the stand.

2/ Morris, W. G. The Details of the Tillamook Fire From Its Origin to the Salvage of the Killed Timber. Manuscript report. Pacific Northwest Forest Expt. Sta. 1935.

Procedure

Since the principal purpose of this second study was to determine the trend of restocking, the field work was less intensive than in 1935. In the 1935 examination, it was not feasible to gridiron the burn completely or to estimate stocking for the entire area; instead, five sample areas were studied that would give a cross-section of typical conditions. The 1937 field work consisted of checking representative strips on three of these five areas. The Cedar Butte double burn, the hemlock-looper-infestation areas in the northwest corner of the burn, and the areas logged and burned before the fire were not reexamined, in order that conflicting factors might not be involved. The crew organization and general procedure in the field were identical with those of 1935.

Location of Study Areas and Strips

The centers of work for this study were the Reehers fire-patrol station, in the northeastern portion of the burn; the Trask Willamette camp and the Trask CCC camp, in the southern part of the burn; and the Harris patrol station, on the lower Wilson River. Recent road and trail construction made it possible to drive to most of the strip locations; thus the field work was speeded up considerably.

To check reproduction in 1937, strips were run as nearly as possible in the same locations as in 1935. Figure 1 shows all lines run in 1935 and those that were checked in 1937.

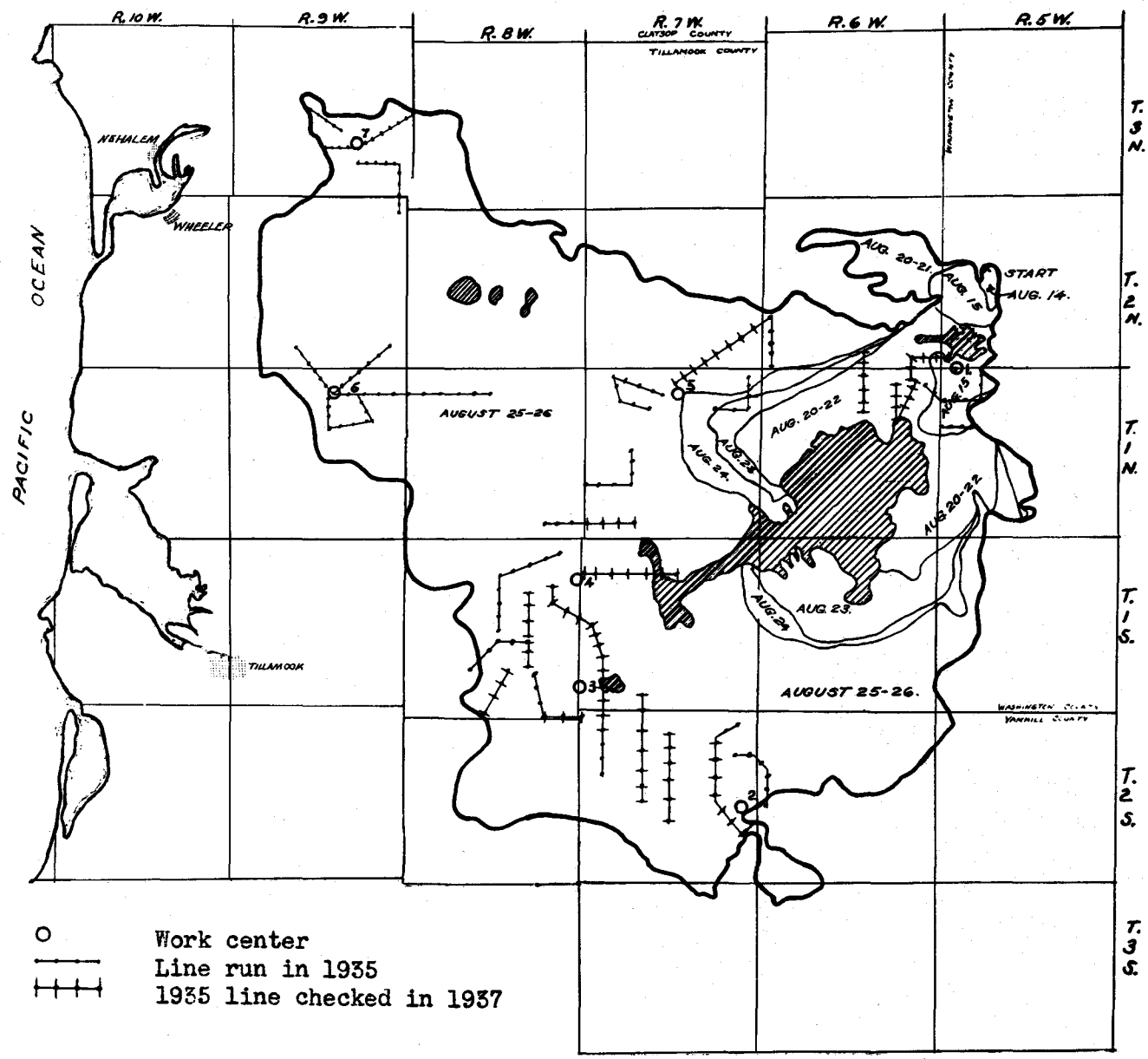


Figure 1. Approximate boundary of Tillamook Burn, showing spread of fire during successive periods, centers of work, and survey lines run.

Work Centers

1. Reeher's station
2. Trask Willamette camp
3. Trask CCC Camp
4. Harris patrol station
5. Smith place station
6. Hammond-Whitney Camp
7. Nehalem CCC Camp

Recording of Data

A modification of the stocked-quadrat system was used for recording reproduction. Because the seedlings were mostly 3 or 4 years old and fairly well established, the standard of full stocking was 1,000 fairly well distributed seedlings per acre, instead of 2,000 per acre as in 1935. Seedling counts were made on quadrats spaced 4 chains apart on each strip. Each quadrat consisted of four squares, 6.6 feet on a side and having a common corner. The single square contained 1/1,000 acre and the four combined contained 1/250 acre. For each small square, and for each species, seedlings were tallied as follows: None, blank; one, 1; more than one, 1+. Seedlings that had germinated in 1937 were tallied separately from those that were older, to give a measure of the current year's increase in stocking. A record of ground-cover conditions was made for each sample quadrat, including predominant species and percentage of ground covered.

Analysis of Data

Since each single sample (6.6 feet square) contained 1/1,000 acre, the presence of one or more established seedlings in each of four adjoining squares indicated that the surrounding area was fully stocked, with at least 1,000 seedlings, fairly well distributed, to the acre. The samples were combined in pairs (groups of eight small squares each) and were classified according to the percentage of small squares having at least 1 established seedling, as follows: 83 percent or more, fully stocked; 19 to 82 percent, partially stocked; 18 percent or less, non-stocked.

Next the number of chains fully stocked, partially stocked, and nonstocked was calculated for each strip. The data were then summarized for the following areas: Wilson River, Trask River, Reehers Camp, unburned salvaged area, and burned salvaged area. In addition, the total number of seedlings on each area was tabulated[3/] according to species and age.

The 1935 data taken on the strips that were checked in 1937 were reanalyzed in a similar manner to facilitate comparison between the two sets of records.

Changes in General Conditions Since 1935

Ground Cover

The variation in amount of ground cover was found to be as widespread in 1937 as it was two years earlier. Percentage of ground covered by surface vegetation still varies from about 0 to 100. On some of the steep southern slopes that were severely burned, the cover is very light. In contrast, the vegetation on many of the moist bottoms and northern slopes was not completely destroyed by the fire and is now luxuriant and very dense. A decided increase in average density was apparent, however, for all the areas checked. On the average, the percentage of soil surface covered by vegetation increased from 55 in 1935 to 70 in 1937. This increase has in many instances resulted in less favorable seedbed conditions than were prevalent two years before. Extensive portions of the burn now have such a heavy cover that tree

3/ In totaling, 1+ was counted as 3, since it always represented at least 2 seedlings and often a great many more.

seedlings must withstand severe competition to germinate and survive.

Fireweed is still the predominant ground-cover species. Senecio and low peavine, both of which were widespread in 1935, have lost ground to perennial plants such as oxalis, Oregon grape, vine maple, blackberry, swordfern, elderberry, and thimbleberry. Bracken, which often constitutes the principal cover on cut-over lands, is gradually making its appearance over the area, and will probably increase, particularly on areas reburned after salvage operations.

Survival of Green Trees

The 1935 study disclosed that, except for the Cedar Butte double burn, there were few large areas entirely devoid of seed trees. Green trees were numerous, as isolated single trees, in groups, and on unburned "islands." They were found in greatest numbers in the northeast corner of the burn, where the fire progressed slowly, but were also scattered sparingly throughout the southern and western portions. The green islands naturally contained a mixture of all the tree species present before the fire, but the single green trees were almost all Douglas fir.

In 1935 it was noticed that many of the remaining green trees were dying. An investigation[4/] at that time by the Bureau of Entomology disclosed that large numbers of the living firs within and bordering the burn were being attacked and killed by the Douglas fir beetle (Dendroctonus pseudotsugae Hopk.). A great quantity of breeding material had been made available to this beetle by the Tillamook fire. Since the beetle does not

4/ Furniss, R. L. Bark Beetles Active Following Tillamook Fire. The Timberman. January 1936.

usually attack trees that have been dead more than one year, the large adult population in the spring of 1935 attacked the green trees on the burn and the green timber around its edges. This outbreak has gradually subsided since 1935, but it undoubtedly caused the death of a large number of the Douglas fir seed trees. Many of the remaining trees are succumbing to fire injury, change in exposure, beetle attack, or a combination of these causes. It is expected that a large annual loss of seed trees will continue for several years. The green trees remaining on the burn and at its borders now provide the only source of seed for additional natural reproduction on the burn. As many of them gradually die, the seed supply will proportionately diminish.

Fire-Hazard Conditions

That fire hazard on the Tillamook burn is severe was recognized immediately after the fire by the State protective agencies. Since that time the area has been closed to entry during the fire season as a precautionary measure, and improvements have been undertaken to reduce the hazard. The fire left many snags standing on almost all parts of the burned area, with a fairly large amount of unburned material on the ground.

Throughout the burn, many of the fire-killed trees are beginning to shed large quantities of bark and limbs. As would be expected, this deterioration seems to be progressing more rapidly with hemlock than with Douglas fir. On some areas, the tops of many of the dead trees have broken out and fallen to the ground; on other areas, noticeably near the western edge of the burn, many of the hemlock snags have been

wind-thrown. Consequently, a large amount of inflammable material is constantly being added to the surface debris. Moreover, after the snags shed their bark, the sapwood weathers and dries and becomes exceedingly inflammable at nearly all seasons of the year. These changes intensify an already severe fire-hazard condition which will remain unabated until logging enters the picture or until the new stand is well enough established to hasten the decay of the snags and debris and to shade out the inflammable vegetation. A study[5/] by McArdle in 1931 showed that if a Douglas fir area restocks promptly and abundantly following a crown fire, the large trees of the new forest crop overtop most of the deteriorating snags about 35 years after the fire. At present, the severe fire hazard offers by far the greatest menace to natural reproduction.

New road and trail construction have greatly improved facilities for transportation onto the area, and logging operations are helping to form effective firebreaks through portions of the burn. With the completion of the roads and trails now under construction and the continuation of salvage logging, much of the burned area will soon be readily accessible, so that, should a fire start, it would be possible at least to reach it promptly and probably to prevent it from spreading throughout the area.

5/ McArdle, R. E. The Height, Condition, and Number of Douglas Fir Snags per Acre at Different Periods Following Fires. File memorandum. Pacific Northwest Forest Expt. Sta. October 30, 1931.

Trends in Restocking Since 1935

New Reproduction

Only 3 percent of the seedlings tallied in 1937 were found to have germinated in this year, in spite of the fact that 1936 was a fairly good seed year. Most of the reproduction was 3 or 4 years old, that is, had become established in the two seasons immediately following the fire, 1934 and 1935. Comparatively few seedlings have germinated and established themselves since the 1935 examination. This is probably the natural result of a diminishing number of seed trees, coupled with the less favorable seedbed conditions that have been created by a substantial increase in competing vegetation. Although a light ground cover is favorable to seedling survival, the heavy cover that is now typical offers severe competition to the new seedlings.

Seedling Distribution and Density

As is shown in table 1, the Reehers vicinity in the northeast corner of the burn still has the best stocking conditions, and the Trask and Wilson River areas in the southern and western portions remain poorly stocked. Of each of the two latter areas more than 50 percent remains nonstocked, as compared with only 27 percent of the Reehers area. In general, the distribution of tree seedlings is about the same now as in 1935. The density, however, has decreased slightly on all three areas. On the average, the proportion of fully stocked area is now only 19 percent, as compared with 27 percent in 1935, and the proportion of nonstocked area has increased from 44 to

53 percent. The proportion of partially stocked area has remained about the same.

Table 1.--Restocking on the three study areas examined in 1935 and checked in 1937

Area	Chains of strip		Percent fully stocked 1/		Percent partially stocked		Percent non-stocked	
	1935	1937	1935	1937	1935	1937	1935	1937
Reehers	220	230	61	53	15	20	24	27
Trask	698	658	15	12	38	27	47	61
Wilson	350	328	23	10	23	35	54	55
Total	1,268	1,216	27	19	29	28	44	53

1/ In 1935, an area was considered to be fully stocked if it contained 2,000 fairly well distributed seedlings per acre. In 1937 the standard of full stocking was lowered to 1,000 seedlings per acre, because the seedlings were by this time fairly well established.

Table 2 contrasts 1935 and 1937 conditions as to seedling density per average acre. The number of seedlings found on the average acre sampled has decreased; only 970 seedlings were found on the average acre in 1937 as compared with 1,315 in 1935, indicating a loss of 26 percent. A few new seedlings came in during 1937, but the increase has been more than offset by mortality of older seedlings. The loss is not significant, however, as the remaining older seedlings are now well established.

Table 2.--Density of tree seedlings on the three study areas examined in 1935 and checked in 1937

Area	Number of seedlings average acre		Percent of seedlings lost in interval
	1935	1937	
Reehers	3,204	2,292	19
Trask	790	695	12
Wilson	1,135	570	50
Total	1,315	970	26

Figure 2 shows the restocking conditions on the study areas as of 1935. The 1937 data indicate a slight decrease in stocking, but this decrease is not sufficient to necessitate a change in the areas previously classified as nonstocked, partially stocked, or fully stocked, except where salvage cutting has been done.

The Cedar Butte double burn and the areas logged and burned before the fire, none of which were examined in 1937, were found in 1935 to be poorly stocked and remote from a source of seed. It is assumed that they are still poorly stocked.

Composition of Reproduction

No significant changes are apparent in species composition as found in 1935. As is shown in table 3, there has been a slight decrease in percentage of Douglas fir, and a slight increase in cedar and spruce; hemlock still constitutes the same proportion.

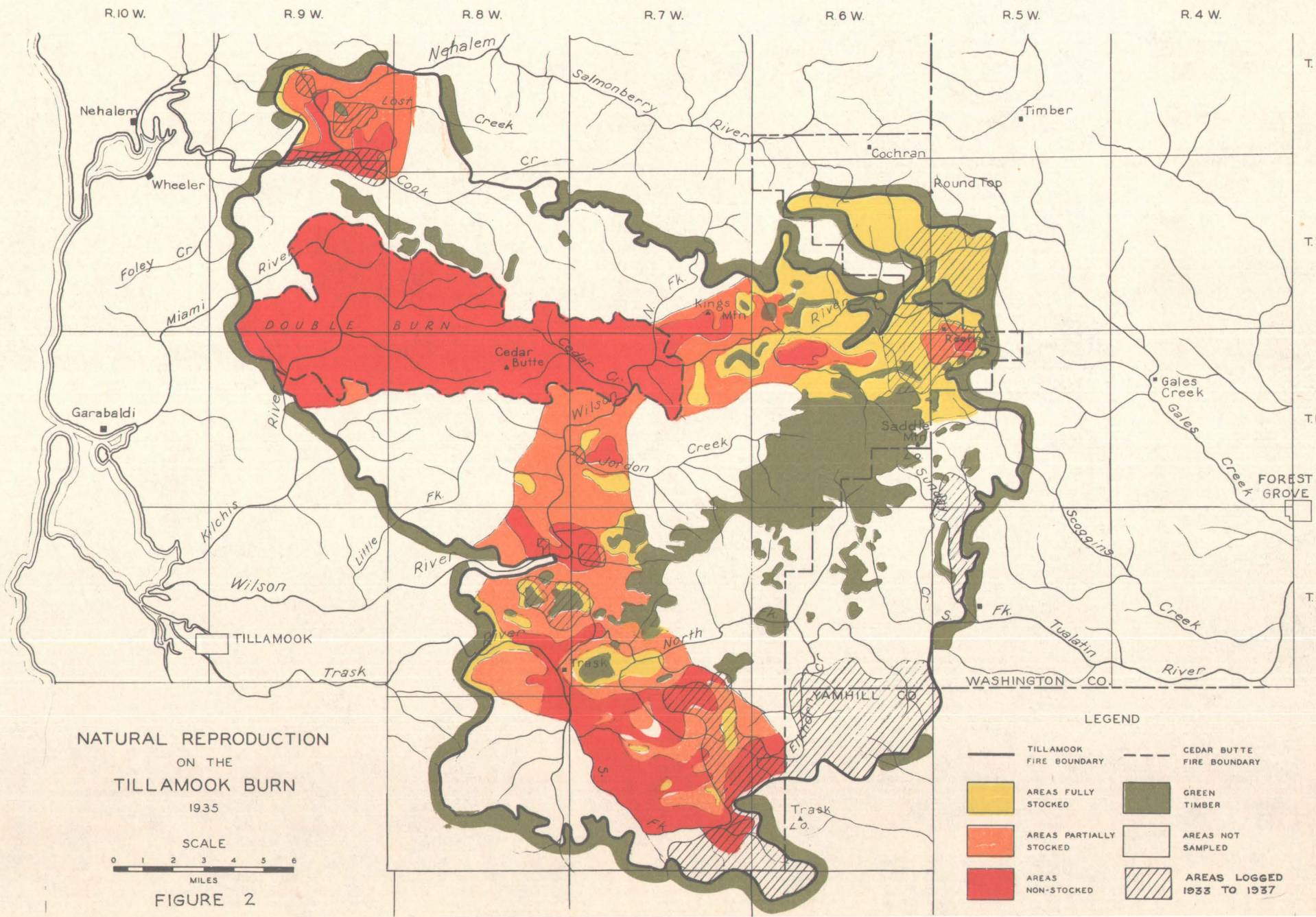
Table 3.--Species composition of reproduction on the three study areas examined in 1935 and checked in 1937

Area	Percent of seedlings of indicated species									
	Douglas fir		Hemlock		Cedar		Spruce		White fir	
	1935	1937	1935	1937	1935	1937	1935	1937	1935	1937
Reehers	28	23	52	59	18	15	--	--	2	3
Trask	25	20	69	61	1	10	5	9	--	--
Wilson	20	17	69	75	5	2	6	6	--	--
Total	25	21	62	62	9	11	3	5	1	1

Effect of Logging on Natural Reproduction

Since the fire, about 36,000[6/] acres of land within the burn has been cut over. The approximate locations of the logged areas are shown in figure 2. In general, the salvage cuttings have been followed by broadcast burning. Along with the usable Douglas fir snags, many of the remaining green trees have been cut. The fire-killed hemlocks are not being utilized, and many remain standing along with the unmerchantable Douglas fir snags. Naturally, the logging does considerable damage to the reproduction on the ground and the subsequent slash fire destroys practically all the remaining seedlings. Logging followed by broadcast burning temporarily lessens the fire hazard, leaving large areas reasonably free of snags and with only a small amount of

6/ Records of State fire warden, Forest Grove, Oregon.



NATURAL REPRODUCTION ON THE TILLAMOOK BURN 1935

FIGURE 2

inflammable material on the ground. It again denudes these areas, however, and leaves them with an inadequate seed supply for natural regeneration. Planting or artificial seeding would likely be necessary to put logged and burned tracts back into production.

Two areas near Reehers camp that had been logged since 1935 were reexamined in 1937. Table 4 shows the changes in stocking that have taken place on both areas. The first area was logged in 1937 and had not been slash-burned at the time of the 1937 examination. Before logging, 88 percent of the area was fully stocked and the remainder was partially stocked. Damage from logging alone reduced the fully stocked portion from 88 to 9 percent, raised the partially stocked portion from 12 to 63 percent, raised the nonstocked portion from 0 to 28 percent, and reduced the number of seedlings per average acre from 6,300 to 850. The ground cover was reduced to about one-half its former density, and a large amount of slash and inflammable debris was left littering the ground.

Table 4.-- Stocking conditions on two areas before logging, in 1935, and after logging, in 1937

Area	Chains of strip		Percent fully stocked		Percent partially stocked		Percent non-stocked	
	1935	1937	1935	1937	1935	1937	1935	1937
Logged	190	94	88	9	12	63	0	28
Logged and burned	56	30	93	0	7	27	0	73

The second area was logged early in 1936 and was burned that fall. Before logging, 93 percent of it was fully stocked and the remainder was partially stocked. Logging and burning reduced the portion fully stocked from 93 to 0 percent, raised the portion partially stocked from 7 to 27 percent, raised the portion nonstocked from 0 to 73 percent, and reduced the number of seedlings per average acre from 6,300 to only 94. Although a few scattered green hemlocks remained around the edge of the cutting area, no 1937 seedlings were found. The ground cover one year after the slash fire was almost 100 percent fireweed, and was as dense as the cover found on the same area in 1935. Logged and burned areas such as this study area should be planted or seeded, if possible, one or two seasons after the slash fire, to forestall the severe competition offered to tree seedlings by the dense surface vegetation that soon develops.

Summary

A 1937 reexamination of the area in northwestern Oregon burned over by the Tillamook fire of 1933, previously examined in 1935, revealed several significant trends in restocking conditions.

Density of surface vegetation has on the average increased from 55 percent in 1935 to about 70 percent in 1937.

Green trees and patches of green timber are still numerous, but many of them were killed by the beetle infestation of 1935 and their numbers are constantly diminishing from fire injury, change in exposure, and insect attack.

A slight decrease in stocking was apparent on all the areas re-examined. Few new seedlings have become established since 1935, probably owing to a diminishing seed supply and an increase in amount of competing vegetation. The addition of new reproduction has been more than offset by mortality of older seedlings. However, the older seedlings are now well established. In general, the northeastern section of the burn is still well stocked, and the southern and western portions remain rather poorly stocked. Restocking conditions on the areas cut over before the fire and on the Cedar Butte double burn were not checked in 1937; these areas were poorly stocked in 1935, and it is assumed that they so remain.

Salvage logging operations have lessened the severe fire hazard, by removing most of the snags on the areas logged. As would be expected, however, logging followed by broadcast burning is destroying practically all the established reproduction on areas so treated and leaving them with an inadequate seed supply for future natural regeneration.

Planting or artificial seeding would probably be necessary to put many of the nonstocked areas back into forest production.

The shedding of large quantities of bark and limbs from the fire-killed trees is gradually increasing the amount of inflammable material on the ground and is leaving the snags in a more inflammable condition. The great number of snags and the widespread accumulation of surface debris combine to form a fire hazard that is by far the greatest obstacle to the regeneration of this highly productive forest area.